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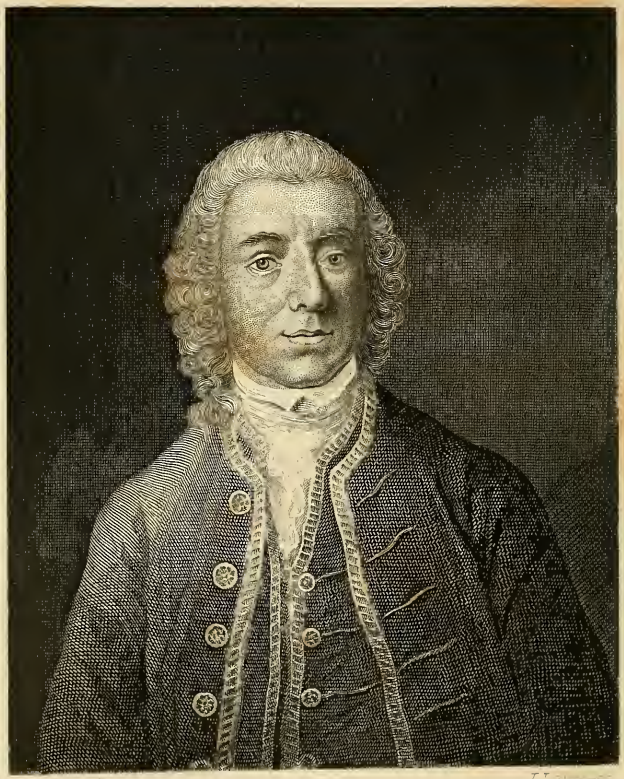
BECKMANN'S
HISTORY OF INVENTIONS,
DISCOVERIES, AND ORIGINS.

"Were I to pray for a taste which should stand me in stead under every variety of circumstances, and be a source of happiness and cheerfulness to me during life, and a shield against its ills, however things might go amiss and the world frown upon me, it would be a taste for reading.....Give a man this taste, and the means of gratifying it, and you can hardly fail of making him a happy man; unless, indeed, you put into his hands a most perverse selection of books. You place him in contact with the best society in every period of history,—with the wisest, the wittiest, the tenderest, the bravest, and the purest characters who have adorned humanity. You make him a denizen of all nations, a contemporary of all ages. The world has been created for him."—Sir John Herschel. *Address on the opening of the Eton Library*, 1833.



A

HISTORY

OF

INVENTIONS, DISCOVERIES,

AND ORIGINS.

By JOHN BECKMANN,

PROFESSOR OF ŒCONOMY IN THE UNIVERSITY OF GÖTTINGEN.

TRANSLATED FROM THE GERMAN,

By WILLIAM JOHNSTON.

Fourth Edition,

CAREFULLY REVISED AND ENLARGED BY

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ADVERTISEMENT.

In revising Beckmann's celebrated Work, we have endeavoured to improve it principally by altering such names, characters, descriptions, and opinions as have become obsolete, or are now known to be erroneous; and by such additions as seemed necessary to bring the accounts of the subjects treated of to the present state of knowledge. In some cases, these additions may appear to diverge from the declared object of the work; but in this we have only followed the example of Beckmann himself, who frequently deviates from a strict historical path, and we think advantageously, for the purpose of introducing curious, instructive, or amusing information. In most cases, where the subject under consideration is a process of manufacture, we have given a brief outline of its practice or theory, unless this had previously been done by the author. The translation, also, has been carefully compared with the German, but in only a very few cases could we detect errors which rendered the passages contradictory or unintelligible: on the whole, it is extremely well executed; and too much praise cannot be given to Johnston, for the judicious manner in which he has embodied in one article, detached essays on the same subject, which Beck-

mann published at different periods, as he acquired fresh information. The only instances in which this had been omitted, are the articles on *Turf*, *Cork*, and *Quarantine*, which were still encumbered with addenda; in the present edition, these have been incorporated. All such quotations from Latin and Greek authors, as might be deemed essential to the understanding of the text, have been given in English; those of a mere critical and philological character, it has been thought advisable to leave untranslated. The book may be classed as a compound of learned research and light reading, suitable both to the popular reader and the scholar; and that character has been preserved in the present edition. To the kindness of John Frodsham, Esq., the present proprietor of Arnold's Chronometer Establishment, we are indebted for much of the interesting information added to the article on 'Clocks and Watches;' and we have also to return our thanks to the publisher, Mr. H. G. Bohn, for the assistance he has constantly afforded us, as well as for his Memoir of the author.

W. Francis.
J. W. Griffith.

TRANSLATOR'S PREFACE.

THAT the arts had their rise in the East, and that they were conveyed thence to the Greeks, and from them to the Romans, is universally admitted. Respecting the inventions and discoveries however of the earliest ages, nothing certain is known. Many of those most useful in common life must have been the production of periods when men were little acquainted with letters, or any sure mode of transmitting an account of their improvements to succeeding generations. The taste which then prevailed of giving to every thing a divine origin, rendered traditional accounts fabulous; and the exaggeration of poets tended more and more to make such authorities less worthy of credit. A variety of works also, which might have supplied us with information on this subject, have been lost; and the relations of some of those preserved are so corrupted and obscure, that the best commentators have not been able to illustrate them. This in particular is the case with many passages in Pliny, an author who appears to have collected with the utmost diligence whatever he thought useful or curious, and whose desire of communicating knowledge seems to have been equal to his thirst for acquiring it.

Of all those nations whose history has been preserved, the most distinguished are certainly the Greeks and the Romans; but, as far as can be judged at this remote period, the former were superior to the latter in point of invention. The Romans indeed seem to have known little, except what they borrowed from the Grecians; and it is evident, by their sending their

young men of rank to finish their education in Greece, that they considered that country as the seat of the arts and the sciences, and as a school where genius would be excited by the finest models, while the taste was corrected and formed. From some hints given however by Pliny and other writers, we have reason to conclude that the Romans possessed more knowledge of the arts than the moderns perhaps are willing to allow, and that some inventions, considered as new, may be only old ones revived and again rendered useful.

When Rome, abandoned to luxury and vice, became an easy prey to those hordes of barbarians who overran the empire, her arts shared in the general wreck, and were either entirely lost, or for a time forgotten. The deplorable state of ignorance in which Europe was afterwards plunged during several centuries, retarded their revival; and it was not till a late period, when favoured and protected by a few men of superior genius, that they began to be again cultivated. It cannot however be denied, that several important discoveries, altogether unknown to the ancients, which must have had considerable influence on the general state of society, were made in ages that can hardly be exempted from the appellation of barbarous. As a proof of this may be mentioned the invention of paper[1], painting in oil[2], the mariner's com

[1] Montfaucon, notwithstanding all his researches in France and Italy, was not able to discover any charter or diploma written on common paper, older than the year 1270. Paper, however, made of cotton, is said to be much older, and to have been introduced into Europe by the Arabs. If we can believe an Arabian author, who wrote in the thirteenth century, quoted by Casiri, in Biblioth. Arabico-Hispana, vol. ii. p. 9, paper (doubtless of cotton) was invented at Mecca by one Joseph Amru, about the year of the Hegira 88, or of the Christian æra 706. According to other Arabian authors, quoted by Casiri and Abulfeda, the Arabs found a manufactory of paper at Samarcand in Bucharia, when they conquered that country in the year of the Hegira 85, or of our æra 704. The art of making paper from silk was, as some pretend, known to the Chinese 180 years before Jesus Christ. See a letter from Father de Mailla to Father Étienne Souciet, in Mémoires des Inscript. et des Belles Lettres, vol. xv. 520.

[2] The oldest picture, known at present, painted in oil-colours on wood is preserved in the Imperial Gallery at Vienna. It was painted in the year 1297, by a painter named Thomas de Mutina, or de Muttersdorf, in Bohe-

pass[1], gunpowder[2], printing[3], and engraving on copper[4]. After the invention of the compass and printing, two grand sources

mia. Two other paintings in the same gallery are of the year 1357; one of them is by Nicholas Wurmser of Strasburg, and the other by Thierry of Prague. It appears therefore that painting in oil was known long before the epoch at which that invention is generally fixed; and that it is erroneously ascribed to Hubert van Eyck and his brother and pupil, John van Eyck, otherwise called John of Bruges, who lived about the end of the fourteenth century, and not the beginning of the fifteenth, as is commonly supposed. [There is evidence in the books of the Painters' Company, under the date of the 11th of Edward I. (1283), that oil painting was in use at that time. See a communication from Sir Francis Palgrave given in the new edition of Carter's Ancient Sculpture and Paintings in England, page 80.]

[1] The person who first speaks of the magnetic needle and its use in navigation, is a Provençal poet, who lived in the beginning of the thirteenth century, and who wrote a poem entitled Bible Guyot. This work is a satire, in which the author lashes with great freedom the vices of that age. Comparing the Pope to the polar star, he introduces a description of the compass, such as it appears to have been in its infancy. This invention however is claimed by the Italians, who maintain that we are indebted for it to a citizen of Amalphi, named Flavius Gioja, and in support of this assertion quote commonly the following line of Panormitanus:

Prima dedit nautis usum magnetis Amalfis.

[2] Of the use of gunpowder in Europe no certain traces occur till towards the middle of the fourteenth century. It seems pretty well proved, that artillery was known in France after the year 1345. In 1356, the city of Nuremberg purchased the first gunpowder and cannon. The same year the city of Louvain employed thirty cannon at the battle of Santfliet against the Flemings. In 1361, a fire broke out at Lubec, occasioned by the negligence of those employed in making gunpowder. In 1363, the Hans-towns used cannon for the first time, in a naval combat which they fought against the Danes. After 1367, the use of fire-arms became general throughout Italy, into which they had been introduced from Germany.

[3] The invention of printing has given rise to many researches. Meermann in his Origines Typographicæ, published in 1768, endeavours to prove that Laurence Coster of Haarlem was the inventor, about the year 1430. Most authors however agree that John Guteuberg was the inventor of moveable types, but they differ respecting the place of the invention. Some make it to be Strasburg, others Mentz, and some fix the epoch of the invention at 1440, and others at 1450.

[4] Vasari, in Vite de' Pittori, vol. iv. p. 264, ascribes the invention of engraving on copper to a goldsmith of Florence, named Maso Finiguerra, about 1460. The oldest engravers whose names and marks are known, were Israel de Mecheln, of Bokholt, in the bishopric of Munster; Martin Schœn, who worked at Colmar in Alsace, where he died in 1486; and Michael Wolgemuth of Nuremberg, who was preceptor to the famous Albert Durer, and engraved the plates in the well-known Nuremberg Chronicle. It may be proper here to observe, that the art of engraving on wood

were opened for the improvement of science. In proportion as navigation was extended, new objects were discovered to awaken the curiosity and excite the attention of the learned; and the ready means of diffusing knowledge, afforded by the press, enabled the ingenious to make them publicly known. Ignorance and superstition, the formidable enemies of philosophy in every age, began soon to lose some of that power which they had usurped; and states, forgetting their former blind policy, adopted improvements which their prejudice had before condemned.

Though it might be expected that the great share which new inventions and discoveries have at all times had in effecting such happy changes among mankind would have secured them a distinguished place in the annals of nations, we find with regret, that the pen of history has been more employed in recording the crimes of ambition and the ravage of conquerors, than in preserving the remembrance of those who, by improving science and the arts, contributed to increase the conveniences of life, and to heighten its enjoyments. So little indeed has hitherto been done towards a history of inventions and discoveries, that the rise and progress of part of those even of modern times is involved in considerable darkness and obscurity: of some the names of the inventors are not so much as known, and the honour of others is disputed by different nations; while the evidences on both sides are so imperfect, that it is almost impossible to determine to which the palm is due. To Professor Beckmann, therefore, those fond of such researches are much indebted for the pains he has been at to collect information on this subject; and though he has perhaps not been able to clear up every doubt respecting the objects on which he treats, he has certainly thrown

seems to be older than the invention of printing, to which perhaps it gave rise. The names of the first engravers on wood are however not known. [In the Athenæum Journal for 1845, page 965, is given a fac-simile of a large wood-engraving, bearing the date of 1418, which was discovered at Malines in 1844, and is now preserved in the public library at Brussels.]

much light on many curious circumstances hitherto buried in oblivion.

The author, with much modesty, gives to this work in the original the title of only Collections towards a History of Inventions: but as he has carefully traced out the rise and progress of all those objects which form the subject of his inquiry, from the earliest periods of their being known, as far as books supplied information, and arranged his matter in chronological order, the original title may admit, without being liable to much criticism, of the small variation adopted in the translation. The author, indeed, has not in these volumes comprehended every invention and discovery, but he has given an account of a great many, most of them very important.

Should any one be disposed to find fault with the author for introducing into his work some articles which on the first view may appear trifling, his own words, taken from the short preface prefixed to the first volume of the original, will perhaps be considered as a better exculpation than anything the translator might advance in his favour. "I am sensible," says he, "that many here will find circumstances which they may think unworthy of the labour I have bestowed upon them; but those who know how different our judgements are respecting utility, will not make theirs a rule for mine. Those whose self-conceit would never allow them to be sensible of this truth, and who reject as useless all ore in which they do not observe pure gold, as they display very little acuteness, must be often duped by the tinsel glare of false metal; and they give me as little uneasiness as those who have no desire to know the origin of inventions, or how they were brought to their present utility. If my extending the term Invention farther than is perhaps usual, by comprehending under it several police-establishments, be a fault, it is at any rate harmless, and on that account may be pardoned without much apology."

MEMOIR OF THE AUTHOR.

JOHN BECKMANN, Professor of Œconomy at Göttingen during a period of forty-five years, was born at Hoye, a small town in the kingdom of Hanover, in 1739. His father held the appointment of postmaster and receiver of taxes in that place, and at the same time cultivated a small farm, which appears to have inspired his son with a taste for agricultural pursuits. The superintendence of his education devolved principally on his mother, a woman of great prudence and strength of mind, who was left a widow when young Beckmann was scarcely seven years old. In a lonely house, amid examples of industry and daily labour, he passed his youth in the perusal of works, which, although of a common-place description, were not without their use, as they led him to contract a methodical habit of mind, and afforded considerable information on various subjects, which in the sequel greatly assisted him in the pursuits to which he owed his celebrity. He himself relates that, when quite a boy, he was in the habit of making extracts of all the striking passages he met with in the course of his reading, by which means he acquired a ready use of the pen. The insufficient circumstances of his family prevented his education being cultivated in the schools till nearly fifteen; at which age he was sent to the Gymnasium of Stade, then under the direction of Gehlen, where in a short time he highly distinguished himself in classical literature. Intended for the clerical profession, he entered the university of Göttingen in 1759, for the purpose of completing his theological studies; but whether the advice of Hollmann (afterwards his father-in-law), with whom he had formed a close intimacy, produced a change in his plans, or that the mathematical instructions of

Professors Kaestner and Mayer were more congenial to his mind than divinity, he abandoned the career marked out for him, and devoted himself to the natural sciences and their application, as well as to mathematics; whilst he cultivated philology with such zeal, that he ultimately made himself master of ten different languages. In order to gain greater proficiency in these pursuits, he made a journey in 1762 to the Netherlands, but returned to Hoye in the following year, in consequence of the serious indisposition of his mother, who dying shortly afterwards, left him destitute of guidance, and in the greatest anxiety respecting his future prospects. At this juncture Büsching advised him to travel to St. Petersburg, where, upon the strong recommendations with which he was provided, he was speedily appointed to the chair of Natural Philosophy. Shortly after, Büsching, quitting the institution, returned to Germany, and dissensions having arisen among the directors, Beckmann likewise resigned his office. He then proceeded to Sweden, with the view of acquiring a detailed knowledge of the working of the mines in that country; making his principal sojourn at Upsal, where he became acquainted with Linnæus, and enjoyed the friendship and hospitality, as well as the instructions, of that eminent naturalist[1]. Leaving Sweden, he directed his course to Denmark, visiting Copenhagen and other towns, where he examined the various museums, libraries and manufacturing establishments. On arriving at Altona, he found there his friend Büsching, who recommended him to Münchhausen, curator of the Academy of Göttingen. After paying a visit to his brother at Marburgh, he proceeded to Hanover; and being approved of by Struve, then president of Göttingen under Münchhausen, he was appointed, in 1766, Professor Extraordinary of Philosophy

[1] Heyne, in his funeral oration, says Beckmann was so struck with admiration at the vast knowledge of Linnæus, that he became ensnared, like the companions of Ulysses in the island of Circe, and was disheartened from proceeding any further in his own botanical studies. To this circumstance is attributed the coolness with which he afterwards cultivated this department of science.

to that university, of which he eventually became one of the brightest ornaments.

His lectures upon œconomy had the recommendation of novelty, and produced so much applause, that in 1770 he was made ordinary professor of that science. They were attended by the flower of the studious youth of all countries, Göttingen being at that period one of the most popular universities in Europe; and many even of the distinguished statesmen and public functionaries of Germany did not disdain to be ranked among his auditors. He was in the habit of accompanying them himself into the workshops, to give them a practical knowledge of the different processes and handicrafts of which he had explained the theory. Once a week, also, he held a *Practicum Camerale*, a scientific meeting, at which he explained subjects of œconomy, administration, and finance, illustrating them by readings from a great variety of sources. He composed, to serve as a guide in this course of instruction, treatises on rural œconomy, policy, finance, commerce, and other departments of knowledge; which, though since carried to a higher degree of perfection, owed to Beckmann their first systematic form. He never entirely relinquished these public lectures, but insensibly his private studies took a direction altogether historical, the motives for which it may not be uninteresting to point out.

It is indispensably requisite at Göttingen that every professor should be able to give account of the progress and existing state of the science to which he is appointed. Any one, who two years after the publication of a work of importance in his department should not have read and analysed it, with a view of enriching his own observations, would not be regarded as a worthy successor to the chair of Haller, of Mosheim, of Gessner and Michaelis. Beckmann, who had studied at Göttingen at a time when the example of these great men dictated the law and gave the tone to the University, and perhaps to the literature of Europe, was determined to

keep pace with the spirit of the age, and not to remain ignorant of the great advances then making throughout Europe, in the numerous sciences which furnished the subjects of his practical investigations. But this was a task of no slight magnitude: and indeed when the immense additions to so many different sciences are considered, can it be wondered at, that, notwithstanding his utmost zeal and application, he found it impossible to read up all the important works which had appeared since 1770, in chemistry, physics, natural history and mathematics? Despairing of success in so Herculean an undertaking, he began to entertain feelings of aversion towards what he deemed the innovations, which were then changing the face and enlarging the scope of science. But his course of lectures, turning principally on practical matters, was not materially affected; he was, however, so fearful of falling under the imputation of being behind the progress of the age, that he devoted his mind, peculiarly fitted for this kind of study, almost exclusively to the history of arts and trades; employing in the illustration of his subjects, the materials to which he had access in the very extensive library belonging to the university; and it is to his consequent labours and researches that we owe the "History of Inventions and Discoveries." In this work, Beckmann traces their first germs from the remotest periods of antiquity, and following their gradual development, exhibits the latest improvements among civilized nations with almost unequalled acumen and ability. It abounds with invaluable materials respecting the general history of the origin and progress of the mechanic arts, which are so important a branch in civilization; and what must give it an additional value in the eyes of all who are unwilling to place reliance on assertions unsupported by authority, or may be anxious to investigate the subject more deeply, the most scrupulous references to original authorities accompany each article. Among the numerous other works of merit for which we are indebted to the literary industry of Beckmann, are,

"A History and Analysis of early Voyages and Travels," a highly interesting collection, which occupied the last years of his life, and was left unfinished at the eighth number; elaborate editions of "De Mirabilibus Auscultationibus," attributed to Aristotle, 1786; "Antigoni Carystii Historiæ Mirabiles," 1791; and "Marbodi Liber de Gemmis," 1799; publications which required the rare combination of physical knowledge with philological learning.

The Royal Society of Göttingen had, in the year 1772, admitted him one of its members, and from that period to 1783 he continued to supply their proceedings with interesting memoirs (all written in Latin), among which are the following: "On the Reduction of Fossils to their original substances;" "On the History of Alum;" "On the Sap of Madder;" "On Meerschaum, from which are formed the heads for tobacco pipes;" "On the History of Sugar," &c. After this period, however, he declined participating any longer in the labours of this learned body; owing, probably, to a change in the objects of his own particular studies. In 1784 he was created an aulic councillor of Hanover; in addition to which he was elected member of the Imperial Academy of Naturalists, of the Swedish Society of Science, of the Academies of Norway and Mayence, of the Physiographical Society of Lund, and of almost all the learned societies in Germany and the North of Europe.

With a copious knowledge of the principal sciences, Beckmann united extensive reading in the works of ancient and modern writers, not only in reference to their immediate connection with his main studies, but in respect also to their application generally to every other branch. Convinced that every professor ought, as much as possible, to have thoroughly searched into all matters relating to the subject on which he treats, he spared no expense in forming a most extensive, as well as choice library; at the same time he did not fail to avail himself of the rich intellectual stores contained in that

belonging to the university. His mind being wholly directed to all that is practical in human knowledge, it was his especial endeavour to bring it into systematic rules, based upon fundamental principles. To him particularly is to be ascribed the merit of having been the first to give to agriculture its scientific form, and to have separated it more distinctly than heretofore from the administrative and financial departments. The number of pupils indebted to him for their education, and who, eventually,—whether filling offices of state or following his footsteps as professors,—brought into effect the principles he had taught them, formed a very numerous body; and whilst he was thus the means of considerably enlarging the circle of academic subjects for the instruction of the student, he contributed not a little towards the prosperity of the university itself. His activity likewise as a writer was as persevering as it was meritorious; he united an extensive knowledge of nature, with a decided turn for applying it to practical purposes; and he published several works in German, which show this tendency of mind; among others, "Principles of German Agriculture," "Introduction to Technology," "Introduction to the Science of Commerce," &c.

To assist his literary researches, he issued a periodical work called "Physico-Œconomical Library," in which quarterly information was communicated respecting the newest works connected with the arts, manufactures, and agriculture, giving short extracts of whatever was valuable, instead of severe criticisms, of which he did not approve. It was commenced in 1770, and continued, with some little interruption, until 1807, forming 23 volumes.

Having said thus much respecting his abilities and genius, we will in conclusion take a brief glance at his private character, which, amiable and virtuous as it was, cannot fail to command the world's estimation. Honest and unpretending, a lover of peace and justice, he lived quite retired, devoted to

the conscientious performance of his duties; his candour, his sincerity in friendship, his affability to the students, have been celebrated with one accord by his coadjutors and auditors. In the domestic relations of life, he presented an example of the most exact system of order and œconomy, and enjoyed the reputation of being one of the richest professors of the university; which enabled him to exercise his ready benevolence during a period of severe dearth and suffering. Among his colleagues, Schlœtzer, the distinguished historian, with whom in his youth he had become acquainted in Russia, was the one with whom he maintained the most uninterrupted intimacy, arising, no doubt, from the congeniality of their pursuits. Few were better qualified than Schlœtzer to appreciate the researches of Beckmann, as he had himself insisted with so much force on the necessity of introducing into history a simultaneous view of the influence exercised on social institutions by the efforts of industry, and the rise and maturity of domestic arts. Beckmann married the daughter of Hollmann, his tutor and friend, with whom he enjoyed a long and uninterrupted course of happiness; she survived him only a few weeks, leaving a son and daughter who had arrived at years of maturity. His decease took place on the 3rd of February, 1811, in the 72nd year of his age. His illustrious colleague, Heyne, pronounced an eloquent eulogium on him before the Academy, which was published in the Göttingen Transactions, from which we subjoin a few extracts.

"O colleagues, if we indulge in deep sorrow at this new diminution of our fraternity by the death of one of its seniors, it must be forgiven, as consonant to our duty and piety, as well as to the affections of human nature. Indeed, when his death was announced, and when I afterwards beheld the mournful pomp of his funeral, I was afflicted with the utmost grief. Nor can this be wondered at, when it is borne in mind that he was nearly of my own age, and next to me the eldest of our Society; the habit, too, of friendly intercourse enjoyed for

many years, has great influence in riveting the affections of the mind.

"There is a narrative in Herodotus, concerning Psammenitus king of Egypt, who was conquered by Cambyses king of Persia. The city of Memphis being taken by storm, he had fallen into the hands of Cambyses; who, enraged at the vigorous defence he had encountered, commanded the royal family to be brought forth and put to death. In the first place, his daughter was paraded before him, with many maidens of noble birth, clothed as slaves; and though the other parents uttered piteous lamentations, yet Psammenitus kept his eyes fixed on the ground: in like manner, when his sons, together with two thousand of the principal youths, their necks bound with ropes, with bridles in their mouths, were ignominiously led to death, the king did not even utter a groan; but on seeing an aged man approach, one of his old friends, who had formerly partaken of the royal table, walking in the dress of a mendicant, and imploring mercy through the different ranks of the army, then indeed the king could restrain his emotions no longer, but broke forth into the most bitter wailings. The cause of this strange grief it would be foreign to our present purpose to discuss; I only wish to draw this conclusion—that the death of an old friend and companion was alone able to subdue his mind, even after it had supported him against the severest calamities. For the force of habit and friendly intercourse is most powerful: we bring to recollection many things which prey upon our feelings; they rush upon our memory with one impetus, and swell the rising grief; we dwell on early struggles, on proofs of mental power, and instances of benevolence, which formerly we had passed unheeded.

"What is known favourably of the character of him who is taken away from us, it is our pleasing duty to bring before you; what is otherwise, if anything exist, it is not our province to remember.

"The studies of Beckmann were applied to other branches

of learning, quite distinct from those in which I am occupied: but it was this very circumstance which cemented our acquaintance. His conversations on scientific subjects could not but prove profitable; especially as he blended them with a feeling for ancient literature. I was accustomed to consult him concerning subjects of nature and art, which I did not sufficiently understand; and he sometimes referred to me respecting philological matters, of which he wished to gain further information. But the varied talents of this illustrious man were wonderful: an unceasing desire to search into the origin of arts and sciences, and the history and success of inventors, was united with an insatiable thirst for general knowledge and classical learning. He was incessantly in our public library, eagerly investigating and comparing rare books in pursuit of his object; seizing their hidden treasures, and then contributing his booty to the mental improvement of the million."

The remainder of this elegant oration concerns the details of his career, which are already embodied in the preceding sketch.

H. G. B.

HISTORY OF INVENTIONS

AND

DISCOVERIES.

ITALIAN BOOK-KEEPING.

Those who are acquainted with the Italian method of book-keeping must allow that it is an ingenious invention, of great utility to men in business, and that it has contributed to extend commerce and to facilitate its operations. It requires no less attention, care, and accuracy, than many works which are styled learned: but it is undoubtedly true, that most mercantile people, without knowing the foundation of the rules on which they proceed, conduct their books in as mechanical a manner as many of the literati do their writings.

The name, Italian book-keeping, *Doppia scrittura*, with several words employed in this branch of science and still retained in all languages, make it probable that it was invented by the Italians; and that other nations borrowed it, as well as various short methods of reckoning, from their mercantile houses, at the time when all the East-India trade passed through Italy.

De la Porte says [1], "About the year 1495, brother Luke, an Italian, published a treatise of it in his own language. He is the oldest author I have seen upon the subject." Anderson, in his Historical and Chronological Deduction of the Origin of Commerce [2], gives the following account: "In all probability, this art of double-entry accounts had its rise, or at least its

[1] La science des négocians et teneurs de livres. Paris 1754.
[2] Vol. i. p. 408.

revival, amongst the mercantile cities of Italy: possibly it might be first known at Venice, about the time that numeral algebra was taught there; from the principles of which science double-entry, or what we call merchants' accounts, seems to have been deduced. It is said that Lucas de Burgo, a friar, was the first European author who published his algebraic work at Venice, anno 1494."

This author, who was one of the greatest mathematicians of the fifteenth century, and who is supposed to be the first person who acquired a knowledge of algebra from the writings of the Arabians, was called Lucas Paciolus, e Burgo S. Sepulchri. He was a Franciscan, and so surnamed from a town in the duchy of Urbino, on the Florentine confines, called Burgo S. Sepulchro [1].

Anderson tells us [2], that he had in his possession the oldest book published in England in which any account is given of the method of book-keeping by double-entry. It was printed at London, in 1569, in folio. The author, whose name is James Peele, says, in his preface, that he had instructed many mercantile people in this art, which had been long practised in other countries, though in England it was then undoubtedly new. One may readily believe that Mr. Anderson was not ignorant of the difference between the method of book-keeping by single and that by double-entry; but he produce, nothing to induce us to believe that Peele taught the latters and not the former; for what he says of debit and credit is of no importance, as it may be applied also to the method by single-entry.

Of this Peele no mention is made in Ames's Typographical Antiquities; but in that work (p. 410) there is an account of a still older treatise of book-keeping, entitled A briefe instruction and manner how to keepe bookes of accompts, after the order of debitor and creditor, and as well for proper accompts, partible, &c. by three bookes, named the memoriall, journall, and leager. Newly augmented and set forth by John Mellis schole maister. London 1588, 12mo. Mellis, in his preface,

[1] Those who are desirous of further information respecting Lucas de Borgo, may consult Scriptores ordinis Minorum, recensuit Fr. Lucas Waddingus, Romæ 1650;—Heilbronneri Historia Matheseos universæ, Lipsiæ 1742;—Histoire des Mathématiques, par Montucla, Paris 1758.

[2] Vol. i. p. 409.

says that he is only the re-publisher of this treatise, which was before published at London in 1543 by a schoolmaster named Hugh Oldcastle. From the above title, and particularly from the three account books mentioned in it, I am inclined to believe that this work contained the true principles of book-keeping by double-entry.

The oldest German work on book-keeping by double-entry with which I am at present acquainted, is one written by John Gotlieb, and printed at Nuremberg, by Frederick Peypus, in 1531[1]. The author in his preface calls himself a citizen of Nuremberg, and says that he means to give to the public a clear and intelligible method of book-keeping, such as was never before printed. It appears, therefore, that he considered his book as the first of the kind ever published in Germany.

It is worthy of remark, that even at the end of the sixteenth century, the Italian method of book-keeping began to be applied to finances and public accounts. In the works of the celebrated Simon Stevin, published at Leyden in Dutch, and the same year in Latin, we find a system of book-keeping, as applied to finances, drawn up it appears for the use of Maurice prince of Orange. To this treatise is prefixed, in Dutch and Latin, a dedication to the duke of Sully, in which the author says, that his reason for dedicating the work to Sully was because the French had paid the greatest attention to improve the method of keeping public accounts. The work begins with a conversation, which took place between Stevin and prince Maurice, respecting the application of book-keeping to public accounts, and in which he explains to the prince the principles of mercantile book-keeping. This conversation commences with explaining the nature of debit and credit, and the principal accounts. Then follow a short journal and ledger, in which occur only the most common transactions; and the whole concludes with an account of the other books necessary for regular book-keeping, and of the manner of balancing. Stevin expressly says, that prince Maurice, in the year 1604, caused the treasury accounts to be made out after the Italian method, by an experienced book-keeper, with the best success; but how long this regulation continued I have not been able to learn. Stevin supposes, in this system, three

[1] The title runs thus: Ein Teutsch verstendig Buchhalten für Herren oder Gesellschafter inhalt wellischem Process.

ministers, and three different accounts: a *quæstor*, who receives the revenues of the domains; an *acceptor*, who receives all the other revenues of the prince; and a *thesaurarius* (treasurer), who has the care of the expenditure. All inferior offices for receiving or disbursing are to send from their books monthly extracts, which are to be doubly-entered in a principal ledger; so that it may be seen at all times how much remains in the hands of each receiver, and how much each has to collect from the debtors. One cannot help admiring the ingenuity of the Latin translator[1], who has found out, or at least invented, words to express so many new terms unknown to the ancient Romans. The learned reader may, perhaps, not be displeased with the following specimen. Book-keeping is called *apologistica* or *apologismus*; a book-keeper *apologista*; the ledger *codex accepti expensique*; the cash-book *arcarii liber*; the expense-book *impensarum liber*; the waste-book *liber deletitius*; accounts are called *nomina*; stock account *sors*; profit and loss account *lucri damnique ratiocinium*, *contentio* or *sortium comparatio*; the final balance *epilogismus*; the chamber of accounts, or counting-house, *logisterium*, &c.

In the end of this work Stevin endeavours to show that the Romans, or rather the Grecians (for the former knew scarcely anything but what the latter had discovered), were in some measure acquainted with book-keeping, and supports his conjecture by quoting Cicero's oration for Roscius. I confess that the following passage in Pliny, *Fortunæ omnia expensa, huic omnia feruntur accepta, et in tota ratione mortalium sola utramque paginam facit*[2], as well as the terms *tabulæ accepti et expensi*; *nomina translata in tabulas*, seem to indicate that the Romans entered debit and credit in their books on two different pages; but it appears to me not yet proved, and improbable, that they were acquainted with our scientific method of book-keeping; with the mode of opening various accounts; of comparing them together, and of bringing them to a final balance. As bills of exchange and insurance were not known in the commerce of the ancients, the business of merchants was not so intricate and complex as to require such a variety of books and accounts as is necessary in that of the moderns.

[1] Bayle says, that the Latin translation of Stevin's works was executed principally by Willebrord Snellius.

[2] Lib. xi. cap. 7.

Klipstein is of opinion that attempts were made in France to apply book-keeping, by double-entry, to the public accounts, under Henry IV., afterwards under Colbert, and again in the year 1716. That attempts were made, for this purpose, under Henry IV., he concludes from a work entitled An Inquiry into the Finances of France; but I do not know whether what the author says be sufficient to support this opinion.

[The system of double-entry began from the commencement of the present century to be adopted by several governments in the management of the public accounts, among others by those of Austria, France and Holland, with highly beneficial effects. Some attempts have been more recently made in this country to introduce it into the government offices, and from the great success which has attended them, this system will probably soon be generally used.]

ODOMETER.

An Odometer, Pedometer, Perambulator, or Way-measurer, is an instrument or machine by which the steps of a person who walks, or the revolutions made by the wheel of a carriage, can be counted, and by which the distance that one has travelled can be ascertained. Vitruvius, in his tenth book[1], describes a machine of this kind for a carriage, and which, in his opinion, would answer for a ship. We are told by Capitolinus, in the life of the emperor Pertinax, that among the effects of the emperor Commodus exposed to sale, there were carriages of various kinds, some of which "measured the road, and pointed out the hours;" but whether by these words we are to understand an odometer, cannot with certainty be determined.

That this instrument was known even in the fifteenth century, can be proved from the carving on the ducal palace at Urbino —an edifice erected in an uncommon style of magnificence,

[1] C. 14. Nicolai, in the first part of his Travels, has translated this description of an odometer, and illustrated it with a figure by H. Catel.

by duke Frederic, who died in 1482. The ornaments here employed form, almost, a complete representation of all the warlike apparatus used at that period. both by sea and land; and among these is the figure of a ship, which seems to be furnished with an odometer; but whether the wheels and springs, carved out apart, be intended to show the construction of it, I will not venture to decide[1].

The celebrated John Fernel, physician to Catherine of Medici, queen of France, measured with an instrument of this kind, in 1550, a degree of the meridian between Paris and Amiens, and found it to be 68,096 geometrical paces, or about 56,747 toises (364,960 English feet); that is, 303 toises less than Picard found it to be; or about 300 toises less than later measurements have made it. Picard himself, in his mathematical measurement, assisted by the newest improvements, erred 123 toises. It is therefore very surprising that Fernel should approach so near the truth with such an instrument. The manner of constructing it however, as far as I know, appears to be lost[2].

Levin Hulsius, in his Treatise of mechanical instruments, published at Frankfort in 1604, describes an odometer, but without naming the inventor. It appears, however, that it was the production of Paul Pfinzing, born at Nuremberg in 1554[3]; and who, besides other works, published, in 1598, Methodus Geometrica, or a Treatise on measuring land, and how to use proper instruments for that purpose, on foot, on horseback, or in a carriage. This treatise, which was never

[1] This palace, with its ornaments, is described in the Memorie concernenti la citta di Urbino. Roma, 1724. fol. The figure to which I allude is in plate 53. Bernardino Baldi, the author of the descriptive part, considers it as an odometer.

[2] In Joannis Fernelii Ambianatis Cosmotheoria, Parisiis 1528, we find only the following passage respecting this invention:—"Nec vulgi supputatione satiatus, vehiculum, quod Parisios recta via petebat, conscendi, in eoque residens tota via 17024 fere rotæ circumvolutiones collegi, vallibus et montibus ad equalitatem, quoad facultas nostra ferebat, redactis. Erat autem rotæ diameter." In Almagesti novi parte posteriori, tomi primi, Bononiæ 1651. fol. the author, Riccioli, says that Fernel contrived his carriage in such a manner, that the revolutions of the wheels were shown by a hammer striking on a bell. Where that jesuit discovered this I cannot learn.

[3] Doppelmayer, Nachricht von Nurnberg Künstlern, p. 82. Will, Nurnbergisches Gelehrten-Lexicon, iii. p. 156.

sold, but given away by the author, contains a description of the same instrument described by Hulsius, and which, as Nicolai says, is still preserved in the collection of curiosities at Dresden.

In the same collection is an odometer which Augustus, elector of Saxony, who reigned between the years 1553 and 1586, employed in measuring his territories. This instrument is mentioned by Beutel[1], without naming the inventor; but I think it very probable that it was made by Martin Feyhel, who was born at Naumburg, and resided at Augsburg; as Von Stetten[2] relates, in his History of the Arts at Augsburg, that Feyhel made a way-measurer (probably odometer) for the elector of Saxony, and that he himself called it a new instrument never before heard of. This artist was an intimate friend of the celebrated Christopher Schissler, also of Augsburg, who in 1579 constructed a quadrant, still to be found at Oxford; and in 1606 an armillary sphere, still preserved at Augsburg.

The emperor Rudolphus II., who reigned from 1576 to 1612, and who was fond of, and acquainted with, the mechanical arts, possessed two very curious odometers, which not only pointed out distances, but also marked them down on paper by the way. The description and use of one of these is given by De Boot[3], who was that prince's librarian; and what he says has been copied by Kircher[4], and illustrated with a coarse figure. It is not improbable that the before-mentioned Schissler was the maker of this instrument, as we are informed by Stetten that he constructed a great many machines and automata for the emperor Rudolphus II. The other odometer, which was much more curious, appears to have been constructed by that emperor himself[5].

About the end of the 17th century, an artist in England, named Butterfield, invented an odometer which met with great approbation. In the first volume of the Philosophical Transactions there are two papers written by this ingenious man; but of his odometer I have not yet been able to find a description.

In the beginning of the last century, Adam Frederick Zur-

[1] Cimelium Geographicum Tripartitum. Dresden, 1680.
[2] Kunstgeschichte von Augsburg, p. 167.
[3] Gemmarum et Lapidum Historia. Lugd. Bat. 1647, 8vo, p. 468.
[4] Magnes, sive De arte magnetica. Coloniæ, 1643, 4to, p. 221.
[5] Boot. Hist. Gemmarum, p. 473.

ner, to whom we are indebted for good maps of the electorate of Saxony, invented also an odometer, or geometrical carriage, a description and figure of which, taken from Schramm's Saxonia Monumentis Viarum illustrata, is given by Nicolai. This instrument is not now to be found in the Dresden collection.

In Bion's Treatise on the construction of mathematical instruments, improved by Doppelmayer, there is a description of a pedometer, and the author praises a new invention by one Sauveur.

In the year 1724 Meynier laid before the Royal Academy of Sciences at Paris an odometer, a short account of which, without a figure, is given in the history of the Academy for that year. This machine was afterwards improved by Outhier; and a description of the improvements, but without any figure, is to be found in the history of the Academy for 1742. A full description, together with a figure, may however be seen in a work, entitled Machines et Inventions approuvées par l'Académie, t. vii.

Perhaps the most perfect machine of this kind was that made at Berlin by an artist named Hohlfeld, a short account of which may be found in the ninth volume of the Hamburg Magazine. A complete description I have not seen; but I learn from Professor Bernoulli's Tour through Brandenburg, Pomerania, &c., that a model of it is preserved in the excellent collection of Count de Podewils at Gusow[1]. The inventor of it was a man of such rare talents, and rendered such benefit to the public, that the following anecdotes of his life may prove not unacceptable to many readers. It was written by Professor Muller at Berlin, and transmitted to me by Dr. Bloch.

Hohlfeld was born of poor parents at Hennerndorf in the mountains of Saxony, in 1711. He learned the trade of lace-making at Dresden, and early discovered a turn for mechanics by constructing various kinds of clocks. From Dresden he removed to Berlin to follow his occupation. As he was an excellent workman, and invented several machines for shorten-

[1] This machine was used by Sulzer during his tour. See his Journal, published at Leipsic, 1780, 8vo, p. 3. It has been since improved by Schumacher, a clergyman at Elbing, by Klindworth, Catel at Berlin, and by an anonymous clergyman in the Schwabisches Magazin, 1777, p. 306.

ing his labour, he found sufficient time to indulge his inclination for mechanics; and he made there, at the same time that he pursued his usual business, air-guns and clocks.

In the year 1748 he became acquainted with the celebrated Sulzer, at whose desire he undertook the construction of a machine for noting down any piece of music when played on a harpsichord. A machine of this kind had been before invented by Von Unger; but Hohlfeld, from a very imperfect description, completed one without any other assistance than that of his own genius. Of this machine, now in the possession of the Academy of Sciences at Berlin, Sulzer gave a figure, from which it was afterwards constructed in England. This ingenious piece of mechanism was universally approved, though several things may be wanting to render it complete; but no one was so generous as to indemnify the artist for his expenses, or to reward him for his labour.

About the year 1756, the Prussian minister, Count de Podewils, took him into his service, chiefly for the purpose of constructing water-works in his magnificent gardens at Gusow. There he invented his well-known thrashing machine, and another for chopping straw more expeditiously. He also displayed his talent for invention by constructing an apparatus, which, being fastened to a carriage, indicates the revolutions made by the wheels. Such machines had been made before, but his far exceeded every thing of the kind. Having lost this machine by a fire, he invented another still simpler, which was so contrived as to be buckled between the spokes of the wheel. This piece of mechanism was in the possession of Sulzer, who used it on his tour, and found that it answered the intended purpose.

In the year 1765, when the duke of Courland, then hereditary prince, resided at Berlin, he paid a visit to Hohlfeld, and endeavoured to prevail on him to go to Courland, by offering him a pension of 800 rix-dollars; but this ingenious man was so contented with his condition, and so attached to his friends, that he would not, merely for self-interest, quit Berlin. His refusal, however, obtained for him a pension of 150 dollars from the king.

Besides the before-mentioned machines, he constructed, occasionally, several useful models. Among these were a loom for weaving figured stuffs, so contrived that the weaver

had no need of anything to shoot through the woof[1]; a pedometer for putting in the pocket; a convenient and simple bed for a sick person, which was of such a nature, that the patient, with the least effort, could at any time raise or lower the breast, and when necessary convert the bed into a stool; and a carriage so formed, that if the horses took fright or ran away, the person in it could, by a single push, loosen the pole and set them at liberty. The two last models have been lost.

Every machine that this singular man saw, he altered and improved in the simplest manner. All his own instruments he made himself, and repaired them when damaged. But as he was fonder of inventing than of following the plans of others, he made them in such a manner that no one except himself could use them. Several of his improvements were, however, imitated by common workmen, though in a very clumsy manner. It is worthy of remark, that he never bestowed study upon anything; but when he had once conceived an idea, he immediately executed it. He comprehended in a moment whatever was proposed, and at the same time saw how it was to be accomplished. He could therefore tell in an instant whether a thing was practicable; if he thought it was not, no persuasion or offer of money could induce him to attempt it. He never pursued chimæras like those mechanics who have not had the benefit of education or instruction; and though this may be ascribed to the intercourse he had with great mathematicians and philosophers, there is every reason to believe that he would have equally guarded against them, even if he had not enjoyed that advantage. The same quickness of apprehension which he manifested in mechanics he showed also in other things. His observations on most subjects were judicious, and peculiar to himself; so that it may be said, without exaggeration, that he was born with a philosophical mind.

A little before his death he had the pleasure of seeing a curious harpsichord he had made, which was purchased by his Prussian Majesty, and placed in an elegant apartment in the new palace at Potsdam. As he had for some time neglected this instrument, the too great attention which he bestowed on putting it in order contributed not a little to bring on that disease which at last proved fatal to him. His clock

[1] This model is preserved in the collection of the Academy.

having become deranged during his illness, he could not be prevented, notwithstanding the admonition of his friend and physician Dr. Stahls, from repairing it. Close application occasioned some obstructions which were not observed till too late; and an inflammation taking place, he died in 1771, at the house of Count de Podewils, in the 60th year of his age.

[The instrument now generally used in this country for measuring the distance gone over, is that invented by Mr. Payne, watchmaker, of Bond-street. In this ingenious contrivance motion is communicated from the traveller to the machinery of the pedometer, by means of a horizontal lever, which is furnished with a weight at one end and a pivot or axis at the other; under the lever is a spring, which keeps the lever when at rest close up to a regulating screw; the spring is so arranged as to be only just sufficiently strong to overcome the weight of the lever and to prevent its falling downwards.

When the body of the traveller is raised in progression, the lever is impelled downwards by the jerk, and immediately returned to its place by the spring, and so long as the motion is continued the lever is constantly in a state of vibration. A small ratchet-wheel is fixed to the axis of the lever, and beneath it is another and larger ratchet-wheel which fits on the same axis, but is not attached to it. These two wheels are connected by a ratchet or pale in such a manner, that when the lever falls, both wheels are moved forward one or more teeth, but when the lever rises again from the force of the spring, the larger ratchet-wheel is held stationary by a ratchet. The larger wheel is connected with a series of toothed wheels and pinions, by means of a pinion fixed on its under-surface. The centre wheel carries an index or hand, which points to figures on the dial-plate. The whole apparatus packs into the case of a watch[1].]

[1] There is a figure of it in the Penny Cyclopædia, vol. xvii. p. 367.

MACHINE FOR NOTING DOWN MUSIC.

As I have occasionally mentioned in the preceding article, a machine for noting down any piece of music played on a harpsichord or other musical instrument, I shall here add a short history of the invention of it, as far as I know; and with the greater pleasure, as another nation has laid claim to it, though it belongs to my countrymen.

It appears incontestable, that a proposal for inventing such a machine was first made known by an Englishman. In the month of March 1747, John Freke transmitted to the Royal Society a paper written by a clergyman of the name of Creed, which was printed in the Philosophical Transactions under the following title:—A Demonstration of the possibility of making a machine that shall write extempore voluntaries, or other pieces of music, as fast as any master shall be able to play them upon an organ, harpsichord, &c.; and that in a character more natural and more intelligible, and more expressive of all the varieties those instruments are capable of exhibiting, than the character now in use[1]. The author of this paper however points out the possibility only of making such a machine, without giving directions how to construct it.

In the year 1745, John Frederic Unger, then land-bailiff and burgomaster of Einbec, and who is known by several learned works, fell upon the same invention without the smallest knowledge of the idea published in England. This invention however, owing to the variety of his occupations, he did not make known till the year 1752, when he transmitted a short account of it, accompanied with figures, to the Academy of Sciences at Berlin. The Academy highly approved of it, and it was soon celebrated in several gazettes, but a description of it was never printed.

A few days after Euler had read this paper of Unger's before the Academy, M. Sulzer informed Hohlfeld of the invention, and advised him to exert his ingenuity in constructing such a machine. In two weeks this untaught mechanic, without having read Unger's paper, and even without inspecting the figures, completed the machine, which Unger himself had

[1] Phil. Trans. vol. xliv. p. ii. No. 483, p. 446.

not been able to execute through want of an artist capable of following his ideas.

Unger's own description of his invention was printed, with copper-plates, at Brunswick, in the year 1774, together with the correspondence between him and Euler, and other documents. A description of Hohlfeld's machine, illustrated with figures, was published after his death by Sulzer, in the new memoirs of the Academy of Berlin, 1771, under the title of 'Description of a machine for noting down pieces of music as fast as they are played upon the harpsichord.' Sulzer there remarks, that Hohlfeld had not followed the plan sketched out by Unger, and that the two machines differed in this—that Unger's formed one piece with the harpsichord, while that of Hohlfeld could be applied to any harpsichord whatever.

When Dr. Burney visited Berlin, he was made acquainted with Hohlfeld's machine by M. Marpurg; and has been so ungenerous, or rather unjust, as to say in his Musical Travels, that it is an English invention, and that it had been before fully described in the Philosophical Transactions. This falsehood M. Unger has sufficiently refuted. Without repeating his proofs, I shall here content myself with quoting his own words, in the following passage:—"How can Burney wish to deprive our ingenious Hohlfeld of the honour of being the sole author of that invention, and to make an Englishman share it with him, because our German happened to execute successfully what his countryman Creed only suggested? Such an attempt is as unjust in its consequences as it is dishonourable to the English nation and the English artists. When we reflect on the high estimation in which music is held in England, the liberality of the English nobility, and their readiness to spare no expenses in bringing forward any useful invention, a property peculiar to the English, it affords just matter of surprise that the English artists should have suffered themselves to be anticipated by a German journeyman lace-maker. To our Hohlfeld, therefore, will incontestably remain the lasting honour of having executed a German invention; and the Germans may contentedly wait to see whether Burney will find an English mechanic capable of constructing this machine, from the information given by his countryman Creed."

REFINING GOLD AND SILVER ORE BY QUICKSILVER.

AMALGAMATION.

It is well known that quicksilver unites very readily with almost all metals, and when added in a considerable quantity forms with them a paste which can be kneaded, and which is called amalgam. On the other hand, as it does not unite with the earths, being a metallic substance, it furnishes an excellent medium for separating gold and silver from the substances with which they are found. The amalgam is squeezed through a piece of leather, in which these precious metals remain with a certain portion of the quicksilver; and the former are freed from the latter by means of fire, which volatilizes the mercury. This amalgam made with gold serves also for gilding metals (water-gilding)[1], if it be rubbed over them, and afterwards heated till the quicksilver be driven off.

[1] [Among the improvements of recent date there are perhaps none of greater importance than those of electro-gilding and gilding by immersion, which have almost entirely superseded the process of gilding by an amalgam of mercury and gold, so fatal to the workmen exposed to the deleterious effects of the mercurial vapours. It is not our intention to enter at present into a history of the invention of these processes; they will more properly be reserved for a future volume, in which the discoveries of the present century will be treated of. The following short outline may however not prove uninteresting to the reader:—It had long been known to experimentalists on the chemical action of voltaic electricity, that solutions of several metallic salts were decomposed by its agency, and the metal produced in its free state. The precipitation of copper by the voltaic current was noticed by Mr. Nicholson[a] in a paper entitled 'Account of the new Electrical Apparatus of Sig. Alex. Volta, and experiments performed with the same;' but the earliest recorded process in electro-gilding is probably that contained in a letter from Brugnatelli to Van Mons[b], in which he states that he had deposited a film of gold on ten silver medals by bringing them into communication by means of a steel wire with the negative pole of a voltaic pile, and keeping them one after the other immersed in ammoniuret of gold newly made and well-saturated. This announcement of a process identical with those now extensively used, attracted no attention at the time it was made, and no further experiments

[a] Nicholson's Journal, July 1800, p. 179.
[b] Philosophical Magazine, 1805.

The first use of quicksilver is commonly reckoned a Spanish invention, discovered about the middle of the sixteenth century; but it appears from Pliny, that the ancients were acquainted with amalgam and its use, not only for separating gold and silver from earthy particles, but also for gilding[1]. Vitruvius describes the manner of recovering gold from cloth in which it has been interwoven. The cloth, he says, is to be put into an earthen vessel, and placed over the fire, in order that it may be burnt. The ashes are to be thrown into water, and quicksilver added to them. The latter attracts the particles of the gold, and unites with them. The water is then to be poured off, and the residue put into a piece of cloth; which being squeezed with the hands, the quicksilver, on account of its fluidity, oozes through the pores, and the gold is left pure in a compressed mass[2]. Isidore of Seville says also, that quicksilver is best preserved in vessels of glass, as it penetrates all other substances; and that without it neither silver nor brass can be gilded[3]. Modern mineralogists however have this advantage over the ancient, that they know how to separate the quicksilver from gold and silver without losing it. Instead of exposing the amalgam to an open fire, as for-

on the application of electricity to the deposition of metals for the purposes of the arts were published until the year 1830, when Mr. E. Davy read a paper before the Royal Society, in which he distinctly states that he had gilded, silvered, coppered and tinned various metals by the voltaic battery[a]. The experiments of Brugnatelli and Davy were however completely lost sight of, and the art may be said to date its origin from the period when the late Professor Daniell described his constant battery. Since that time the art has continued to advance most rapidly, either in the perfecting of the apparatus or in the pointing out of more suitable salts of gold and silver, from which the metals might be precipitated. Among those who have contributed to its advancement we may particularly instance the names of our countrymen, Woolrich, Spencer, Jordan, Mason, Murray, Smee, Elkington, Fox Talbot, and Tuck. Nearly all the gilt articles manufactured at Birmingham are now gilded by the process patented by Mr. Elkington, in which, after the articles have been cleansed by a weak acid, they are placed in a hot solution of nitro-muriate of gold, to which a considerable excess of bicarbonate of potash has been added; in the course of a few seconds they thus receive a beautiful and permanent coating of gold.]

[a] Phil. Trans. 1831, p. 147.

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[1] Lib. xxxiii. cap. 6.
[2] Vit. lib. vii. c. 8
[3] In Origin. lib. xvi. c. 18.

merly, and driving off the volatile metal, it is now put into a retort, and the quicksilver is collected in a receiver for further use.

Those also who wash gold from the sand found near rivers, use quicksilver before their work is completed; and I am strongly inclined to believe that this method prevailed in Germany long before the discovery of the mines in America. In the year 1582, John Michael Heberer described the washing of gold as he saw it practised at Selz, not far from Strasburg; and at that time quicksilver had been long employed for that purpose. In Treitlinger's Dissertation, also, concerning the collecting of gold, and particularly in the Rhine, there is a description of the manner in which gold sand is washed by means of quicksilver, but no date is mentioned[1].

The history of employing mercury in procuring the American silver is, as far as I know, most fully given by the jesuit Acosta[2], whose relation of the Indies abounds with curious and useful information. The quicksilver mines of Peru are situated in an extensive ridge of mountains near Guamanga, on the south side of Lima, and at no great distance from it. They are called Guancabelica, or Guancavilia. The mines were discovered about the year 1566 or 1567, when Castro was viceroy of Peru, by Henry Garces, or Graces, as he is called by the Portuguese. This man was a native of Porto, went to Peru in the Spanish service, and after the death of his wife became canon of the cathedral of Mexico. He translated the Lusiad of Camoens from the Portuguese into Spanish, and this has procured him a place in Professor Dieze's translation of Velasquez's History of Spanish Poetry. He caused a law to be enacted that no silver bullion should be suffered to circulate in Peru; but his greatest service was the discovery of the quicksilver mines. As he was one day examining the red earth, which the Indians use for paint, and call *limpi*, he observed that it was native cinnabar; and as he knew that quicksilver was extracted from it in Europe, he went to the place where it was dug up, made some experiments, and thus laid a foundation for the most important works. No one however thought of employing this metal in the silver mines till the year 1571, when Francis de Toledo

[1] De Aurilegio, præcipue in Rheno. Argent. 1776.
[2] Historia naturale e morale delle Indie. Venetia, 1596.

being viceroy, one Pero Fernandes de Velasco came to Peru, and offered to refine the silver by mercury, as he had learnt at the smelting-houses in Mexico. His proposal being accepted, and his attempts proving successful, the old methods were abandoned, and that of amalgamation was adopted in its stead [1]. From this account it appears that Garces was not the inventor of amalgamation, that it was introduced into Peru in the year 1571, and that it had been long before practised in Mexico; but at what period it was first used there I have not been able to learn. The abbé Raynal says, that quicksilver was a free article of trade till the year 1571, when it was declared to belong exclusively to the crown; and this regulation was made in consequence of its being employed in refining. Robertson, in his History of America, tells us that the mines of Guanacabelica were discovered in 1563, and that amalgamation was introduced in 1574.

Anderson says, in his History of Commerce [2], that in the second volume of Hakluyt there is a letter which shows the use of quicksilver to have been a new invention in the year 1572. This letter I found, not in the second, but in the third and last volume of the Voyages collected by Hakluyt [3]. It was written in the above year by a merchant named Henry Hawks, and contains only the following information: "A good owner of mines must have much quicksilver; and as for this charge of quicksilver, it is a new invention, which they find more profitable than to fine their ore with lead."

Gobet, in a work entitled The Ancient Mineralogists of France, accuses Alphonso Barba of asserting that he found out amalgamation in the year 1609. To examine this charge, it will be necessary to give some account of the metallurgic works of that Spaniard, which, perhaps, may not prove unacceptable to those who are fond of metallurgy and mineralogy. Alvaro Alphonso Barba was born at Lepe, a small town in Andalusia, and officiated many years as clergyman of the church of St. Bernard, at Potosi. The first edition of this

[1] The same account as that given by Acosta may be seen in Garcilasso de la Vega, Commentarios reales; Lisboa 1609, p. 225; in Rycaut's English translation, London 1688, fol. i. p. 347; and in De Laet, Novus Orbis, Lugd. Bat. 1633, fol. p. 447.

[2] Vol. i. p. 414.

[3] Hakluyt's Collection of Voyages. London, 1600, fol. vol. iii. p. 466.

work was printed in quarto, at Madrid, in 1640, in the Spanish language, and illustrated with cuts. This book the Spaniards for a long time concealed, because they considered it as containing all their metallurgic secrets; though at that time there were much better works of the kind in Germany, and though amalgamation had been long known and practised. Edward earl of Sandwich, being ambassador to Spain, found however an opportunity of procuring a copy of it, as a great rarity; and he began a translation of it into English, but translated only the first two books. This translation was published at London in octavo, in 1674, after the earl's death, and entitled The First Book of the Art of Metals, in which is declared the manner of their generation, and the concomitants of them. Written in Spanish by Albaro Alonso Barba, translated by the earl of Sandwich. From this English edition several German translations have been made, of which I am acquainted with the following: two at Hamburg, one printed in 1676, and the other in 1696; and two at Frankfort, one in 1726, and another in 1739. In the year 1749 a new edition appeared at Vienna. This edition, which is very different from any of the former, was translated from the French by one Godar, who was not a German, and who on that account apologises in the preface for the badness of his style. All these editions however are imperfect; for the original contains five books, as we learn from Leibnitz, who caused them to be transcribed. In the year 1751 a new translation came out at Paris, entitled Metallurgy, or the art of extracting and purifying metals, translated from the Spanish of Alphonso Barba, by M. Gosfort, with the most curious dissertations on mines and metallic operations; of this translation the celebrated abbé Lenglet de Fresnoy is said to have been the editor[1].

To judge by two of the German editions, Gobet has done Barba an injustice. In that of 1676, I find Barba expressly says he does not believe the ancients were acquainted with the art of extracting silver from pounded ore by the means of quicksilver. This certainly does not indicate that he laid claim to the invention; besides, he everywhere speaks of amalgamation as an art long used in America, but complains

[1] See La France littéraire. Paris, 1769, 2 vols. 8vo, vol. ii. p. 410.

of the negligence with which it was practised. In a passage however in the Vienna edition, and which has probably been added by Gobet, we are told that in the year 1609, Barba attempted to fix quicksilver, and with that view bethought himself of mixing it with finely pounded silver ore; that he at first imagined, with surprise, that he had obtained a mass of silver, but that he soon perceived that the mercury was not changed into silver, but had only attracted the particles of that metal. "I was," adds Barba, "highly pleased with my new discovery of managing ore, of extracting its contents, and of refining it; and this method I continued to practise." I imagine that Barba was still in Europe in 1609, and made that experiment before he was acquainted with the smelting-works in America. I am however of opinion, that one will see by the original that Barba did not wish to claim the invention of amalgamation as practised in the mines of America.

COLD OR DRY GILDING.

Dry gilding, as it is called by some workmen, is a light method of gilding, by steeping linen rags in a solution of gold, then burning them; and with a piece of cloth dipped in salt water, rubbing the ashes over silver intended to be gilt. This method requires neither much labour nor much gold, and may be employed with advantage for carved work and ornaments. It is however not durable.

I am of opinion that this manner of gilding is a German invention, and that foreigners, at least the English, were first made acquainted with it about the end of the last century; for Robert Southwell describes it in the Philosophical Transactions for the year 1698, and says that it was known to very few goldsmiths in Germany.

GOLD VARNISH.

As mankind could not have everything that they wished for of gold, they were contented with incrusting many articles with this precious metal. For that purpose the gold was beat into plates, with which the walls of apartments, dishes, and other vessels were covered. In early ages these plates were thick, so that gilding in this manner was very expensive[1]; but in process of time the expense was much lessened, because the art was discovered of making these gold plates thinner, and of laying them on with a size. Articles however ornamented in this manner were still costly, and the valuable metal was always lost. Yellow golden colours of all kinds were then tried; but these did not fully produce the required effect, as they wanted that splendour peculiar to metals, and appeared always languid and dull. It was not till modern times that artists conceived the idea of overlaying with silver, or some cheaper white metal, such things as they wished to have the appearance of gold, and then daubing them over with a yellow transparent varnish, in order to give to the white metal the colour of gold, and to the colour the splendour of metal. "When we cover our houses with gold," says Seneca, "do we not show that we delight in deception? for we know that coarse wood is concealed under that gold[2]."

This ingenious process, which at present is employed all over Europe in gilding wooden frames, coaches, and various articles, and which was formerly used in the preparation of the now old-fashioned leather tapestry, was invented towards the end of the 17th century. Anderson, in his Historical and chronological deduction of the Origin of Commerce, says that it was introduced into England by one Evelyn in the year 1633; and quotes, in support of this assertion, The Present State of England, printed in 1683.

This invention, however, does not belong to the English, but to the Italians, and properly to the Sicilians. Antonino

[1] One may see in Homer's Odyssey, book iii. v. 432, the process employed for gilding in this manner, the horns of the cow brought by Nestor as an offering to Minerva.

[2] Epist. 115.

Cento, an artist of Palermo, found out the gold varnish, and in the year 1680 published there an account of the method of preparing it. That work I have never seen; but I found this information in a book printed at Palermo in 1704, and entitled The Inventions of the Sicilians[1]. Among the few important things contained in this book, the greater part of which is compiled from old Latin writers, there is, in the additions, a receipt how to prepare the gold varnish (*vernice d'oro*). The whole account I shall transcribe, as the authors of the French Journal of Agriculture, Commerce, and the Arts, thought it worth their trouble to make it known in that work in 1778.

"Take shell-lac, and having freed it from the filth and bits of wood with which it is mixed, put it into a small linen bag, and wash it in pure water, till the water no longer becomes red; then take it from the bag and suffer it to dry. When it is perfectly dry, pound it very fine; because the finer it is pounded the more readily will it dissolve. Then take four parts of spirit of wine, and one of the lac, reduced, as before directed, to an impalpable powder, so that for every four pounds of spirit you may have one of lac: mix these together, and, having put them into an alembic, graduate the fire so that the lac may dissolve in the spirit. When dissolved, strain the whole through a strong piece of linen cloth; throw away what remains in the cloth, as of no use, and preserve the liquor in a glass bottle closely corked. This is the gold varnish which may be employed for gilding any kind of wood.

"When you wish to use it, you must, in order that the work may be done with more smoothness, employ a brush made of the tail of a certain quadruped called the vari, well-known to those who sell colours for painting; and with this instrument dipped in the liquor wash gently over, three times, the wood which has been silvered. You must, however, remember every time you pass the brush over the wood to let it dry; and thus your work will be extremely beautiful, and have a resemblance to the finest gold."

After this invention was made known, it was not difficult to vary, by several methods, the manner of preparing it. Different receipts, therefore, have for that purpose been given in a number of books, such as Croker's Painter, and others: and, on this account, young artists are frequently at a loss which

[1] La Sicilia inventrice. Palermo, 1704, 4to.

to choose; and when a receipt is found better than another, experienced artists keep it always secret.

With the preparation of that varnish used for gilding leather tapestry Reaumur was acquainted, and from his papers it was made known by Fougeroux de Bondaroy. The method of making the English varnish was communicated by Scarlet to Hellot, in the year 1720; and by Graham to Du Fay, in 1738. In the year 1761, Hellot gave the receipt to the Academy of Sciences at Paris, who published it in their memoirs for that year.

If it be true, as Fougeroux says, that gilded tapestry was made above two hundred years ago, it might be worth the little trouble that such an examination would require to investigate the method used to gild it.

TULIPS.

The greater part of the flowers which adorn our gardens have been brought to us from the Levant. A few have been procured from other parts of the world; and some of our own indigenous plants, that grow wild, have, by care and cultivation, been so much improved as to merit a place in our parterres. Our ancestors, perhaps, some centuries ago paid attention to flowers; but it appears that the Orientals, and particularly the Turks, who in other respects are not very susceptible of the inanimate beauties of nature, were the first people who cultivated a variety of them in their gardens for ornament and pleasure. From their gardens, therefore, have been procured the most of those which decorate ours; and amongst these is the tulip.

Few plants acquire through accident, weakness, or disease, so many tints, variegations, and figures, as the tulip. When uncultivated, and in its natural state, it is almost of one colour, has large leaves, and an extraordinary long stem. When it has been weakened by culture, it becomes more agreeable in the eyes of the florist. The petals are then paler, more variegated, and smaller; the leaves assume a fainter or softer green

colour: and this masterpiece of culture, the more beautiful it turns, grows so much the weaker; so that, with the most careful skill and attention, it can with difficulty be transplanted, and even scarcely kept alive.

That the tulip grows wild in the Levant, and was thence brought to us, may be proved by the testimony of many writers. Busbequius found it on the road between Adrianople and Constantinople[1]; Shaw found it in Syria, in the plains between Jaffa and Rama; and Chardin on the northern confines of Arabia. The early-blowing kinds, it appears, were brought to Constantinople from Cavala, and the late-blowing from Caffa; and on this account the former are called by the Turks *Cavalá lalé*, and the latter *Café lalé*. Caval is a town on the eastern coast of Macedonia, of which Paul Lucas gives some account; and Caffa is a town in the Crimea, or peninsula of Gazaria, as it was called, in the middle ages, from the Gazares, a people very little known[2].

Though florists have published numerous catalogues of the species of the tulip, botanists are acquainted only with two, or at most three, of which scarcely one is indigenous in Europe[3].

[1] "As we passed, we saw everywhere abundance of flowers, such as the narcissus, hyacinth, and those called by the Turks tulipan, not without great astonishment, on account of the time of the year, as it was then the middle of winter, a season unfriendly to flowers. Greece abounds with narcissuses and hyacinths, which have a remarkably fragrant smell: it is, indeed, so strong as to hurt those who are not accustomed to it. The tulipan, however, have little or no smell, but are admired for their beauty and variety of their colour. The Turks pay great attention to the cultivation of flowers; nor do they hesitate, though by no means extravagant, to expend several aspers for one that is beautiful. I received several presents of these flowers, which cost me not a little."—*Busbequii Ep.*, Basiliæ, 1740, 8vo, p. 36.

[2] See some account of them in Memoriæ populorum ad Danubium by Stritter.

[3] The *Tulipa sylvestris*, Linn. grows wild in the southern parts of France. Dodonæus says, in his Florum coronariarum herbarum historia, Antverpiæ 1569, 8vo, p. 204, "In Thracia et Cappadocia tulipa exit; Italiæ et Belgio peregrinus est flos. Minores alicubi in Gallia Narbonensi nasci feruntur." Linnæus reckons it among the Swedish plants, and Haller names it among those of Switzerland, but says, afterwards, I do not believe it to be indigenous, though it is found here and there in the meads.—*Hist. Stirp.* ii. p. 115. It appears that this species is earlier than the common *Tulipa Gesneriana*, though propagated from it. The useless roots thrown perhaps from Gesner's garden have grown up in a wild state, and become naturalized, as the European cattle have in America. See Miller's Gardener's Dictionary, iv. p. 518.

All those found in our gardens have been propagated from the species named after that learned man, to whom natural history is so much indebted, the Linnæus of the sixteenth century, Conrad Gesner, who first made the tulip known by a botanical description and a figure. In his additions to the works of Valerius Cordus, he tells us that he saw the first in the beginning of April 1559, at Augsburg, in the garden of the learned and ingenious counsellor John Henry Herwart. The seeds had been brought from Constantinople, or, according to others, from Cappadocia. This flower was then known in Italy under the name of tulipa, or tulip, which is said to be of Turkish extraction, and given to it on account of its resembling a turban[1].

Balbinus asserts that Busbequius brought the first tulip-roots to Prague, from which they were afterwards spread all over Germany[2]. This is not improbable; for Busbequius says, in a letter written in 1554, that this flower was then new to him; and it is known that besides coins and manuscripts he collected also natural curiosities, and brought them with him from the Levant. Nay, he tells us that he paid very dear to the Turks for these tulips; but I do not find he anywhere says that he was the first who brought them from the East.

In the year 1565 there were tulips in the garden of M. Fugger, from whom Gesner wished to procure some[3]. They first appeared in Provence, in France, in the garden of the celebrated Peyresc, in the year 1611[4].

After the tulip was known, Dutch merchants, and rich people at Vienna, who were fond of flowers, sent at different times to Constantinople for various kinds. The first roots planted in England were sent thither from Vienna, about the end of the sixteenth century, according to Hakluyt[5]; who is,

[1] See Martini Lexicon Philologieum, and Megiseri Diction. Turcico-Lat., where the word *tulbent*, a turban, is derived from the Chaldaic.

[2] Balbini Miscellanea Bohemiæ, p. 100.

[3] Gesneri Epistolæ Medicinales. Tiguri, 1577, 8vo, p. 79 and 80.

[4] Vita Peireseii, auctore Gassendo. 1655, 4to, p. 80.

[5] Hakluyt says, "And now within these four years there have been brought into England from Vienna in Austria, divers kind of flowers called tulipas, and those and others procured thither a little before, from Constantinople, by an excellent man, Carolus Clusius." See Biographia Britannica, ii. p. 164. [Gerarde in his Herbal, 1597, speaks of the Tulip in the following manner:—"My loving friend Mr. James Garret, a curious searcher of

however, wrong in ascribing to Clusius the honour of having first introduced them into Europe; for that naturalist only collected and described all the then known species.

These flowers, which are of no further use than to ornament gardens, which are exceeded in beauty by many other plants, and whose duration is short and very precarious, became, in the middle of the 17th century, the object of a trade such as is not to be met with in the history of commerce, and by which their price rose above that of the most precious metals. An account of this trade has been given by many authors; but by all late ones it has been misrepresented. People laugh at the Tulipomania[1], because they believe that the beauty and rarity of the flowers induced florists to give such extravagant prices: they imagine that the tulips were purchased so excessively dear in order to ornament gardens; but this supposition is false, as I shall show hereafter.

This trade was not carried on throughout all Europe, but in some cities of the Netherlands, particularly Amsterdam, Haarlem, Utrecht, Alkmaar, Leyden, Rotterdam, Hoorn, Enkhuysen, and Meedenblick; and rose to the greatest height in the years 1634–37[2]. Munting has given, from some of the books kept during that trade, a few of the prices then paid, of which I shall present the reader with the following. For a

simples, and learned apothecary in London, hath undertaken to find out, if it were possible, the infinite sorts by diligent sowing of their seeds, and by planting those of his own propagation, and by others received from his friends beyond the seas for the space of twenty years, not being yet able to attain to the end of his travail, for that each new year bringeth forth new plants of sundry colours not before seen; all of which, to describe particularly, were to roll Sisyphus' stone, or number the sands."]

[1] This word was coined by Menage.

[2] The principal works in which an account of this Tulipomania is to be found are,—Eerste Tzamenspraak tuschen Waermondt en Gaargoed nopens deopkomst en ondergang van Flora. Amsterdam, 1643, 12mo.—Meterani Novi, or New History of the Netherlands, part fourth. Amsterdam, 1640, folio, p. 518, from which Marquard, De Jure Mercatorum, p. 181, has taken his information.—Naauwkeurige beschryving der Aardgewassen, door Abraham Munting. Leyden en Utrecht, 1696, folio, p. 907.—De Koophandel van Amsterdam, door Le Long, ii. p. 307.—Le Negoce d'Amsterdam, par J. P. Ricard. A Rouen, 1723, 4to, p. 11.—Breslauer Samlung von Natur- und Kunst-Geschichten, 1721, May, p. 521.—Francisci Schaubühne, vol. ii. p. 639.—Tenzel, Monatliche Unterredungen, 1690, November, p. 1039.—Année Littéraire, 1773, xv. p. 16.—Martini Zeiler Miscellanea, p. 29.—Christ. Funcii Orbis Politicus, p. 879.

root of that species called the Viceroy the after-mentioned articles, valued as below expressed, were agreed to be delivered :—

	Florins.
2 lasts of wheat	448
4 ditto rye	558
4 fat oxen	480
3 fat swine	240
12 fat sheep	120
2 hogsheads of wine	70
4 tons of beer	32
2 ditto butter	192
1000 pounds of cheese	120
a complete bed	100
a suit of clothes	80
a silver beaker	60
Sum	2500

These tulips afterwards were sold according to the weight of the roots. Four hundred perits [1] of Admiral Leifken cost 4400 florins; 446 ditto of Admiral Von der Eyk, 1620 florins; 106 perits Schilder cost 1615 florins; 200 ditto Semper Augustus, 5500 florins; 410 ditto Viceroy, 3000 florins, &c. The species Semper Augustus has been often sold for 2000 florins; and it once happened that there were only two roots of it to be had, the one at Amsterdam and the other at Haarlem. For a root of this species, one agreed to give 4600 florins, together with a new carriage, two gray horses, and a complete harness. Another agreed to give for a root twelve acres of land; for those who had not ready money, promised their moveable and immoveable goods, houses and lands, cattle and clothes. A man whose name Munting once knew, but could not recollect, won by this trade more than 60,000 florins in the course of four months. It was followed not only by mercantile people, but also by the first noblemen, citizens of every description, mechanics, seamen, farmers, turf-diggers, chimney-sweeps, footmen, maid-servants and old clothes-women, &c. At first, every one won and no one lost. Some of the poorest people gained in a few months houses, coaches and horses, and

[1] A perit is a small weight less than a grain.—TRANS.

figured away like the first characters in the land. In every town some tavern was selected which served as a 'Change, where high and low traded in flowers, and confirmed their bargains with the most sumptuous entertainments. They formed laws for themselves, and had their notaries and clerks.

When the nature of this trade is considered, it will readily be perceived, that to get possession of these flowers was not the real object of it, though many have represented it in that light. The price of tulips rose always higher from the year 1634 to the year 1637; but had the object of the purchaser been to get possession of the flowers, the price in such a length of time must have fallen instead of risen. "Raise the prices of the productions of agriculture, when you wish to reduce them," says Young; and in this he is undoubtedly right, for a great consumption causes a greater reproduction. This has been sufficiently proved by the price of asparagus at Göttingen. As it was much sought after, and large prices paid for it, more of it was planted, and the price has fallen. In like manner plantations of tulips would have in a short time been formed in Holland, and florists would have been able to purchase flowers at a much lower price. But this was not done; and the chimney-sweeper, who threw aside his besom, did not become a gardener, though he was a dealer in flowers. Roots would have been imported from distant countries, as asparagus was from Hanover and Brunswick to Göttingen; the high price would have induced people to go to Constantinople to purchase roots, as the Europeans travel to Golconda and Visapour to procure precious stones; but the dealers in tulips confined themselves to their own country, without thinking of long journeys. I will allow that a flower might have become scarce, and consequently dearer; but it would have been impossible for the price to rise to a great height, and continue so for a year. How ridiculous would it have been to purchase useless roots with their weight of gold, if the possession of the flower had been the only object! Great is the folly of mankind; but they are not fools without a cause, as they would have been under such circumstances.

During the time of the Tulipomania, a speculator often offered and paid large sums for a root which he never received, and never wished to receive. Another sold roots which he never possessed or delivered. Oft did a nobleman

purchase of a chimney-sweep tulips to the amount of 2000 florins, and sell them at the same time to a farmer; and neither the nobleman, chimney-sweep or farmer had roots in their possession, or wished to possess them. Before the tulip season was over, more roots were sold and purchased, bespoke and promised to be delivered, than in all probability were to be found in the gardens of Holland; and when Semper Augustus was not to be had, which happened twice, no species perhaps was oftener purchased and sold. In the space of three years, as Munting tells us, more than ten millions were expended in this trade in only one town of Holland.

To understand this gambling traffic, it may be necessary to make the following supposition. A nobleman bespoke of a merchant a tulip-root, to be delivered in six months, at the price of 1000 florins. During these six months the price of that species of tulip must have risen or fallen, or remained as it was. We shall suppose that at the expiration of that time the price was 1500 florins; in that case the nobleman did not wish to have the tulip, and the merchant paid him 500 florins, which the latter lost and the former won. If the price was fallen when the six months were expired, so that a root could be purchased for 800 florins, the nobleman then paid to the merchant 200 florins, which he received as so much gain; but if the price continued the same, that is 1000 florins, neither party gained or lost. In all these circumstances, however, no one ever thought of delivering the roots or of receiving them. Henry Munting, in 1636, sold to a merchant at Alkmaar, a tulip-root for 7000 florins, to be delivered in six months; but as the price during that time had fallen, the merchant paid, according to agreement, only ten per cent. "So that my father," says the son, "received 700 florins for nothing; but he would much rather have delivered the root itself for 7000." The term of these contracts was often much shorter, and on that account the trade became brisker. In proportion as more gained by this traffic, more engaged in it; and those who had money to pay to one, had soon money to receive of another; as at faro, one loses upon one card, and at the same time wins on another. The tulip-dealers often discounted sums also, and transferred their debts to one another; so that large sums were paid without cash, without bills, and without goods, as by the *Virements* at Lyons. The

whole of this trade was a game at hazard, as the Mississippi trade was afterwards, and as stock-jobbing is at present. The only difference between the tulip-trade and stock-jobbing is, that at the end of the contract the price in the latter is determined by the Stock-exchange; whereas in the former it was determined by that at which most bargains were made. High- and low-priced kinds of tulips were procured, in order that both the rich and the poor might gamble with them; and the roots were weighed by perits, that an imagined whole might be divided, and that people might not only have whole, but half and quarter lots. Whoever is surprised that such a traffic should become general, needs only to reflect upon what is done where lotteries are established, by which trades are often neglected, and even abandoned, because a speedier mode of getting fortunes is pointed out to the lower classes. In short, the tulip-trade may very well serve to explain stock-jobbing, of which so much is written in gazettes, and of which so many talk in company without understanding it; and I hope, on that account, I shall be forgiven for employing so much time in illustrating what I should otherwise have considered as below my notice[1].

At length, however, this trade fell all of a sudden. Among such a number of contracts many were broken; many had engaged to pay more than they were able; the whole stock of the adventurers was consumed by the extravagance of the winners; new adventurers no more engaged in it; and many, becoming sensible of the odious traffic in which they had been concerned, returned to their former occupations. By these means, as the value of tulips still fell, and never rose, the sellers wished to deliver the roots *in natura* to the purchasers at the prices agreed on; but as the latter had no desire for tulips at even such a low rate, they refused to take them or to pay for them. To end this dispute, the tulip-dealers of Alkmaar sent in the year 1637 deputies to Amsterdam; and a resolution was passed on the 24th of February, that all contracts made prior to the last of November 1636 should be null and void; and that, in those made after that date, purchasers should be free on paying ten per cent. to the vender.

The more people became disgusted with this trade, the

[1] [How well the author's remarks apply to the recent mania in railway scrip!]

more did complaints increase to the magistrates of the different towns; but as the courts there would take no cognizance of it, the complainants applied to the states of Holland and West Friesland. These referred the business to the determination of the provincial council at the Hague, which on the 27th of April 1637 declared that it would not deliver its opinion on this traffic until it had received more information on the subject; that in the mean time every vender should offer his tulips to the purchaser; and, in case he refused to receive them, the vender should either keep them, or sell them to another, and have recourse on the purchaser for any loss he might sustain. It was ordered also, that all contracts should remain in force till further inquiry was made. But as no one could foresee what judgement would be given respecting the validity of each contract, the buyers were more obstinate in refusing payment than before; and venders, thinking it much safer to accommodate matters amicably, were at length satisfied with a small profit instead of exorbitant gain; and thus ended this extraordinary traffic, or rather gambling.

It is however certain, that persons fond of flowers, particularly in Holland, have paid, and still pay, very high prices for tulips, as the catalogues of florists show[1]. This may be called the lesser Tulipomania, which has given occasion to many laughable circumstances. When John Balthasar Schuppe was in Holland, a merchant gave a herring to a sailor who had brought him some goods. The sailor, seeing some valuable tulip-roots lying about, which he considered as of little consequence, thinking them to be onions, took some of them unperceived, and ate them with his herring. Through this mistake the sailor's breakfast cost the merchant a much greater sum than if he had treated the prince of Orange. No less laughable is the anecdote of an Englishman who travelled with Matthews. Being in a Dutchman's garden, he pulled a

[1] In the year 1769, the dearest kinds in England were *Don Quevedo* and *Valentinier*; the former cost 2*l.* 2*s.* and the latter 2*l.* 12*s.* 6*d.* See Weston's Botanicus Universalis, part 2. In the German catalogues none of the prices are so high. The name *Semper Augustus* is not once to be found in new catalogues. [They still remain flowers of considerable value among florists; for, according to Mr. Hogg, a moderate collection of choice bulbs cannot now be purchased for a sum much less than 1000*l.*, at the usual prices.—See Chambers' Journal, March 15. 1845.

couple of tulips, on which he wished to make some botanical observations, and put them in his pocket; but he was apprehended as a thief, and obliged to pay a considerable sum before he could obtain his liberty[1].

Reimman and others accuse Just. Lipsius of the Tulipomania[2]; but if by this word we understand that gambling traffic which I have described, the accusation is unfounded. Lipsius was fond of scarce and beautiful flowers, which he endeavoured to procure by the assistance of his friends, and which he cultivated himself with great care in his garden; but this taste can by no means be called a mania[3]. Other learned men of the same age were fond of flowers, such as John Barclay[4], Pompeius de Angelis, and others, who would probably have been so, even though the cultivation of flowers had not been the prevailing taste. It however cannot be denied, that learned men may be infected with epidemical follies. In the present age, many have become physiognomists because physiognomy is in fashion; and even animal magnetism has met with partisans to support it.

[1] Blainville's Travels.

[2] Introd. in Hist. Lit. iii. 3, p. 92.

[3] That he might relax and refresh his mind, worn out by study, he amused himself with the cultivation of his garden and of flowers, and particularly of tulips, the roots of which he was at great pains to procure from all parts of the world, by means of Dodonæus, Clusius, and Boisotus, men singularly well-skilled in horticulture, and by others of his friends. Here, at a distance from civil tumult, with a cheerful countenance and placid eye, he sauntered through his plants and flowers, contemplating sometimes one declining, sometimes another springing up, and forgetting all his cares amidst the pleasure which these objects afforded him. See the Life of Lipsius, prefixed to the edition of his works printed at Antwerp in 1637. This is confirmed by what Lipsius says himself in his book De Constantia, ii. 2, 3, in praise of gardening.

[4] He rented a house near to the Vatican, with a garden, in which he had planted the choicest flowers, and those chiefly which are not propagated from seeds or roots, but from bulbs. These flowers were not known about thirty years before, nor had they been ever seen at Rome, but lay neglected in the Alps.—Of these flowers, which have no smell, but are esteemed only on account of their colours, Barclay was remarkably fond, and purchased their bulbs at a great price. Erythræi Pinacotheca. Lips. 1712, 8vo, iii. 17, p. 623. See also Freheri Theatrum, p. 1515.

CANARY BIRD.

This little bird, highly esteemed for its song, which is reared with so much care, particularly by the fair sex, and which affords an innocent amusement to those who are fond of the wild notes of nature, is a native of those islands from which it takes its name. As it was not known in Europe till the fifteenth century, no account of it is to be met with in any of the works of the old ornithologists. Bellon, who about the year 1555 described all the birds then known, does not so much as mention it. At that period it was brought from the Canary Islands. It was therefore so dear that it could be procured only by people of fortune, and those who purchased were even often imposed on[1]. It was called the sugar-bird, because it was said to be fond of the sugar-cane, and that it could eat sugar in great abundance. This circumstance seems to be very singular; for that substance is to many birds a poison. Experiments have shown, that a pigeon to which four drachms of sugar were given died in four hours, and that a duck which had swallowed five drachms did not live seven hours after. It is certain, therefore, that the power of poison is relative.

The first figure of this bird is given by Aldrovandus, but it is small and inaccurate. That naturalist reckons the Canary bird among the number of those which were scarce and expensive, as it was brought from a distant country with great care and attention. The first good figure of it is to be found in Olina[2]: it has been copied by both Johnston and Willughby.

In the middle of the seventeenth century these birds began to be bred in Europe, and to this the following circumstance, related by Olina, seems to have given occasion. A vessel, which, among other commodities, was carrying a number of Canary birds to Leghorn, was wrecked on the coast of Italy; and these birds, being thus set at liberty, flew to the nearest land, which was the Island of Elba, where they found the climate so favourable, that they multiplied, and perhaps would

[1] Gesneri Historiæ Animalium, liber tertius. Tiguri, 1555, fol. p. 234.

[2] Uccelliera, overo Discorso della natura di diversi Uccelli. Roma, 1622, 4to.

have become domesticated, had they not been caught in snares; for it appears that the breed of them there has been long since destroyed. Olina says that the breed soon degenerated; but it is probable that these Canary birds, which were perhaps all males, did at the Island of Elba what the European sailors do in India. By coupling with the birds of the island, they may have produced mules. Such hybrids are described by Gesner and other naturalists[1].

The breeding of these birds was at first attended with great difficulty; partly because the treatment and attention they required were not known, and partly because males chiefly, and few females, were brought to Europe. We are told that the Spaniards once forbade the exportation of males, that they might secure to themselves the trade carried on in these birds, and that they ordered the bird-catchers either to strangle the females or to set them at liberty[2]. But this order seems to have been unnecessary; for, as the females commonly do not sing, or are much inferior in the strength of their notes to the males, the latter only were sought after as objects of trade. In the like manner, as the male parrots are much superior in colour to the females, the males are more esteemed, and more of them are brought to Europe than of the females. It is probable, therefore, that in our system of ornithology, many female parrots belonging to species already well-known are considered as distinct species. It was at first believed that those Canary birds bred in the Canary Islands were much better singers than those reared in Europe; but this at present is doubted[3]. In latter times various treatises have been published in different languages, on the manner of breeding these birds, and many people have made it a trade, by which they have acquired considerable gain. It does no discredit to the industry of the Tyrolese that they have carried it to the greatest extent. At Ymst there is a company who, after the breeding season is over, send out persons to different parts of Germany and Switzerland to purchase birds from those who breed them.

[1] Gesneri redivivi, aucti et emendati, tomus ii. Franc. 1669, fol. p. 62. More information respecting hybrids may be found in Brisson, Ornithologie, t. iii. p. 187; and Frisch, Vorstellung der Vögel in Teutschland, the twelfth plate of which contains several good figures.

[2] Coleri Œconomia ruralis et domestica. Franc. 1680, folio.

[3] Barrington's paper in the Phil. Trans. vol. lxiii. p. 249.

Each person brings with him commonly from three to four hundred, which are afterwards carried for sale, not only through every part of Germany, but also to England, Russia, and even Constantinople. About sixteen hundred are brought every year to England; where the dealers in them, notwithstanding the considerable expense they are at, and after carrying them about on their backs, perhaps a hundred miles, sell them for five shillings apiece. This trade, hitherto neglected, is now carried on in Schwarzwalde; and at present there is a citizen here at Göttingen, who takes with him every year to England several Canary birds and bullfinches (*Loxia pyrrhula*), with the produce of which he purchases such small wares as he has occasion for.

The principal food of these birds is the Canary seed, which, as is commonly affirmed, and not improbably, was first brought, for this purpose, from the Canary Islands to Spain, and thence dispersed all over Europe. Most of the old botanists, however, are of opinion that the plant which produces it is the same as that called *Phalaris* by Dioscorides[1]. Should this be true, it will follow that this kind of grass must have grown wild in other places besides the island it takes its name from; which is not improbable. But those who read the different descriptions which the ancients have given of *Phalaris*, will, in my opinion, observe that they may be equally applied to more plants; and Pliny seems to have used this name for more than one species of grass[2].

However this may be, it is certain that this seed, when it was used as food for these birds, began to be cultivated first in Spain, and afterwards in the southern parts of France. At present it is cultivated in various parts, and forms no inconsiderable branch of trade, particularly in the island of Sicily, where the plant is called *Scagliuola*, or *Scaghiola*. The seed is sold principally to the French and the Genoese. In England, the industrious inhabitants of the Isle of Thanet, particularly those around Margate and Sandwich, gain considerably by this article, as they can easily transport it to London by water.

That this plant might be cultivated with little trouble

[1] *Phalaris Canariensis.* The best figure and description of it are to be found in Schreber's Beschreibung der Gräser, ii. p. 83, tab. x. 2.

[2] Lib. iii. c. 159, and lib. xxvii. c. 12.

in Germany, is shown by the yearly experience of those who raise it in their gardens, and by its having become so naturalized in some parts of Hesse, that it propagates by seed of itself in the fields. The use of the seed might also be extended, for it yields a good meal; but the grains are not easily freed from the husks.

I shall here take occasion to remark, that Savary[1] has been guilty of an error, when he says that archil is cultivated in the Canary Islands in order to be sold as food for Canary birds. One may easily perceive that this mistake has arisen from his confounding that lichen used for dyeing with this kind of grass; and I should not have considered it worth notice, had it not been copied into Ludovici's Dictionary of Trade, from which, perhaps, it may be copied into the works of others.

ARCHIL.

Under the names Orseille, Orceille, Orsolle, Ursolle, Orcheil, Orchel, in Italian Oricello[2], Orcella, Roccella, in Dutch Orchillie, and in English Archil, Canary weed or Orchilla weed, is understood a lichen used for dyeing, and from which a kind of paint is also prepared. This species of lichen, of which the best figure and a full description may be seen in Dillenius[3], is by Linnæus called *Lichen roccella*. It is found in abundance in some of the islands near the African coast, particularly in the Canaries, and in several of the islands in the Archipelago. It grows upright, partly in single partly in double stems, which are about two inches in height. When it is old these stems are crowned with a button, sometimes round and sometimes of a flat form, which Tournefort very properly

[1] Dictionnaire de Commerce, t. v. 1765, fol. p. 1149.

[2] In the Dictionary of the Academy della Crusca the word *oricello* is thus explained: Tintura colla quale si tingono i panni, che si fa con orina d'uomo, e con altri ingredienti.

[3] Historia Muscorum, Ox. 1741, 4to, p. 120.

compares to the excrescences on the arms of the Sepia. Its colour is sometimes a light, and sometimes a dark gray. Of this lichen with lime, urine, ammoniacal salts, or a solution of ammonia prepared by distillation, is formed a dark red paste, which in commerce has the same name, and which is much used in dyeing. That well-known substance called litmus is also made of it.

Theophrastus[1], Dioscorides[2], and their transcriber Pliny[3], give the name of *Phycos thalassion* or *pontion* to a plant which, notwithstanding its name, is not a sea-weed but a lichen, as it grew on the rocks of different islands, and particularly on those of Crete or Candia. It had in their time been long used for dyeing wool, and the colour it gave when fresh was so beautiful, that it excelled the ancient purple, which was not red, as many suppose, but violet. Pliny tells us, that with this lichen dyers gave the ground or first tint to those cloths which they intended to dye with the costly purple. At least I so understand, with Hardouin and others, the words *conchyliis substernitur*, which the French dyers express by the phrase *donner le pied*.

Though several kinds of lichen produce a similar red dye, I agree in opinion with Dillenius, that *Phycos thalassion* is our archil; for at present no species is known which communicates so excellent a colour, and which corresponds so nearly with the description of Theophrastus. Besides, it is still collected in the Grecian islands, and it appears that it has been used there since the earliest ages[4].

Tournefort[5] found this lichen in the island Amorgos, which lies on the eastern side of Naxos, and which at present is called Morgo. In his time it was sent to England and Alexandria, at the rate of ten rix-dollars per hundred weight; and he says expressly that it was common in the other islands.

[1] Hist. Plant. iv. c. 7. [2] Lib. iv. c. 95.

[3] Lib. xxvi. c. 10; xxxii. c. 6.

[4] Hardouin quotes Aristot. Hist. Animal. vi. c. 9. But that naturalist speaks of a sea-weed which was cast on shore by the Hellespont. A dye or paint was made of it, and the people in the neighbourhood imagined that the purple of this sea-weed, which served as food to certain shell-fish, communicated to them their beautiful dye. A proof that sea-weeds (*fuci*) can communicate a red colour may be found in the Transactions of the Swedish Academy, iv. p. 29.

[5] Voyage du Levant. Amsterd. 1718, 4to, i. p. 89.

He shows from Suidas, Julius Pollux[1], and other ancient writers, that this island was once celebrated for a kind of red linen cloth, which in commerce had the name of the island; and he conjectures, not without probability, that it might have been dyed with this lichen.

Imperati[2] says, that the *roccella*, of which he gives a figure, was procured from the Levant. This naturalist gives the figure also of a lichen from Candia, used for dyeing, which was then called *rubicula*, and which, as may be seen in Bauhinus[3], is comprehended under the name of Roccella. Dillenius and Linnæus, however, make it a distinct species; and the latter names it *Lichen fuciformis*. This distinction is, perhaps, not improper: for the *rubicula* does not grow like a shrub or bush, as the *roccella*, but belongs rather to the foliaceous lichens. Be this as it may, it is certain, as Dillenius has remarked, and as I know from my own observation, that *L. fuciformis* is often mixed with the real roccella, and particularly with that brought from the Canary Islands; but whether it be equally good, experience has not yet taught us.

From what has been said, I think I may venture to conclude that our archil was not unknown to the ancient Grecias. But when was it first employed as a dye by the moderns, and introduced into our commerce? Some writers are of opinion that this drug was first found in the Canary Islands, and afterwards in the Levant. The use of it, therefore, is not older than the last discovery of that island. That this opinion is false, will appear from what follows.

Among the oldest and principal Florentine families is that known under the name of the Oricellarii or Rucellarii, Rucellai or Rucellai, several of whom have distinguished themselves as statesmen and men of letters. This family are descended from a German nobleman named Ferro or Frederigo, who lived in the beginning of the twelfth century[4]. One of

[1] "Præterea Amorgina, optima quidem in Amorgo fiunt, sed et hæc e lino esse asserunt. Tunica autem Amorgina etiam amorgis nuncupatur." —Onomasticon, vii. c. 16.

[2] Histor. Nat. lib. xxvii. c. 11.

[3] Pinax Plant. p. 365. Hist. Plant. iii. 2. p. 796.

[4] Other accounts say that he was an Englishman; but the name Frederigo confirms his German extraction.

his descendants in the year 1300 carried on a great trade in the Levant, by which he acquired considerable riches, and returning at length to Florence with his fortune, first made known in Europe the art of dyeing with archil. It is said that a little before his return from the Levant, happening to make water on a rock covered with this lichen, he observed that the plant, which was there called *respio* or *respo*, and in Spain *orciglia*, acquired by the urine a purple, or, as others say, a red colour. He therefore tried several experiments; and when he had brought to perfection the art of dyeing wool with this plant, he made it known at Florence, where he alone practised it for a considerable time, to the great benefit of the state. From this useful invention the family received the name of Oricellarii, from which at last was formed Rucellai[1].

As several documents, still preserved among the Florentine archives, confirm the above account of the origin of this family name, from the discovery of dyeing with oricello[2], we may,

[1] Giornale de' Letterati d' Italia, t. xxxiii. parte i. p. 231.

[2] These documents from the Florentine records may be found in Dominici Mariæ Manni de Florentinis Inventis Commentarium. Ferrariæ, 1731, p. 37, from which I have extracted the following:—"One of this family resided formerly a long time in the Levant, where he carried on trade, according to the custom of the Florentine nation. Being one day in the fields, and happening to make water on a plant, of which there was great abundance, he observed that it immediately became extraordinarily red. Like a prudent man, therefore, he resolved to make use of this secret of nature, which till that time had lain hid; and having made several experiments on that herb, and finding it proper to dye cloth, he sent some of it to Florence, where, being mixed with human urine and other things, it has always been employed to dye cloth purple. This plant, which is called *respo*, is in Spain named *orciglia*, and by botanists commonly *corallina*. The mixture made with it is called *oricello*, and has been of great utility and advantage to the woollen manufacture, which is carried on to greater extent in Florence than in any other city. From this circumstance the individuals of that family, by being the inventors of oricello, have been called Oricellai, and have been beloved by the people for having procured to them this particular benefit. Thus has written John di Paolo Rucellai (*Manni says that this learned and opulent man wrote in the year* 1451); and the same account is still given by dyers in our city, who relate and affirm that their ancestors have for a century exercised the art of dyeing, and that they know the above from tradition."

This is confirmed by another passage:—"One of this family, on account

in my opinion, consider it as certain that the Europeans, and first the Florentines, were made acquainted with this dye-stuff and its use in the beginning of the fourteenth century. At that time the Italians brought from the East the seeds of many arts and sciences, which, afterwards sown and nurtured in Europe, produced the richest harvests; and nothing is more certain than that the art of dyeing was brought to us from the East by the Italians. I do not believe that the merit of having discovered this dye by the above-mentioned accident is due to that Florentine; but I am of opinion that he learnt the art in the Levant, and on his return taught it to his countrymen, which was doing them no small service[1]. After that period the Italians long procured archil from the Levant for themselves, and afterwards for all Europe. I say for a long time, because since the discovery of the Canary Islands the greater part of that substance has been procured from them.

These islands, after being a considerable time lost and forgotten, were again discovered about the end of the fourteenth or the beginning of the fifteenth century, and since that time they have been much frequented by the Europeans. One of the first who endeavoured to obtain an establishment there, was John de Betancourt, a gentleman of Normandy, who in 1400, or, as others say, in 1417, landed on Lancerotta. Amongst the principal commodities which this gentleman and other Europeans brought back with them was archil, which was found there more beautiful and in greater abundance than anywhere else; and Betancourt enjoyed in idea the great profit which he hoped to derive from this article in commerce. Glass is surprised that the Europeans, immediately upon their arrival, sought after this lichen with as much eagerness and skill as

of the trade carried on faithfully and honestly by the Florentines, travelled to the Levant, and brought thence to Florence the art, or rather secret, of dyeing in oricello."

[1] In the genealogical history of the noble families of Tuscany and Umbria, written by P. D. Eugenio Gamurrini, and published at Florence 1668–1673, 3 vols. in folio, is the following account, vol. i. p. 274, of the origin of this family:—"This family acquired their name from a secret brought by one of them from the Levant, which was that of dyeing in oricello, never before used in this country. On that account they were afterwards called Oricellari, as appears from several records among the archives of Florence, and then by corruption Rucellari and Rucellai. Of their origin many speak, and all agree that they came into Tuscany from Britain."

they did after gold in America, though they were not so well acquainted with the former as the latter before the discovery of these new lands [1]. But as this is not true, the wonder will cease.

According to information procured in the year 1731, the island of Teneriffe produced annually five hundred quintals of this moss; Canary, four hundred; Forteventura, Lancerotta, and Gomera, three hundred each; and Fero, eight hundred; making in all two thousand six hundred quintals. In the islands of Canary, Teneriffe and Palma, the moss belongs to the crown; and in the year 1730 it was let by the king of Spain for one thousand five hundred piastres. The farmers paid then for collecting it from fifteen to twenty rials per hundred weight [2]. In the rest of the islands it belongs to private proprietors, who cause it to be collected on their own account. In the beginning of the last century a hundred weight, delivered on board at Santa Cruz, the capital of Teneriffe, was worth from only three to four piastres; but since 1725 it has cost labour amounting to ten piastres, because it has been in great request at London, Amsterdam, Marseilles, and throughout all Italy [3]. In the year 1726 this lichen cost at London eighty pounds sterling per ton, as we are told by Dillenius, and in 1730 it bore the same price.

Towards the end of the year 1730, the captain of an English vessel, which came from the Cape de Verde islands, brought a bag of archil to Santa Cruz by way of trial. He discovered his secret to some Spanish and Genoese merchants, who, in the month of July 1731, resolved to send a ship to these islands. They landed on that of St. Anthony and St. Vincent, where in a few days they obtained five hundred quintals of this lichen, which they found in such abundance, that it cost them nothing more than a piastre per cent. by way of present to the governor. The archil of the Cape de Verde islands

[1] The History of the Discovery and Conquest of the Canary Islands, by George Glass. London, 1764, 4to.

[2] [Dr. Ure copies this information in his Dictionary, but gives it as the return of an official report for the year 1831!]

[3] This information is to be found in Hellot's Art of Dyeing, into which it has been copied, as appears by the Dictionnaire d'Histoire Naturelle, par Valmont de Bomare, from an account written by M. Porlier, who was consul at Teneriffe in 1731.

appears larger, richer, and longer than that of the Canaries, and this, perhaps, is owing to its not being collected every year[1]. Adanson, in 1749, found also the greater part of the rocks in Magdalen island, near Senegal, covered with this lichen. Though the greater part of our archil is at present procured from the Canary and Cape de Verde islands, a considerable quantity is procured also from the Levant, from Sicily, as Glass says, and from the coast of Barbary; and some years ago the English merchants at Leghorn caused this lichen to be collected in the island of Elba, and paid a high price for it[2].

Our dyers do not purchase raw archil, but a paste made of it, which the French call *orseille en pâte*. The preparation of it was for a long time kept a secret by the Florentines. The person who, as far as I know, made it first known was Rosetti; who, as he himself tells us, carried on the trade of a dyer at Florence. Some information was afterwards published concerning it by Imperati[3] and Micheli the botanist[4]. In later times this art has been much practised in France, England, and Holland. Many druggists, instead of keeping this paste in a moist state with urine, as they ought, suffer it to dry, in order to save a little dirty work. It then has the appearance of a dark violet-coloured earth, with here and there some white spots in it.

The Dutch, who have found out better methods than other nations of manufacturing many commodities, so as to render them cheaper, and thereby to hurt the trade of their neighbours, are the inventors also of lacmus[5], a preparation of archil called *orseille en pierre*, which has greatly lessened the use of that *en pâte*, as it is more easily transported and preserved, and fitter for use; and as it is besides, if not cheaper, at least not dearer. This art consists, undoubtedly, in mixing with that commodity some less valuable substance, which either

[1] As the archil grows in the African islands, and on the coast of Africa, Glass supposes that the Getulian purple of the ancients was dyed with it; but this opinion is improbable, for Horace praises "Gætula *murice* tinctas vestes."

[2] Lettres sur l'Histoire Naturelle de l'Isle d'Elbe, par Koestlin. Vienne, 1780, 8vo p. 100.

[3] Lib. xxvii. c. 9.

[4] Nova Plantarum Genera. Flor. 1729.

[5] Some translate this word *lacca musica, musiva.*

improves or does not much impair its quality, and which at the same time increases its weight[1]. Thus they pound cinnabar and smalt finer than other nations, and yet sell both these articles cheaper. In like manner they sift cochineal, and sell it at a less price than what is unsifted.

It was for a long time believed that the Dutch prepared their lacmus from those linen rags which in the south of France are dipped in the juice of the *Croton tinctorium*[2]; and this idea appeared the more probable, as most of this *tournesol en drapeaux* was bought up by the Hollanders: but, as they are the greatest adulterators of wine in Europe, they may perhaps have used these rags to colour Pontack and other wines. It is however not improbable that they at first made lacmus of them, as their dye approaches very near to that of archil. At present it is almost certainly known that *orseille en pâte* is the principal ingredient in *orseille en pierre*, that is in lacmus[3]: and for this curious information we are indebted to Ferber[4]. But whence arises the smell of the lacmus, which appears to me like that of the Florentine iris? Some of the latter may,

[1] [According to Dr. Ure, the Dutch first reduce the lichen to a fine powder by means of a mill, then mix a certain proportion of potash with it. The mixture is watered with urine and allowed to undergo a species of fermentation. When this has arrived at a certain degree, carbonate of lime in powder is added to give consistence and weight to the paste, which is afterwards reduced into small parallelopipeds, which are carefully dried.]

[2] This plant grows in the neighbourhood of Montpelier, and above all, in the flats of Languedoc. In harvest, the time when it is collected, the peasants assemble from the distance of fifteen or twenty leagues around, and each gathers on his own account. It is bruised in a mill, and the juice must be immediately used; some mix with it a thirtieth part of urine. It is poured over pieces of canvas, which they take care to provide, and which they rub between their hands. These rags are dried in the sun, and then exposed, above a stone stove, to the vapour of urine mixed with quick-lime or alum. After they have imbibed the juice of the plant, the same operations are repeated till the pieces of cloth appear of a deep blue colour. They are called in commerce *tournesol en drapeaux*. Large quantities of them are bought up by the Dutch, who make use of them to colour wines and the rinds of their cheese.—TRANS.

[3] [Lacmus or litmus is now prepared from *Lecanora tartarea*, the famous *Cudbear*, so called after a Mr. Cuthbert, who first brought it into use. It is imported largely from Norway, where it grows more abundantly than with us; yet in the Highland districts many an industrious peasaut gets a living by scraping off this lichen with an iron hoop, and sending it to the Glasgow market.]

[4] Linn. Mantissa Plantarum, i. p. 132.

perhaps, be mixed with it; for I think I have observed in it small insoluble particles, which may have been pieces of the roots. The addition of this substance can be of no use to improve the dye; but it may increase the weight, and give the lac more body; and perhaps it may be employed to render imperceptible some unpleasant smell, for which purpose the roots of that plant are used on many other occasions.

Another kind of lichen, different from the roccella, which in commerce is known by the names *orseille de terre*, *orseille d'Auvergne*, is used also for the like purpose; but it contains fewer and weaker colouring particles. This species, in botany, is called *Lichen Parellus* (*Lecanora Parella*), and is distinguished from the roccella by its figure, as it grows only in a thin rind on the rocks It is collected in Auvergne, on rocks of granite and volcanic productions, and in some parts of Languedoc; the greater part of it is brought from St. Flour. Its name, *perelle*, comes from an old Languedocian word *pére* (*pierre*, a rock); as *roccella*, afterwards transformed into *orseille*, is derived from *rocca*. The use of *perelle* is very trifling: the Dutch purchase it to make lacmus, perhaps on account of its low price. This lichen has been found also in Northumberland[1] and other mountainous districts of Great Britain, but it is not collected there for any purpose.

MAGNETIC CURES.

The external use of the magnet, to cure the tooth-ache and other disorders, is a remedy brought into fashion in modern times, but not a new discovery, as supposed by Lessing, who ascribes it to Paracelsus[2]. It was known to Aëtius, who lived so early as the year 500. That author says, "We are assured that those who are troubled with the gout in their hands or

[1] See Wallis's Natural History and Antiquities of Northumberland, 1769, 2 vols 4to, i. p. 279.

[2] In his Kollektaneen. Berlin, 1790, ii. p. 117.

their feet, or with convulsions, find relief when they hold a magnet in their hand[1]." He does not however give any proof of this from his own experience: and perhaps he doubted the truth of it. The above passage contains the oldest account known at present respecting this virtue; for the more ancient writers speak only of the internal use of the magnet.

It is evident therefore that this cure has not been discovered in later times, but that it has been preserved by the old physicians copying it from each other into their works. In like manner, many things are mentioned in the Materia Medica which were used or proposed by the ancients, but into the properties of which they never made sufficient inquiry.

Paracelsus recommended the magnet in a number of diseases, as fluxes, hæmorrhages, &c. Marcellus, who lived in the fifteenth century, assures us that it cures the tooth-ache[2]. The same virtue is ascribed to it by Leonard Camillus[3], who lived in the sixteenth century: and Wecker[4], who was nearly contemporary, says that the magnet when applied to the head, cures the head-ache; and adds that Holler had taken this cure from the works of the ancients[5]. We read also in Porta[6], that it was recommended for the head-ache; and in Kircher[7], that it was worn about the neck as a preventive against convulsions, and affections of the nerves. About the end of the 17th century magnetic tooth-picks and ear-pickers were made, and extolled as a secret preventive against pains in the teeth, eyes and ears[8].

[In addition to these external uses of the magnet, in which it was supposed to act by a peculiar power over the nervous system, it has been employed on account of its true magnetic properties. Thus Kirkringius, Fabricius Hildanus, and subsequently Morgagni, have used it to remove particles of iron which had accidentally fallen into the eyes. Kircher employed

[1] Aëtii Op. l. ii. c. 25.

[2] In Stephani Artis Med. Princip. ii. p. 253.

[3] De Lapidibus, lib. ii. p. 131.

[4] J. J. Wecker, De Secretis.

[5] I took the trouble to search for this passage in Jac. Hollerii lib. de morbis internis, Parisiis 1711, 4to, but I could not find it, though the beginning of the book treats expressly of head-aches.

[6] Magia Naturalis, lib. vii.

[7] Kircheri Magnes, sive De Arte Magnetica, lib. iii. c. i.

[8] P. Borrelli, Hist. et Observ. Medico-physic. cent. 4. obs. 75.

it also to cure hernia. The patient took iron-filings internally; and the loadstone in the state of powder mixed with some vegetable substance, thus forming a magnetic plaster, was applied to the hernia. Even Ambrose Paré states on the authority of a surgeon, that several patients had been thus cured.

About the 16th and early in the 17th century, two cases occurred, one near Prague in Bohemia, the other in Prussia, in which a knife was swallowed, but it unfortunately got too far and passed into the stomach. By the application of these magnetic plasters, the point became attracted towards the surface, so that it could be removed by incision [1].

In the 18th century, after the properties of magnets had begun to be scientifically investigated, they were made of various forms and their effects studied in numerous parts of Europe, and many treatises were published on their supposed properties. Perhaps the most important and best authenticated, are those of MM. Audry and Thouret. These experimenters believed that they were effective agents.

Since that time, the use of magnets as remedial agents has been almost entirely laid aside and forgotten, it having been found that no constancy was exhibited in the results of their application, and that their occasional supposed efficacy depended upon other circumstances, which were overlooked from the sufferers' attention being engrossed by the magnet. The application of the magnet to remove small particles of iron or steel which have accidentally fallen into the eyes, has been lately revived. In some manufactories, where these minute particles are constantly thrown off in the grinding of hardware and driven into the eyes, large magnets are kept fixed at a proper height, so that the workmen can resort to them immediately. Such is the case for instance at Fairbairne in Belgium, and we believe the same has been adopted in some of our own manufactories to catch the floating particles, and thus to prevent their being drawn into the lungs during respiration. The reader may form some idea of the effective manner in which magnets can be applied, from the following incident which occurred to Prof. Faraday, whilst experimenting with a powerful (electro-) magnet; an iron candlestick which happened to be standing near its poles on the table at which

[1] Observations sur l'usage de l'aimant en médecine, par MM. Audry et Thouret.

he was at work flew to them, attracted with such violence as to displace or break everything in its way.

In the 18th century, a new supposed magnetic power was discovered, and with various success has continued to be applied to the delusion of the public. About 1770, Father Hehl, a jesuit, the Professor of Astronomy at Vienna, who had great faith in the influence of the loadstone on human diseases, and had invented steel plates of a peculiar form, which he impregnated with magnetic virtues and applied to the cure of diseases, communicated his discoveries to Anton Mesmer, who subsequently invented animal magnetism or mesmerism. Mesmer made use of his friend Hehl's plates to employ the magnet according to certain notions of his own. In his subsequent experiments magnets were gradually dispensed with, and as practised in modern times, they have been found unnecessary. Hence mesmerism or animal magnetism has no relation to the magnetism of the magnet, and may therefore form the subject of a future article.

About the year 1798, a man named Perkins invented a method of treating various diseases with metallic bars called tractors; these were applied to and drawn over various parts of the body, and were supposed to cure numerous maladies, such as ulcers, head-aches, &c. These instruments were patented. A few years afterwards, Dr. Falconer had wooden tractors made so exactly to resemble those of Perkins, that they could not be distinguished by the eye; on employing these on a large scale at the Bath hospital, he found that exactly the same effects and cures were produced by one as the other. Since that time these tractors have hardly been heard of, and are now forgotten.

Quite recently, a new means has been contrived in England for deluding the public, in the form of rings, which are to be worn upon the fingers or toes, and are said to prevent the occurrence of, and cure various diseases. They are called galvanic rings. But this invention may be with propriety classed with the real magnet, animal magnetism and tractation.

What has been stated relative to the metallic tractors, equally applies to the magnetic rings; for although by the contact of the two metals of which they are composed an infinitesimally minute current of electricity, hence also of magnetism, is generated, still from the absurd manner in which the

pieces of metal composing the ring are arranged, and which displays the most profound ignorance of the laws of electricity and magnetism, no trace of the minute current traverses the finger or toe on which the ring is worn; so that a wooden, any other ring, or none at all, would have exactly the same effect, as regards the magnetism or galvanism.]

SECRET POISON.

Under this name are generally understood all poisons which can be administered imperceptibly, and which gradually shorten the life of man, like a lingering disease. They were not first discovered in the 17th century in France and Italy as many believe, but were known to the ancient Greeks and Romans, by whom they were used. I must however allow, that they were never prepared with more art at any period, or in any country, or employed oftener and with more success, than they were in these countries, and at that time. If it be true that they can be prepared in such a manner as to occasion death at a certain period previously determined, or that the person to whom they are given will die within a certain time limited, it must be confessed that the ancient poisoners have been far exceeded by the modern. But this advantage will be considered as scarcely possible, when one reflects upon the many variable circumstances which have an influence on the operation of medicines and poisons; and it has often happened that a company have swallowed the same poison, at the same time, and in the same quantity, some of whom have died sooner and some later, while some have survived. Thus died Pope Alexander VI. in the year 1503, and Cæsar Borgia recovered without any loss of health, though, by the bottles being changed through mistake, he drank of the poison that had been prepared for the other guests alone. At any rate, I am of opinion that the celebrated Tophania, when she engaged to free wives from disagreeable husbands within stated weeks

and days, must have had certain and very accurate information respecting their contitution and manner of living, or, as the physicians say, their idiosyncrasy

Some physicians have doubted respecting secret poison[1]; and others have only denied that its effects can with certainty be regulated to a fixed time[2]. I agree in opinion with the latter; but the former can be confuted by many examples both of ancient and modern times; for that the ancients were acquainted with this kind of poison, can be proved by the testimony of Plutarch, Quintilian, and other respectable authors. We are told by Plutarch, that a slow poison, which occasioned heat, a cough, spitting of blood, consumption, and a weakness of intellect, was administered to Aratus of Sicyon[3]; and Quintilian in his Declamations, speaks of this poison in such a manner as proves that it must then have been well known[4]. It cannot be said that such an invention was too great for that period, or that it required more knowledge of chemistry than any one possessed; for the Indians in America are acquainted with a most perfect poison of this kind, and can employ it with so much skill, that the person to whom it is given cannot guard against the treachery, even with the utmost precaution, but infallibly dies, though in a lingering manner, often after the expiration of some years[5].

[1] Heberden in the Neue Hamburg. Mag. xvii. p. 219. I am convinced that many of the accounts we have of the extraordinary effects of poison are fabricated, like those mentioned in Frid. Hoffmanni Dissert. de Læsionibus externis, abortivis Venenis ac Philtris. Francof. 1729, et recusa Lips. 1755. That author, however, denies some which are true. It is, for example, certain that camphor and rue do not produce the effects ascribed to them by Dioscorides, Paulus Ægineta, and others; but there are without doubt other substances which will produce these effects.

[2] Scnnerti Instit. Med. ii. 2, 12.

[3] He gave to Aratus a poison, not speedy and violent, but of that kind which at first occasions a slow heat in the body, with a slight cough, and then gradually brings on a consumption. One time, when Aratus spat up blood, he said, "This is the effect of royal friendship." See Plutarch, Vit. Arati.

[4] Quint. Declamat. xvii. 11.

[5] With the poison of the Indians, however, the ancients could not be acquainted, as it is prepared from a plant unknown in Europe before the discovery of America. Kalm, in his Travels, does not name it, and in that he has done right; for, as the plant is now to be found everywhere, no government could guard against a misapplication of it, were it publicly known.

Theophrastus speaks of a poison which could be moderated in such a manner as to have effect in two or three months, or at the end of a year, or two years; and he remarks that the death, the more lingering it was, became the more miserable. This poison was prepared from aconitum, a plant which, on that account, people were forbidden to have in their possession, under pain of capital punishment[1]. He relates also, that Thrasyas had discovered a method of preparing from other plants a poison which, given in small doses of a drachm, occasioned an easy but certain death, without any pain, and which could be kept back for a long time without causing weakness or corruption. This Thrasyas, whose scholar Alexias carried the art still further, was a native of Mantinea, a city in Arcadia, and is celebrated by Theophrastus on account of his abilities, and particularly his knowledge of botany; but those are mistaken who ascribe to him the discovery of secret poison.

This poison was much used at Rome about two hundred years before the Christian æra. As several persons of distinction died the same year at that period, and of the like distemper, an inquiry being made into the cause, a maid-servant gave evidence against some ladies of the first families, who, she said, prepared and distributed poison; and above a hundred and fifty of them were convicted and punished[2]. As so many had learnt this destructive art, it could not be suppressed; and we find sufficient proofs in the Roman history that it was continually preserved. Sejanus caused such a secret poison to be administered by an eunuch to Drusus, who gradually declined afterwards, as by a consumptive disorder, and at length died[3]. Agrippina, being desirous of getting rid of Claudius, but not daring to despatch him suddenly, and yet wishing not to leave him sufficient time to make new regulations respecting the succession to the throne, made choice of a poison which should deprive him of his reason, and gradually consume him. This she caused to be prepared by an

[1] They say a poison can be prepared from aconite so as to occasion death within a certain period, such as two, three, or six months, a year, and even sometimes two years. Those, we are told, whose constitutions are able to hold out longest, die in the greatest misery; for the body is gradually consumed, and must perish by continual wasting. Those die easiest who die speedily. No remedy has been found out for this poison.—Theophr. Hist. Plant. ix. c. 16.

[2] Livius, lib. viii. c. 18.

[3] Taciti Annal. lib. iv. c. 8.

expert poisoner, named Locusta, who had been condemned to death for her infamous actions, but saved that she might be employed as a state engine. The poison was given to the emperor in a dish of mushrooms; but as, on account of his irregular manner of living, it did not produce the desired effect, it was assisted by some of a stronger nature[1]. This Locusta prepared also the poison with which Nero despatched Britannicus, the son of Agrippina, whom his father Claudius wished to succeed him on the throne. As this poison occasioned only a dysentery, and was too slow in its operation, the emperor compelled Locusta by blows, and by threatening her with death, to prepare in his presence one more powerful. It was first tried on a kid; but as the animal did not die till the end of five hours, she boiled it a little longer, until it instantaneously killed a pig to which it had been given, and this poison despatched Britannicus as soon as he had tasted it[2]. For this service the emperor pardoned Locusta, rewarded her liberally, and gave her pupils whom she was to instruct in her art, in order that it might not be lost.

The art of preparing this poison must have been well understood also at Carthage. When M. Attilius Regulus, the Roman general, who had been taken by the Carthaginians, was sent to Rome to propose to the senate that the Carthaginian prisoners might be restored in exchange for him, he prevented this negotiation, because he knew that a poison had been administered to him, by which the state would soon be deprived of his services. He returned, therefore, to Carthage, in compliance with the promise he had made to the enemy, who put him to death with the most exquisite torture[3].

All these poisons were prepared from plants, particularly aconite, hemlock and poppy, or extracted from animal substances. Among those made from the latter, none is more remarkable than that supplied by the sea-hare, *lepus marinus*,

[1] The account given by Tacitus deserves to be read; see lib. xii. c. 66.

[2] The history of this horrid affair may be found both in Tacitus, Annal. xiii. c. 15 and 16, and in Suetonius, vi. cap. 33. Respecting Locusta, see also Juvenal, sat. i. 71.

[3] This account is given by Aulus Gellius from the now lost works of Tuditanus.—Noct. At. lib. vi. cap. 4. Cicero often speaks of the magnanimity of Regulus; as, for example, in his Oration against Piso, and in his Offices, book iii. chap. 27; but he makes no mention of his having been poisoned. Valerius Maximus also, book i. chap. i. 14, says nothing of poison.

with which, as Philostratus says[1], Titus was despatched by Domitian. Without here attempting to define the substances employed by the ancients to compose their poisons, I shall only observe, that the *lepus marinus*, the terrible effects of which are expressly mentioned by Dioscorides, Galen, Nicander, Aëtius, Ælian[2], Pliny[3], and others, is that animal called at present in the Linnæan system *Aplysia depilans*[4], as Rondelet conjectured, and has been since fully proved by Bohadsch[5]. This animal poison however seems to have been seldom used, as it easily betrays itself by some peculiar symptoms. It appears that it was not known to Aristotle, at least he makes no mention of it[6]. With the far stronger, and now common mineral poisons the ancients were not acquainted; for their arsenic was what we call orpiment, and not that pernicious metallic oxide which formed the principal ingredient of those secret poisons which in latter times were in France and Italy brought to a diabolical perfection[7].

No one was ever more infamous by this art than Tophania, or Toffana, a woman who resided first at Palermo, and after-

[1] Apollonii Vit. lib. vi. c. 14.

[2] Histor. Animal. lib. ii. c. 45. [3] Lib. ix. c. 48, and lib. xxxii. c. 1.

[4] In Linnæi Systema Nat., through an error of the press, stands *Laplysia*, which word has since become common. Ἀπλυσία signifies an uncleanness which cannot be washed off; and in Aristotle's History of Animals, b. v. ch. 15, and Pliny, b. ix. ch. 45, it is the name of a zoophyte. In the like manner other errors in the System of Linnæus have been copied into the works of others, such as *Dytiscus* instead of *Dyticus*, &c.

[5] J. B. Bohadsch De quibusdam animalibus marinis. Dresdæ, 1761, 4to, p. 1–53. In this work there is a full description, with a figure of this animal, under the name of *Lernæa*, which was used in the first editions of Linnæus.

[6] The accounts given by the ancients of the sea-hare have been collected in Grevini Lib. de Venenis, Antverpiæ 1571, p. 209. In the Annals of Glycas, iii. (*Script. Byz.*), it is said that Titus was despatched by this poison; and in the first book, b. 27, he says the sea-hare occasions speedy and inevitable destruction to man.

[7] See Stenzelii Diss. de venenis terminatis et temporaneis, quæ Galli *les poudres de succession* vocant; resp. J. G. Arnold. Vitebergæ, 1730. This tract contains several historical relations; but the reader is often referred to authors who either do not say that for which they were quoted, or who must relate the same thing in a different manner in some other place. As for example, Galen in b. ii. c. 7, De Antidotis, speaks of poisons without mentioning secret poison in particular. Avicenna is made to say, in his book De Viribus Cordis, that the Egyptian kings often employed this poison;

wards at Naples. She sold those drops, which from her acquired the name of *aqua Tophania*, *aqua della Toffana*, and which were called also *acquetta di Napoli*, or only *acquetta*; but she distributed her preparation by way of charity to such wives as wished to have other husbands. From four to six drops were sufficient to destroy a man; and it was asserted that the dose could be so proportioned as to operate in a certain time. As she was watched by the government, she fled to an ecclesiastical asylum; and when Keysler was at Naples in 1730, she was then still living, because no one could, or was willing to take away her life, while under that protection. At that time she was visited by many strangers out of curiosity.

In Labat's Travels through Italy[1] we also find some information which may serve still further to illustrate the history of Tophania. She distributed her poison in small glass phials, with this inscription, *Manna of St. Nicholas of Bari*, and ornamented with the image of the saint. A miraculous oil, employed by folly in the cure of many diseases, drops from the tomb of that saint which is shown at Bari in the kingdom of Naples; and on this account it is dispersed in great abundance under the like name. It was therefore the best appellation which Tophania could give to her poison, because the reputed sanctity of it prevented the custom-house officers from examining it too closely. When the viceroy was informed of this, which I think was in 1709, Tophania fled from one convent to another, but was at length seized and thrown into prison. The clergy raised a loud outcry on account of this violation of ecclesiastical freedom, and endeavoured to excite the people to insurrection. But they were soon appeased on a report being spread that Tophania had confessed she had poisoned all the springs in the city. Being put to the rack, she acknowledged her wickedness, and confessed to having caused the death of not less than 600 persons; named those who had protected her, who were immediately dragged from churches and monasteries; and declared that the day before she had absconded, she had sent two boxes of her manna to

but if by that quotation we are to understand Fen. undecima de dispositionibus cordis, I have sought for this information in vain. In lib. iv. fen. 6. tract. 2. c. 14, it is said "Fel canis aquatici interficit post hebdomadam." Rhodiginus also does not relate that for which he is quoted by Stenzel. p. 7.

[1] Vol. iv. p. 33.

Rome, where it was found in the custom-house, but she did not accuse any one of having ordered it. She was afterwards strangled, and to mitigate the archbishop, her body was thrown at night into the area of the convent from which she had been taken. Tophania however was not the only person at Naples who understood the making of this poison; for Keysler says that at the time he was there it was still secretly prepared and much employed.

In the year 1659, under the government of Pope Alexander VII., it was observed at Rome that many young married women were left widows, and that many husbands died when they became disagreeable to their wives. Several of the clergy declared also, that for some time past various persons had acknowledged at confession that they had been guilty of poisoning. As the government employed the utmost vigilance to discover these poisoners, suspicion fell upon a society of young married women, whose president appeared to be an old woman who pretended to foretell future events, and who had often predicted very exactly many deaths to persons who had cause to wish for them. To ascertain the truth, a crafty female, given out to be a person of considerable distinction, was sent to this old woman, pretending that she wished to obtain her confidence, and to procure some of her drops for a cruel and tyrannical husband. The whole society were by this stratagem arrested; and all of them, except the fortune-teller, whose name was Hieronyma Spara, confessed before they were put to the torture.—"Where now," cried she, "are the Roman princes, knights and barons, who on so many occasions promised me their protection! Where are the ladies who assured me of their friendship! Where are my children whom I have placed in so distinguished situations!" In order to deter others from committing the like crime, one Gratiosa, Spara's assistant, three other women, and the obstinate Spara herself, who still entertained hopes of assistance till the last moment, were hanged in the presence of innumerable spectators. Some months after, several more women were executed in the same manner; some were whipt, and others were banished from the country. Notwithstanding these punishments, the effects of this inveterate wickedness have been from time to time remarked. Le Bret, to whom we are indebted

for the above account, says[1] that Spara was a Sicilian, and acquired her knowledge from Tophania at Palermo. If that be true, the latter must have been early initiated in villany, and must have become when very young a teacher of her infamous art. Keysler calls her a little old woman.

The art of poisoning never excited more attention than it did in France about the year 1670[2]. Mary Margaret d'Aubray, daughter of the lieutenant-civil Dreux d'Aubray, was in the year 1651 married to the Marquis de Brinvillier, son of Gobelin president of the Chamber of Accounts, who had a yearly income of thirty thousand livres, and to whom she brought a portion of two hundred thousand. He was mestre-de-camp of the regiment of Normandy, and during the course of his campaigns became acquainted with one Godin de Sainte Croix, a young man of a distinguished family, who served as a captain of cavalry in the regiment of Trassy. This young officer, who was then a needy adventurer, became a constant visitor of the marquis, and in a short time paid his addresses to the marchioness, who lost her husband after she had helped to dissipate his large fortune, and was thus enabled to enjoy her amours in greater freedom. Her indecent conduct, however, gave so much uneasiness to her father, that he procured a lettre de cachet, had Sainte Croix arrested while in a carriage by her side, and thrown into the Bastille[3]. Sainte Croix there got acquainted with an Italian named Exili, who understood the art of preparing poison, and from whom he learnt it. As they were both set at liberty after a year's imprisonment, Sainte Croix kept Exili with him until he became perfectly master of the art, in which he afterwards instructed the marchioness, in order that she might employ it in bettering the circumstances of both. When she had acquired the prin-

[1] J. F. le Bret, Magazin zum Gebrauche der Staaten und-Kirchen-Geschichte, part iv. Francf. and Leips. 1774, 8vo, p. 131–141.

[2] The following account is collected from Causes celèbres, par M. Guyot de Pitaval, tome i.—Lettres de Mad. de Sevigné, tome iv.—Histoire du Règne de Louis XIV., par M. de Reboulet. Avignon, 1746, v. p. 159.—Histoire de Louis XIV., par M. B. de la Martinière, 1740, iv. p. 229.—Le Siècle de Louis XIV., par Voltaire, etc.

[3] Voltaire says that the father did not get Sainte Croix thrown into the Bastille, but sent to his regiment. This however is not the case, for this reprobate was at that time not in the army.

ciples of the art, she assumed the appearance of a nun, distributed food to the poor, nursed the sick in the Hôtel-Dieu, and gave them medicines, but only for the purpose of trying the strength of her poison undetected on these helpless wretches[1]. It was said in Paris, by way of satire, that no young physician, in introducing himself to practice, had ever so speedily filled a churchyard as Brinvillier. By the force of money, she prevailed on Sainte Croix's servant, called La Chaussée, to administer poison to her father, into whose service she got him introduced, and also to her brother, who was a counsellor of the parliament, and resided at his father's house. To the former the poison was given ten times before he died; the son died sooner; but the daughter, Mademoiselle d'Aubray, the marchioness could not poison, because perhaps she was too much on her guard; for a suspicion soon arose that the father and son had been poisoned, and the bodies were opened. She would however have escaped, had not Providence brought to light the villany.

Sainte Croix, when preparing poison, was accustomed to wear a glass mask; but as this once happened to drop off by accident, he was suffocated, and found dead in his laboratory. Government caused the effects of this man, who had no family, to be examined, and a list of them to be made out. On searching them, there was found a small box, to which Sainte Croix had affixed a written request, that after his death it might be delivered to the Marchioness de Brinvillier, or in case she should not be living, that it might be burnt[2]. No-

[1] This circumstance is denied by Voltaire, but only, as appears, to contradict Pitaval, whom he calls *un avocat sans cause.*

[2] This request was as follows:—"I humbly beg that those into whose hands this box may fall, will do me the favour to deliver it into the hands only of the Marchioness de Brinvillier, who resides in the Rue Neuve Saint Paul, as everything it contains concerns her, and belongs to her alone; and as, besides, there is nothing in it that can be of use to any persons except her; and in case she shall be dead before me, to burn it, and everything it contains, without opening or altering anything; and in order that no one may plead ignorance, I swear by the God whom I adore, and by all that is most sacred, that I advance nothing but what is true. And if my intentions, just and reasonable as they are, be thwarted in this point, I charge their consciences with it, both in this world and the next, in order that I may unload mine, protesting that this is my last will. Done at Paris this 25th of May in the afternoon, 1672.

"De Sainte Croix."

thing could be a greater inducement to have it opened than this singular petition; and that being done, there was found in it a great abundance of poisons of every kind, with labels on which their effects, proved by experiments made on animals, were marked. When the marchioness heard of the death of her lover and instructor, she was desirous to have the casket, and endeavoured to get possession of it, by bribing the officers of justice; but as she failed in this, she quitted the kingdom. La Chaussée, however, continued at Paris, laid claim to the property of Sainte Croix, was seized and imprisoned, confessed more acts of villany than were suspected, and was in consequence broke alive on the wheel in 1673.

A very active officer of justice, named Desgrais, was despatched in search of the Marchioness de Brinvillier, who was found in a convent at Liège, to which she had fled from England. To entice her from this privileged place, which folly had consecrated for the protection of vice, Desgrais assumed the dress of an abbé, found means to get acquainted with her, acted the part of a lover, and, having engaged her to go out on an excursion of pleasure, arrested her. Among her effects at the convent, there was found a confession, written by her own hand, which contained a complete catalogue of her crimes. She there acknowledged that she had set fire to houses, and that she had occasioned the death of more persons than any one ever suspected. She remarked also, that she had continued a virgin only till the seventh year of her age. Notwithstanding all the craft which she employed to escape, she was conveyed to Paris, where she at first denied everything; and, when in prison, she played picquet to pass away the time. She was however convicted, brought to a confession of her enormities, became a convert, as her confessor termed it, and went with much firmness to the place of execution, on the 16th of July, 1676; where, when she beheld the multitude of the spectators, she exclaimed in a contemptuous manner, "You have come to see a fine spectacle!" She was beheaded and afterwards burnt; a punishment too mild for such an offender[1]. As she had been amused with some hopes

[1] Martinière says that she was burnt alive, together with all the papers respecting her trial. The latter is improbable, and the former certainly false, notwithstanding the account given in the Encyclopédie.

of a pardon, on account of her relations, when she mounted the scaffold, she cried out, "*C'est donc tout de bon*!"[1]

Among a number of persons suspected of being concerned in this affair, was a German apothecary, named Glaser, who on account of his knowledge in chemistry, was intimate with Exili and Sainte Croix. From him they had both procured the materials which they used, and he was some years confined in the Bastille; but the charge against him being more minutely investigated, he was declared innocent, and set at liberty. He was the author of a Treatise on Chemistry, printed at Paris in 1667, and reprinted afterwards at Brussels in 1676, and at Lyons in 1679.

By the execution of this French Medea, the practice of poisoning was not suppressed; many persons died from time to time under very suspicious circumstances; and the archbishop was informed from different parishes that this crime was still confessed, and that traces of it were remarked both in high and in low families. For watching, searching after, and punishing poisoners, a particular court, called the *Chambre de Poison* or *Chambre ardente*, was at length established in 1679. This court, besides other persons, detected two women named La Vigoreux and La Voisin[2], who carried on a great traffic in poisons. The latter was a midwife. Both of them pretended to foretell future events, to call up ghosts, and to teach the art of finding hidden treasures, and of recovering lost or stolen goods. They also distributed philtres, and sold secret poison to such persons as they knew they could depend upon, and who wished to employ them either to get rid of bad husbands, or recover lost lovers. Female curiosity induced se-

[1] The following description of Brinvillier may perhaps be of use to our physiognomists:—"In order to satisfy the curiosity of those who may be desirous of knowing if such a celebrated criminal partook of the beauties of her sex, I shall observe that nature had not been sparing of them to the marchioness; her features were exceedingly regular, and the form of her face, which was round, was very graceful. This beautiful outside concealed a heart extremely black. Nothing proves more that *metoposcopy*, or the science of physiognomy, is false; for this lady had that serene and tranquil air which announces virtue."—Pitaval, p. 269.

[2] Some information respecting La Voisin may be found in Lettres Historiques et Galantes par Madame de C——. A Cologne, 1709–1711, 4 vols. 12mo, ii. p. 101, and iv. p. 376. The authoress of these letters was Mad. du Noyer.

veral ladies of the first rank, and even some belonging to the court, to visit these women, particularly La Voisin; and who, without thinking of poison, only wished to know how soon a husband, a lover, the king or his mistress, would die. In the possession of La Voisin was found a list of all those who had become dupes to her imposture. They were arrested and carried before the above-mentioned court, which, without following the usual course of justice, detected secret crimes by means of spies, instituted private trials, and began to imitate the proceedings of the holy inquisition. In this list were found the distinguished names of the Countess de Soissons, her sister the Duchess de Bouillon, and Marshal de Luxembourg. The first fled to Flanders to avoid the severity and disgrace of imprisonment; the second saved herself by the help of her friends; and the last, after he had been some months in the Bastille, and had undergone a strict examination, by which he almost lost his reputation, was set at liberty as innocent. Thus did the cruel Louvois the war minister, and the Marchioness de Montespan, ruin those who opposed their measures. La Vigoreux and La Voisin were burnt alive on the 22nd of February 1680, after their hands had been bored through with a red-hot iron and cut off. Several persons of ordinary rank were punished by the common hangman; those of higher rank, after they had been declared by this tribunal not guilty, were set at liberty; and in 1680 an end was put to the *Chambre ardente*, which in reality was a political inquisition.

It is certain that notwithstanding such punishments, like crimes have given occasion to unjust succession both in Italy and in France, and that attempts have been made for the same purpose even in the northern kingdoms. It is known that in Denmark Count Corfitz de Ulfeld was guilty, though it was not proved, of having intended to give the king a poison, which should gradually destroy him like a lethargy[1]. Charles XI. also, king of Sweden, died by the effects of such a poison. Having ruined several noble families by seizing on their property, and having after that made a journey to Torneo, he fell into a consumptive disorder which no medicine could cure. One day he asked his physician in a very earnest manner,

[1] Leben des Grafen von Ulfeld, von H. P. aus dem Dänischen übersetzt. Copenhagen und Leipzig, 1775, 8vo, p. 200.

what was the cause of his illness? The physician replied, "Your majesty has been loaded with too many maledictions." "Yes," returned the king, "I wish to God that the reduction of the nobility's estates had not taken place, and that I had never undertaken a journey to Torneo!" After his death his intestines were found to be full of small ulcers[1].

The oftener poisoning in this manner happens, the more it is to be wished that preventives and antidotes were found out, and that the symptoms were ascertained; but this is hardly possible as long as it is not known of what the poison properly consists. Governments, however, have wisely endeavoured to conceal the recipes, by suppressing the criminal procedures. Pope Alexander VII. caused them to be shut up in the castle of St. Angelo; in France, it is said, they were burnt together with the criminals; in Naples only the same precaution was not taken. I do not know that observations on the bodies of persons destroyed by slow poison have been ever published; for what Pitaval says on that subject is not sufficient[2]. People talk of powders and pills, but the greater part of this kind of poison appears to be a clear insipid water, and that prepared by Tophania never once betrayed itself by any particular effects on the body. The sale of aqua-fortis was a long time forbidden at Rome, because it was considered as the principal ingredient; but this is very improbable. At Paris it was once believed that succession powder consisted of diamond dust pounded exceedingly fine. Without assenting to this idea, one may contradict Voltaire, who conceives that diamond dust is not more prejudicial than powder of coral. It may be rather compared to that fine sand which is rubbed off from our mill-

[1] This anecdote was told to me by the celebrated Linnæus. An account of what appeared on opening the body of this prince may be seen in Baldinger's Neues Magazin für Aerzte, vol. i. p. 91.

[2] "The lieutenant-civil continued still to grow worse. After having languished a long time, being seized with a loathing of every kind of food presented to him, his vomitings still continuing, and nature being at length exhausted, he expired without any fever. The three last days he had wasted very much; he was become extremely shrunk, and he felt a great heat in his stomach. When opened, that part and the duodenum were found to be black, and sloughing off in pieces; the liver was mortified, and as it were burnt. The counsellor was ill three months, had the like symptoms as the lieutenant-civil, and died in the same manner. When opened, his stomach and liver were found in a similar state."—pp. 274, 275.

stones, and which we should consider and guard against as a secret poison, were we not highly negligent and careless of our health in the use of food[1]. In the casket of Sainte Croix were found corrosive sublimate, opium, regulus of antimony, vitriol, and a large quantity of poison ready prepared, the principal ingredients of which the physicians were not able to distinguish. Many have affirmed that sugar of lead was the chief ingredient[2]; but the consequences of the poison did not seem to indicate the use of that metal. For some years past a harmless plant, which is only somewhat bitter and astringent, the ivy-leaved Toadflax (*Linaria Cymbalaria*), that grows on old walls, has been loaded with the opprobrium of producing this slow poison, while at the same time it has been celebrated by others on account of its medicinal properties; but it is perhaps not powerful enough to do either mischief or good; and it is probable that it has been added to poisons either through ignorance, or to conceal other ingredients; for the

[1] In one year a ton of sand, at least, which is baked with the flour, is rubbed off from a pair of mill-stones. If a mill grinds only 4385 bushels annually, and one allows no more than twelve bushels to one man, a person swallows in a year above six pounds, and in a month half a pound of pulverized sandstone, which, in the course of a long life, will amount to upwards of three hundred weight. Is not this sufficient to make governments more attentive to this circumstance?

[Although not very agreeable to the reader to learn that he swallows above six pounds of mill-stone powder in the course of the year, it may perhaps ease his mind to know that the learned author is entirely mistaken in regarding it as a poison. The inhabitants of the northern countries of Europe frequently mix quartz powder with their heavy food to assist in its digestion; and we are informed by Professor Ehrenberg, that in times of scarcity, the inhabitants of Lapland mix the siliceous shells of some species of fossil Infusoria with the ground bark of trees for food. It is probably from this circumstance that the infusorial deposit derives its name of *Bergmehl*, or *Mountain-meal*.]

[2] For the following important information I am indebted to Professor Baldinger:—"There is no doubt that the slow poison of the French and Italians, commonly called succession powder (*poudre de la succession*), owes its origin to sugar of lead. I know a chemist who superintends the laboratory of a certain prince on the confines of Bohemia, and who by the orders (perhaps not very laudable) of his patron, has spent much time and labour in strengthening and moderating poisons. He has often declared, that of sugar of lead, with the addition of some more volatile corrosive, a very slow poison could be prepared; which, if swallowed by a dog or other animal, would insensibly destroy it, without any violent symptoms, in the course of some weeks or months."

emperor Charles VI., who was king of the Two Sicilies at the time when Tophania was arrested, told his physician Garelli, who communicated the same in a letter[1] to the celebrated Hoffmann, in 1718 or 1719, that the poison of that Italian Circe was composed of an arsenical oxide, dissolved in *aqua cymbalariæ*, and which I suppose was rendered stronger and more difficult to be detected by a salt that may be readily guessed. It is dreadful to think that this secret poison is administered as a febrifuge by ignorant or unprincipled physicians, quacks, and old women. It drives off obstinate fevers, it is true; but it is equally certain that it hastens death: it is therefore a cure, which is far worse than the disease, and against which governments and physicians cannot exclaim too severely. It was remarked at Rome, by accident, that lemon juice and the acid of lemons are, in some measure, counterpoisons; and a physician named Paul Branchaletti, respecting whom I can find no information, wrote a book expressly on this antidote to these drops, according to the account of Keysler, who however adds, "Everything hitherto found out, supposes that one has taken the drops only for a short time, or that one has had an opportunity to be upon one's guard when suspicious circumstances occurred, and to discover the threat ened danger."

It seems to be almost certain that the poisons prepared by Tophania and Brinvillier were arsenical mixtures, or, as Dr. Hahneman[2] rightly conjectures, neutral salts of arsenic. Loss of appetite, faintness, gnawing pains in the stomach, loss of strength without any visible cause, a continual indisposition, followed by a wasting of the viscera, a slow fever, &c., are all symptoms which seem to announce that dangerous metallic

[1] Garelli, the emperor's principal physician, lately wrote to me something remarkable in the following words:—"Your elegant dissertation on the errors respecting poisons brought to my recollection a certain slow poison, which that infamous poisoner, still alive in prison at Naples, employed to the destruction of upwards of six hundred persons. It was nothing else than crystallised arsenic, dissolved in a large quantity of water by decoction, with the addition, but for what purpose I know not, of the herb cymbalaria. This was communicated to me by his imperial majesty himself, to whom the judicial procedure, confirmed by the confession of the criminal, was transmitted. This water, in the Neapolitan dialect, is called *aqua del Toffnina*. It is certain death, and many have fallen a sacrifice to it."—Hoffmanni Med. Rationalis System., p. ii. c. 2. § 19.

[2] Ueber die Arsenikvergiftung. Leips. 1786, 8vo, p. 35.

oxide. The opinion, however, that it was composed of opium and cantharides has, in latter times, received so many confirmations, that one is almost induced to believe that there are more kinds than one of this Stygian water. The information given by the abbé Gagliani, seems to carry too much weight with it to be denied[1]. It is confirmed also by M. Archen-

[1] On the 20th of December, 1765, died the dauphin, father of Louis XVI., and in 1767 died the dauphiness. It was a public report that they were both despatched by secret poison: and the gradual decline of their health, the other circumstances which accompanied their illness, and the cabals which then existed at court, make this at least not improbable. Many private anecdotes respecting these events may be found in a book entitled L'Espion Dévalisé. Feliciter audax. London, 1782. In page 61 it is said, that on account of the suspicions then entertained, it was wished that information might be procured respecting secret poison, and the methods of preparing it; and that the abbé Gagliani, well known as a writer, has given the following:—"It is certain that in Europe the preparation of these drugs renders them pernicious and mortal. For example, at Naples the mixture of opium and cantharides, in known doses, is a slow poison; the surest of all, and the more infallible as one cannot mistrust it. At first it is given in small doses, that its effects may be insensible. In Italy we call it *aqua di Tufania*, Tufania water. No one can avoid its attacks, because the liquor obtained from that composition is as limpid as rock water, and without taste. Its effects are slow and almost imperceptible: a few drops of it only are poured into tea, chocolate, or soup, &c. There is not a lady at Naples who has not some of it lying carelessly on her toilette with her smelling-bottles. She alone knows the phial, and can distinguish it. Even the waiting-woman, who is her confidant, is not in the secret, and takes this phial for distilled water, or water obtained by precipitation, which is the purest, and which is used to moderate perfumes when they are too strong.

"The effects of this poison are very simple. A general indisposition is at first felt in the whole frame. The physician examines you, and perceiving no symptoms of disease, either external or internal, no obstructions, no collection of humours, no inflammations, orders detergents, regimen, and evacuation. The dose of poison is then doubled, and the same indisposition continues without being more characterized. The physician, who can see in this nothing extraordinary, ascribes the state of the patient to viscous and peccant humours, which have not been sufficiently carried off by the first evacuation. He orders a second—a third dose—a third evacuation—a fourth dose. The physician then sees that the disease has escaped him; that he has mistaken it, and that the cause of it cannot be discovered but by changing the regimen. He orders the waters, &c. In a word, the noble parts lose their tone, become relaxed and affected, and the lungs particularly, as the most delicate of all, and one of those most employed in the functions of the animal œconomy. The first illness then carries you off; because the critical accumulation settles always on the weak part, and consequently on the lobes of the lungs; the pus there fixes

holz[1]; but what he says of the use made of Spanish flies, by the Chinese, to invigorate the sixth sense, gives reason to suspect that his voucher is *L'Espion Dévalisé*, to whom the abbé Gagliani ascribes the same words. It appears to me, however, if I may be allowed to judge from probabilities, that the poison known in the East Indies under the name of *powst* is also water which has stood a night over the juice of poppies. It is given in the morning fasting to those persons, and particularly princes, whom people wish to despatch privately, and without much violence. It consumes them slowly, so that they at length lose all their strength and understanding, and in the end die torpid and insensible[2].

[Chemical science has made such rapid progress of late years, that there are but few, if any, poisonous substances which cannot be detected with certainty. The improved state of our medical knowledge, and the institution of coroners' inquests in all cases where any suspicion of the cause of death occurs, fortunately renders secret poisoning almost, if not quite impossible, at least in this country.]

WOODEN BELLOWS.

After the discovery of fire, the first instrument employed to blow it and strengthen it, has undoubtedly been a hollow reed, until the art was found out of forming a stick into a pipe by boring it. Our common bellows, which consist of two boards joined together by a piece of leather, and which probably are an imitation of the lungs, appear to have been early known to the Greeks. I have, however, met with no passage in any ancient author from which I could learn the oldest

itself, and the disease becomes incurable. By this method they follow one as long as they choose for months, and for years. Robust constitutions resist a long time. In short, it is not the liquor alone that kills, it is rather the different remedies, which alter and then destroy the temperament, exhaust the strength, extenuate and render one incapable of supporting the first indisposition that comes."

[1] England und Italien, ii. p. 354.

[2] Universal History, xxiii. p. 299–323.—The information contained there is taken from Fraser's History of Nadir Shah. Aurengzebe also caused one of his sons to be put to death by this poison.

construction of this machine, which in latter times has received many improvements. Had I found such information, I should have endeavoured to explain it, as it would have contributed to enlarge the knowledge we have of the metallurgy of the ancients.

It may be remarked on the following lines of Virgil,

..... Alii taurinis follibus auras
Accipiunt redduntque[1].....

that bull's leather is unfit for bellows, and that ox or cow leather only can be used for that purpose; but accuracy is not to be expected in a poet; and besides, Virgil is not the only author who employs the expression *folles taurinos*; for Plautus says also, "Quam folles taurini habent, cum liquescunt petræ, ferrum ubi fit."

Strabo[2] tells us, from an old historian, that Anacharsis, the Scythian philosopher, who lived in the time of Solon, invented the bellows, the anchor, and the potter's wheel: but this account is very doubtful, as Pliny, Seneca[3], Diogenes Laërtius[4], and Suidas, who likewise speak of the inventions ascribed to that philosopher, mention only the last two, and not the bellows: besides, Strabo himself remarks that the potter's wheel is noticed in Homer, and this poet is certainly older than Anacharsis. The latter, perhaps, became acquainted with that useful instrument during the course of his travels, and on his return, made his countrymen first acquainted with it. However this may be, it is well known that the person who introduces a foreign invention among a people, is often considered as the author of it.

In the oldest smelting-houses the bellows were worked by men. Refuse, therefore, and other remains of metal, are often found in places where until a recent period no works could be erected, on account of the want of water.

Bellows made with leather, of which I have hitherto spoken, are attended with many inconveniences. They require careful management; are expensive in their repairs; and besides last often not more than six or seven years. If thin leather is employed, it suffers a great deal of the air to escape through it; an evil which must be guarded against by continually besmearing it with train-oil, or other fat substances; and this is

[1] Georg. iv. 171. [2] Lib. vii. [3] Epist. 90. [4] Lib. i. 8.

even necessary when thick leather is used, to prevent it from cracking in the folds. Damage by fire and water must also be avoided; and every time they are repaired, the leather must be again softened with oil, which occasions a considerable loss of time.

In wooden bellows these inconveniences are partly lessened, and partly remedied. As these bellows, except the pipe, consist entirely of wood, many, who are not acquainted with the construction of them, can hardly conceive the possibility of making such a machine. Though they cannot be properly described without a figure, I shall endeavour to give the reader some idea of them by the following short sketch. The whole machine consists of two boxes placed the one upon the other, the uppermost of which can be moved up and down upon the lower one, in the same manner as the lid of a snuff-box, which has a hinge, moves up and down when it is opened or shut; but the sides of the uppermost box are so broad as to contain the lower one between them, when it is raised to its utmost extent. Both boxes are bound together, at the smallest end, where the pipe is, by a strong iron bolt. It may be readily comprehended, that when both boxes fit each other exactly, and the upper one is raised over the under one, which is in a state of rest, the space contained by both will be increased; and consequently more air will rush in through the valve in the bottom of the lower one; and when the upper box is again forced down, this air will be expelled through the pipe. The only difficulty is to prevent the air, which forces its way in, from escaping anywhere else than through the pipe; for it is not to be expected that the boxes will fit each other so closely as to prevent entirely the air from making its way between them. This difficulty, however, is obviated by the following simple and ingenious method. On the inner sides of the uppermost box there are placed moveable slips of wood, which, by means of metal springs, are pressed to the sides of the other box, and fill up the space between them. As these long slips of wood might not be sufficiently pliable to suffer themselves to be pressed close enough, and as, though planed perfectly straight at first, they would in time become warped in various directions, incisions are made in them across through their whole length, at the distance of from fifteen to eighteen inches from each other, so as to leave only a small space in

their thickness, by which means they acquire sufficient pliability to be everywhere pressed close enough to the sides[1].

The advantages of these wooden bellows are very great. When made of clean fir-wood without knots, they will last thirty or forty years, and even longer, though continually kept in action forty-six or forty-eight weeks every year: nay, Polhem assures us, that, when properly made, they will last a century. The effect produced by them is stronger, as well as more uniform, and can be moderated according to circumstances. They are worked also with greater facility. The slips of wood on their sides are apt to become damaged; but they can soon and easily be repaired. Every three or four months, however, the outer sides only of the inner box, and the bolt which keeps the boxes together, must be smeared with oil. If we reckon up the price of such bellows, and the yearly expense, they will, according to Grignon's account, be only a fifth part of those of the old leather bellows.

That the invention of these wooden bellows belongs to the Germans, is certain. Grignon[2] expressly affirms so; and in Becher's[3] time they were to be found in Germany, but not in England. Genssane, who ascribes the invention to the Swiss, is certainly mistaken; and perhaps he was led into this error, because these bellows were first made known in France by a Swiss. I cannot, however, ascertain the name of the real inventor. In the middle of the sixteenth century lived at Nuremberg an artist called Hans Lobsinger, who, in the year 1550, gave to the magistrates of that city a catalogue of his machines. From this catalogue Doppelmayer concludes that he understood the art of making small and large bellows without leather, and entirely of wood, which could be used in

[1] A complete description and a figure of these bellows may be found in Schluter's Unterricht von Hütten-werken. Brunswick, 1738.—Traité de la fonte des mines par le feu du charbon de terre; par M. de Genssane. Paris, 1770, 2 vols. 4to. [Ure's Dictionary, p. 1128, also contains an excellent figure of these wooden bellows.]

[2] "Germany is the country of machines. In general the Germans lessen manual labour considerably by machines adapted to every kind of movement; not that we are destitute of able mechanics; we have the talent of bringing to perfection the machines invented by our neighbours."—P. 200. [This remark of Grignon will sound rather odd to English ears.]

[3] Becher's Narrische Weisheit und weise Narrheit. Frankfort, 1683, 12mo, p. 113.

smelting-houses and for organs, and likewise copper bellows that always emitted a like degree of wind. As Lobsinger made organs, he, perhaps, fell upon this invention; but in what it actually consisted, or whether it might not have died with him, I have not been able to learn. Agricola, who died in the year 1555, makes no mention of wooden bellows.

Samuel Reyher, formerly professor at Kiel, in a dissertation on air[1], printed there in 1669, tells us, that about forty years before that period, two brothers, Martin and Nicholas Schelhorn, millers at the village of Schmalebuche in Coburg, first invented wooden bellows. Both the brothers, he says, kept the invention secret, though he thinks they did not conceal it so closely as to prevent its being guessed at; and he relates also how he himself formed an idea of it[2].

To these bellows Schluter has assigned a much nobler inventor, who, perhaps, was the first person who made them known by a description. He says expressly that they were invented by a bishop of Bamberg[3]: but of this I have been able to find no confirmation; and I am inclined to ascribe that service rather to an organ-builder, or a miller, than to a bishop. According to Schluter's account, these bellows were employed so early as the year 1620, in the Harz forest, to which they were first brought by some people from Bamberg. What Calvor says respecting the introduction of these bellows into the Harz forest is much more probable; that in the year 1621

[1] In this dissertation, the time of the invention is stated to be about forty years before, which would be the year 1629 or 1630; but in an improved edition, printed with additions at Hamburg, in 1725, a different period is given. "About eighty years ago," says the author, "a new kind of bellows, which ought rather to be called the pneumatic chests, was invented in the village of Schmalebuche, in the principality of Coburg, in Franconia. Two brothers, millers in that village, Martin and Nicholas Schelhorn, by means of some box made by them, the lid of which fitted very exactly, found out these chests, as I was told by one of their friends, a man worthy of credit. These chests are not of leather, but entirely of wood joined together with iron nails. In blacksmiths' shops they are preferred to those constructed with leather, because they emit a stronger blast, as leather suffers the more subtile part of the air to escape through its pores."

[2] In many places these bellows were at first put in a wooden case, to prevent their construction from being known.

[3] In J. P. Ludewig, Scriptores Rerum Episcopatus Bambergensis. Francof. 1718, fol. Where any bishop of latter times is praised, I find no mention of this useful and ingenious invention.

Lewis Pfannenschmid, from Thuringia, settled at Ostfeld near Goslar, and began to make wooden bellows. The bellows-makers of that place conspired therefore against him, and swore they would put him to death; but he was protected by the government. He would disclose his art to no one but his son, who, as well as his grandson a few years ago, had the making of all the bellows in the forest.

We are told by French authors, that the art of making these bellows was introduced into France, particularly into Berry, Nivernois, and Franche Comté, by a German.

COACHES.

If by this name we are to understand every kind of covered carriage in which one can with convenience travel, there is no doubt that some of them were known to the ancients. The *arcera*, of which mention is made in the twelve tables, was a covered carriage used by sick and infirm persons[1]. It appears to have been employed earlier than the soft *lectica*, and by it to have been brought into disuse. A later invention is the *carpentum*, the form of which may be seen on antique coins, where it is represented as a two-wheeled car with an arched covering, and which was sometimes hung with costly cloth[2]. Still later were introduced the *carrucæ*, first mentioned by Pliny; but so little is known of them, that antiquaries are uncertain whether they had only one wheel, like our wheelbarrows, or, as is more probable, four wheels. This much, however, is known, that they were first-rate vehicles, ornamented with gold and precious stones, and that the Romans considered it as an honour to ride in those that were remarkably high[3]. In the Theodosian code the use of them is not only allowed to civil and military officers of the first rank, but commanded as a mark of their dignity[4].

[1] See Leges XII. tab. illustratæ a J. N. Funccio, p. 72. Gellius, xx. 1.

[2] Scheffer de Re Vehiculari, Spanhem. de Præstant. Numismatum. Amst. 1671, 4to, p. 613. Propertius, iv. 8. 23, mentions *serica carpenta*.

[3] In my opinion the height here alluded to is to be understood as that of the body, rather than that of the wheels, as some think.

[4] Codex Theodos. lib. xiv. tit. 12. and Cod. Justin. lib. xi. tit. 19.

After this, covered carriages seem more and more to have become appendages of Roman pomp and magnificence; but the manner of thinking which prevailed under the feudal system banished the use of them for some time. As it was of the greatest importance to the feudal lords that their vassals should be always able to serve them on horseback, they could not think of indulging them with elegant carriages. They foresaw that by such luxury the nobility would give over riding on horseback, and become much more indolent and less fit for military service. Masters and servants, husbands and wives, clergy and laity, all rode upon horses or mules, and sometimes women and monks upon she-asses, which they found more convenient. The minister rode to court, and the horse, without any conductor, returned alone to his stable, till a servant carried him back to court to fetch his master. In this manner the magistrates of the imperial cities rode to council in the beginning of the sixteenth century; so that in the year 1502 steps to assist in mounting were erected by the Roman gate at Frankfort[1]. The members of the council who, at the diet and on other occasions, were employed as ambassadors, were on this account called *Rittmeister*; and even at present the expression *riding servant* is preserved in some of the imperial cities. The public entry of great lords into any place, or their departure from it, was never in a carriage, but on horseback; and in all the works which speak of the papal ceremonies there is no mention of a state coach or body coachmen, but of state horses or state mules. It was necessary that a horse for his holiness should be of a gray colour; not mettlesome however, but a quiet, tractable nag; that a stool with three steps should be brought to assist him to mount, and the emperor and kings, if present, were obliged to hold his stirrup and to lead the horse[2], &c. Bishops made their public entrance on horses or asses richly decorated[3]. At the coronation of the emperor, the electors and principal officers of the empire were ordered to make their entrance on horses, and to perform their service on horseback[4]. Formerly

[1] Lersner, Chronica der Stadt Frankfurt. i. p. 23.

[2] Sacrarum Cæremoniarum Romanæ Ecclesiæ Libri tres, auctore J. Catalano. Romæ, 1750, 2 vols. fol. i. p. 131.

[3] See Cæremoniæ Episcoporum, lib. i. c. 11.

[4] Ludewig's Erläuter. der Güldenen Bulle. Franc. 1719, vol. i. p. 569.

it was requisite that those who received an investiture should make their appearance on horseback: the vassal was obliged to ride with two attendants to his lord's court, where, having dismounted from his horse, he received his fief.

Covered carriages were known in the beginning of the sixteenth century; but they were used only by women of the first rank, for the men thought it disgraceful to ride in them. At that period, when the electors and princes did not choose to be present at the meetings of the states, they excused themselves by informing the emperor that their health would not permit them to ride on horseback; and it was considered as an established point, that it was unbecoming for them to ride like women[1]. What, according to the then prevailing ideas, was not allowed to princes, was much less permitted to their servants. In the year 1544, when Count Wolf of Barby was summoned by John Frederic, elector of Saxony, to go to Spires to attend the convention of the states assembled there, he requested leave, on account of his ill state of health, to make use of a close carriage with four horses. When the counts and nobility were invited to the marriage solemnity of the elector's half brother, duke John Ernest, the invitation was accompanied with a memorandum, that such dresses of ceremony as they might be desirous of taking with them should be transported in a small waggon[2]. Had they been expected in coaches, such a memorandum would have been superfluous. The use of covered carriages was for a long time forbidden even to women. In the year 1545 the wife of a certain duke obtained from him, with great difficulty, permission to use a covered carriage in a journey to the baths, in which however much pomp was displayed, but with this express stipulation, that her attendants should not have the same indulgence[3]. It is nevertheless certain, that the emperor, kings and princes, about the end of the fifteenth century, began to employ covered carriages on journeys, and afterwards on public solemnities.

In the year 1474 the emperor Frederic III. came to Frankfort in a close carriage; and as he remained in it on account of the wetness of the weather, the inhabitants had no occasion

[1] Ludolf, Electa Juris Publici, v. p. 417.
[2] Ludolf, *l. c.*
[3] Sattler, Historische Beschreibung des Herzogthums Würtemberg.

to support the canopy which was held over him, but while he went to the council-house, and again returned. In the year following the emperor visited the same city in a very magnificent covered carriage. In the description of the splendid tournament held by Joachim, elector of Brandenburg, at Ruppin, in 1509, we read of a carriage gilt all over, which belonged to the electress; of twelve other coaches ornamented with crimson, and of another of the duchess of Mecklenburg, which was hung with red satin. At the coronation of the emperor Maximilian, in the year 1562, the elector of Cologne had twelve carriages. In 1594, when the margrave John Sigismund did homage at Warsaw on account of Prussia, he had in his train thirty-six coaches with six horses each[1]. Count Kevenhiller, speaking of the marriage of the emperor Ferdinand II. with a princess of Bavaria, says, "The bride rode with her sisters in a splendid carriage studded with gold; her maids of honour in carriages hung with black satin, and the rest of the ladies in neat leather carriages." The same author mentions the entrance of Cardinal Dietrichstein into Vienna in 1611, and tells us that forty carriages went to meet him[2]. At the election of the emperor Matthias, the ambassador of Brandenburg had three coaches[3]. When the consort of that emperor made her public entrance, on her marriage in 1611, she rode in a carriage covered with perfumed leather. Mary, infanta of Spain, spouse of the emperor Ferdinand III., rode, in Carinthia, in 1631, in a glass carriage in which no more than two persons could sit. The wedding carriage of the first wife of the emperor Leopold, who was also a Spanish princess, cost together with the harness 38,000 florins[4]. The coaches used by that emperor are thus described by Rink:—"In the imperial coaches no great magnificence was to be seen: they were covered over with red cloth and black nails. The harness was black, and in the whole work there was no gold. The pannels were of glass, and on this

[1] Suite des Mémoires pour servir à l'Hist. de Brandenburg, p. 63, where the royal author adds, "The common use of carriages is not older than the time of John Sigismund."

[2] Annal. Ferdin. V. p. 2199; and vii. p. 375.

[3] In Suite des Mém. pour serv. à l'Hist. de Brandenburg, p. 63, it is remarked that they were coarse coaches, composed of four boards put together in a clumsy manner.

[4] Rink, Leben K. Leopold, p. 607.

account they were called the imperial glass coaches. On festivals the harness was ornamented with red silk fringes. The imperial coaches were distinguished only by their having leather traces; but the ladies in the imperial suite were obliged to be contented with carriages the traces of which were made of ropes." At the magnificent court of duke Ernest Augustus at Hanover, there were, in the year 1681, fifty gilt coaches with six horses each[1]. So early did Hanover begin to surpass other cities in the number of its carriages. The first time that ambassadors appeared in coaches on a public solemnity was at the imperial commission held at Erfurth in 1613, respecting the affair of Juliers[2].

The great lords at first imagined that they could suppress the use of coaches by prohibitions. In the archives of the county of Mark there is still preserved an edict, in which the feudal nobility and vassals are forbid the use of coaches, under pain of incurring the punishment of felony. In the year 1588, duke Julius of Brunswick published an order, couched in very expressive terms, by which his vassals were forbid to ride in carriages. This curious document is in substance as follows:—"As we know from ancient historians, from the annals of heroic, honourable and glorious achievements, and even by our own experience, that the respectable, steady, courageous and spirited Germans were heretofore so much celebrated among all nations on account of their manly virtue, sincerity, boldness, honesty and resolution, that their assistance was courted in war, and that in particular the people of this land, by their discipline and intrepidity, both within and without the kingdom, acquired so much celebrity, that foreign nations readily united with them; we have for some time past found, with great pain and uneasiness, that their useful discipline and skill in riding, in our electorate, county and lordship, have not only visibly declined, but have been almost lost (and no doubt other electors and princes have experienced the same among their nobility); and as the principal cause of this is that our vassals, servants and kinsmen, without distinction, young and old, have dared to give themselves up to indolence and to riding in coaches, and that few of them provide themselves with well-equipped riding horses and with

[1] Lünig's Theatr. Cer. i. p. 289.
[2] Ludolf, v. p. 416. Von Moser's Hofrecht, ii. p. 337.

skilful experienced servants, and boys acquainted with the roads: not being able to suffer any longer this neglect, and being desirous to revive the ancient Brunswick mode of riding, handed down and bequeathed to us by our forefathers, we hereby will and command, that all and each of our before-mentioned vassals, servants and kinsmen, of whatever rank or condition, shall always keep in readiness as many riding-horses as they are obliged to serve us with by their fief or alliance; and shall have in their service able, experienced servants, acquainted with the roads; and that they shall have as many horses as possible with polished steel harness and with saddles proper for carrying the necessary arms and accoutrements, so that they may appear with them when necessity requires. We also will and command our before-mentioned vassals and servants to take notice, that when we order them to assemble, either altogether or in part, in times of turbulence or to receive their fiefs, or when on other occasions they visit our court, they shall not travel or appear in coaches, but on their riding-horses, &c."[1] Philip II., duke of Pomerania-Stettin, reminded his vassals also, in 1608, that they ought not to make so much use of carriages as of horses[2]. All these orders and admonitions however were of no avail, and coaches became common all over Germany.

It would be difficult to give an exact description of these carriages without a figure, and drawings or paintings of them do not seem to be common.

In the month of October 1785, when I visited the senate-house at Bremen, I saw in the tax-chamber a view of the city, painted on the wall in oil colours, by John Landwehr, in 1661. On the left side of the fore-ground I observed a long quadrangular carriage, which did not appear to be suspended by leather straps. It was covered with a canopy supported by four pillars, but had no curtains, so that one could see all the persons who were in it. In the side there was a small door, and before there seemed to be a low seat, or perhaps a box. The coachman sat upon the horses. It was evident, from their dress, that the persons in it were burgomasters.

In the history of France we find many proofs that at Paris,

[1] Lunig. Corp. Jur. Feud. Germ. ii. p. 1447.

[2] An attempt was made also to prevent the use of coaches by a law in Hungary in 1523.

in the fourteenth, fifteenth, and even sixteenth centuries, the French monarchs rode commonly on horses, the servants of the court on mules, and the princesses, together with the principal ladies, sometimes on asses. Persons of the first rank frequently sat behind their equerry, and the horse was often led by servants. When Charles VI. wished to see incognito the entrance of the queen, he placed himself on horseback behind Savoisy, who was his confidant, with whom, however, he was much incommoded in the crowd[1]. When Louis, duke of Orleans, that prince's brother, was assassinated in 1407, the two *ecuyers* who accompanied him rode both upon the same horse[2]. In the year 1534, queen Eleonora and the princesses rode on white horses (*des haquenées blanches*) during a sacred festival. That private persons also, such as physicians, for example, used no carriages in the fifteenth century, is proved by the principal entrance to their public school, which was built in 1472, being so narrow that a carriage could not pass through it, though it was one of the widest at that period. In Paris also, at all the palaces and public buildings, there were steps for mounting on horseback, such as those which the parliament caused to be erected in 1599; and Sauval says on this occasion, that though many of these steps in latter periods had been taken away, there still remained several of them in his time at old buildings.

Carriages, however, appear to have been used very early in France. An ordinance of Philip the Fair, issued in 1294, for suppressing luxury, and in which the citizens' wives are forbid to use carriages (*cars*), is still preserved[3]. Under Francis I., or about 1550, somewhat later, there were at Paris, for the first time, only three coaches, one of which belonged to the queen, another to Diana de Poictiers, the mistress of two kings, Francis I. and Henry II., by the latter of whom she was created duchess of Valentinois, and the third to René de Laval, lord of Bois-dauphin. The last was a corpulent unwieldy nobleman, who was not able to ride on horseback. Others say, that the first three coaches belonged to

[1] Histoire des Antiquités de Paris, par Sauval, i. p. 187.

[2] Sauval; also Mezeray, Abregé Chron. de l'Histoire de France. Amsterdam, 1696, iii. p. 167.

[3] This ordonnance is to be found also in Traité de la Police, par De la Marc, i. p. 418.

Catherine de Medici; Diana, duchess of Angoulême, the natural daughter of Henry II., who died in 1619, in the eightieth year of her age; and Christopher de Thou, first president of the parliament. The last was excused by the gout; but the rest of the ministers of state soon followed his example[1]. Henry IV. was assassinated in a coach; but he usually rode through the streets of Paris on horseback, and to provide against rain, carried a large cloak behind him. For himself and his queen he had only one coach; as appears by a letter still preserved, in which he writes to a friend, "I cannot wait upon you to-day, because my wife is using my coach[2]." We, however, find two coaches at the public solemnity on the arrival of the Spanish ambassador, Don Peter de Toledo, under Henry IV.[3] This contradiction is not worth further research; but it shows that all writers do not speak of the same kind of carriages or coaches, and that every improvement has formed as it were an epoch in the history of them, which perhaps would be best elucidated by figures or engravings.

Roubo, in his costly Treatise on joiners' work[4], has given three figures of such (*chars*) carriages as were used under Henry IV., from drawings preserved in the king's library. By these it is seen that those coaches were not suspended by straps, that they had a canopy supported by ornamented pillars, and that the whole body was surrounded by curtains of stuff or leather, which could be drawn up. The coach in which Louis XIV. made his public entrance, about the middle of the seventeenth century, appears, from a drawing in the king's library, to have been a suspended carriage.

The oldest carriages used by the ladies in England were known under the now-forgotten name of *whirlicotes*. When Richard II., towards the end of the fourteenth century, was obliged to fly before his rebellious subjects, he and all his followers were on horseback; his mother only, who was indisposed, rode in a carriage. This, however, became afterwards somewhat unfashionable, when that monarch's queen, Ann, the

[1] Valesiana. Paris, 1695, 12mo, p. 35.

[2] Variétés Historiques, p. 96.

[3] Sauval says, "I shall here remark, that this was the first time coaches were used for that ceremony (the entrance of ambassadors), and that it was only at this period they were invented, and began to be used."

[4] L'Art du Menuisier-carossier, p. 457, planche 171.

daughter of the emperor Charles IV., showed the English ladies how gracefully and conveniently she could ride on a side-saddle. Whirlicotes therefore were disused, except at coronations and other public solemnities[1]. Coaches were first known in England about the year 1580, and, as Stow says, were introduced from Germany by Fitz-allen, earl of Arundel[2]. In the year 1598, when the English ambassador came to Scotland, he had a coach with him[3]. Anderson places the period when coaches began to be in common use, about the year 1605. The celebrated duke of Buckingham, the unworthy favourite of two kings, was the first person who rode with a coach and six horses, in 1619. To ridicule this new pomp, the earl of Northumberland put eight horses to his carriage.

Towards the end of the thirteenth century, when Charles of Anjou made his entrance into Naples, the queen rode in a carriage, called by historians *caretta*, the outside and inside of which were covered with sky-blue velvet, interspersed with golden lilies, a magnificence never before seen by the Neapolitans. At the entrance of Frederic II. into Padua, in the year 1239, it appears that there were no carriages, for the most elegantly dressed ladies who came to meet him were on palfreys ornamented with trappings (*sedentes in phaleratis et ambulantibus palafredis*). It is well known that the luxury of carriages spread from Naples all over Italy.

Coaches were seen for the first time in Spain in the year 1546. Such at least is the account of Twiss, who, according to his usual custom, says so without giving his authority[4].

Towards the end of the sixteenth century, John of Finland, on his return from England, among other articles of luxury, brought with him to Sweden the first coach[5]. Before that period, the greatest lords in Sweden, when they travelled by land, carried their wives with them on horseback. The princesses even travelled in that manner, and, when it rained, took with them a mantle of wax-cloth.

It appears that there were elegant coaches in the capital

[1] Stow's Survey of London, 1633, fol. p. 70.
[2] Anderson's Hist. of Commerce, iv. p. 180.
[3] Arnot's Hist. of Edinburgh, p. 596.
[4] Twiss's Travels through Spain and Portugal.
[5] Dalin, Geschichte des Reichs Schweden, iii. 1, p. 390 and 402.

of Russia so early as the beginning of the seventeenth century[1].

But to what nation ought we to ascribe the invention of coaches? If under this name we comprehend covered carriages, these are so old as not to admit of any dispute respecting the question. To the following, however, one might expect an answer, Who first fell on the idea of suspending the body of the carriage from elastic springs, by which the whole machine has undoubtedly been much improved? To this question, however, I can find no answer, except the information before mentioned, that suspended carriages were known in the time of Louis XIV.

As the name coach is now adopted, with a little variation, in all the European languages, some have thought to determine the country of this invention from the etymology of the word[2]. But even allowing that one could fix the origin of the word, it would by no means be ascertained what kind of a carriage we ought properly to understand by it. M. Cornides[3] has lately endeavoured to prove that the word *coach* is of Hungarian extraction, and that it had its rise from a village in the province of Wieselburg, which at present is called *Kitsee*, but was known formerly by the name of *Kotsee*, and that this travelling machine was even there first invented. However this may be, the grounds on which he supports his assertion deserve to be here quoted, as they seem at least to prove that in the sixteenth century, or even earlier, a kind of covered carriages was known, under the name of Hungarian carriages[4]. As the word *Gutschi*, and not *Gutsche*, was used

[1] Bacmeister, Essai sur la Bibliothèque de l'Académie de S. Pétersburg, 1776, 8vo, p. 38.

[2] Joh. Ihre, Glossarium Sueogothic. i. col. 1178. *Kusk*, a coachman. It seems properly to denote the carriage itself. Gall. *cocher*. Hisp. id. Ital. *cocchio*. Ang. *coach*. Hung. *cotczy*. Belg. *goetse*. Germ. *kutsche*. The person who drives such carriages is by the English called *coachman*, which in other languages is made shorter, as the French say *cocher*, and the Germans *kusk*. It is difficult, however, to determine whence it is derived, as we do not know by whom these close carriages were invented. Menage makes it Latin, and by a far-fetched derivation from *vehiculum*; Junius derives it somewhat shorter from ὀχέω to carry. Wachter thinks it comes from the German word *kutten*, to cover; and Lye from the Belgic *koetsen*, to lie along, as it properly signifies a couch or chair.

[3] Ungrisches Magaz. Pressburg, 1781, vol. i. p. 15.

[4] Stephanus Broderithus says, speaking of the year 1526, "When the

at first in Germany, the last syllable gives us reason to conjecture that it is rather of Hungarian than German extraction. As Hortleder[1] tells us that Charles V., because he had the gout, laid himself to sleep in an Hungarian *Gutsche*, one might almost conclude that the peculiarity of these carriages consisted in their being so constructed as to admit people to sleep in them. This conjecture is supported by the meaning of the word *Gutsche*, which formerly signified a couch or sofa[2]. As the writers quoted by Cornides call the Hungarian coaches sometimes (*leves*) light, sometimes (*veloces*) swift, they ought rather to be considered as a particular kind of carriages for travelling with expedition. It is, however, still more worthy of remark, that, so early as the year 1457, the ambassador of Ladislaus V., king of Hungary and Bohemia, brought with him to the queen of France, besides other presents, a carriage which excited great wonder at Paris, and which, as an old historian says, was *branlant et moult riche*[3]. Does not the first word of this expression seem to indicate that the carriage was suspended?

A peculiar kind of coach has been introduced in latter times under the name of Berlin. The name indicates the place

archbishop received certain intelligence that the Turks had entered Hungary, not contented with informing the king by letter of this event, he speedily got into one of those light carriages, which, from the name of the place, we call *Kotcze*, and hastened to his majesty." Siegmund baron Herberstein, ambassador from Louis II. to the king of Hungary, says, in Commentario de Rebus Moscoviticis, Basil 1571, fol. p. 145, where he occasionally mentions some stages in Hungary, "The fourth stage for stopping to give the horses breath is six miles below Jaurinum, in the village of *Cotzi*, from which both drivers and carriages take their name, and are still generally called *cotzi*." That the word *coach* is of Hungarian extraction is confirmed also by John Cuspinianus (Spiesshammer), physician to the emperor Maximilian I., in Bell's Appar. ad Histor. Hungariæ, dec. 1, monum. 6, p. 292. "Many of the Hungarians rode in those light carriages called in their native tongue *Kottschi*." In Czvittinger's Specimen Hungariæ Litteratæ, Franc. et Lips. 1711, 4to, we find an account of the service rendered to the arts and sciences by the Hungarians; but the author nowhere makes mention of coaches.

[1] In his Account of the German War, p. 612.

[2] Examples may be seen in Frisch's German Dictionary, where it appears that the beds which are used for raising tobacco plants are at present called *Tabacks kutschen*, tobacco beds. This expression is old, for I find it in Pet. Laurembergii Horticultura, Franc. 1631, p. 43.

[3] Roubo, p. 457. The historian, however, gives it no name.

which gave birth to the invention, as the French themselves acknowledge; though some, with very little probability, wish to derive it from the Italian[1]. Philip de Chiese, a native of Piedmont, and descended from the Italian family of Chiesa, was a colonel and quarter-master-general in the service of Frederic William, elector of Brandenburg, by whom he was much esteemed on account of his knowledge in architecture. Being once sent to France on his master's business, he caused to be built, on purpose for this journey, a carriage capable of containing two persons; which, in France and everywhere else, was much approved, and called a berline. This Philip de Chiese died at Berlin in 1673[2].

Coaches have given rise to a profession which in large cities affords maintenance to a great number of people, and which is attended with much convenience; I mean that of letting out coaches for hire, known under the name of *fiacres*, hackney-coaches[3]. This originated in France; for about the year 1650 one Nicholas Sauvage first thought of keeping horses and carriages ready to be let out to those who might have occasion for them. The Parisians approved of and patronised this plan; and as Sauvage lived in the street St. Martin, in a house called the *hôtel St. Fiacre*, the coaches, coachmen and proprietor, were called *fiacres*. In a little time this undertaking was improved by others, who obtained a license for their new institutions on paying a certain sum of money[4]. Some kept coaches ready in certain places of the streets, and let them out as long as was required, to go from one part of the city to another. These alone, at length, retained the name of *fiacre*, which at first was common to every kind of hired carriage without distinction. Others kept carriages at their houses, which they let out for a half or a whole

[1] "*Berlin*. A kind of carriage which takes its name from the city of Berlin, in Germany; though some persons ascribe the invention of it to the Italians, and pretend to find the etymology of it in *berlina*, a name which the latter give to a kind of stage on which criminals are exposed to public ignominy."—Encyclopédie, ii. p. 209.

[2] Nicolai Beschreibung von Berlin, Anhang, p. 67.

[3] At Rome, however, at a very early period, there appears to have been carriages to be let out for hire: Suetonius calls them (i. chap. 57) *rheda meritoria*, and (iv. c. 39) *meritoria vehicula*.

[4] Charles Villerme paid in 1650, into the king's treasury, for the exclusive privilege of keeping coaches for hire within the city of Paris, 15,000 livres.

day, a week, or a month: these coaches were known by the name of *carosses de remise*. Others kept carriages which at a certain stated time went from one quarter of the city to another, like a kind of stages, and took up such passengers as presented themselves; and in the year 1662 some persons set up carriages with four horses, for the purpose of conveying people to the different palaces at which the court might be; these were called *voitures pour la suite de la cour*. The proprietors often quarreled respecting the boundaries prescribed to them by their licenses; and on this account they were sometimes united into one company, and sometimes separated. The police established useful regulations, by which the safety and cleanliness of these carriages were promoted; marks were affixed to them, by which they might be known; and young persons and women of the town were forbidden to use them[1], &c.

A particular kind of hackney carriage, peculiar to the Parisians, in the opinion of some does no great honour to their urbanity. I mean the *brouettes*, called sometimes *roulettes*, and by way of derision *vinaigrettes*. The body of these is almost like that of our sedans, but rolls upon two low wheels, and is dragged forwards by men. An attempt was made to introduce such machines under Louis XIII.; but the proprietors of the sedans prevented it, as they apprehended the ruin of their business. In the year 1669 they were however permitted, and came into common use in 1671, but were employed only by the common people. Dupin, the inventor of these *brouettes*, found means to contrive them so that they did not jolt so much as might have been expected; and he was able to conceal this art so well, that for a long time he was the only person who could make them[2]. The number of all the coaches at Paris is by some said to be fifteen thousand; the author of Tableau de Paris reckons the number of the hackney coaches to amount to eighteen hundred, and asserts that more than a hundred foot passengers lose their lives by them every year.

[1] A full history of the Parisian *fiacres*, and the orders issued respecting them, may be seen in Continuation du Traité de la Police. Paris, 1738, fol. p. 435. See also Histoire de la Ville de Paris, par Sauval, i. p. 192.

[2] An account of the manner in which these *brouettes* were suspended may be seen in Roubo, p. 588. He places the invention of post-chaises in the year 1664.

Coaches to be let for hire were first established at London in 1625. At that time there were only twenty, which did not stand in the streets, but at the principal inns. Ten years after, however, they were become so numerous, that king Charles I. found it necessary to issue an order for limiting their number. In the year 1637 there were in London and Westminster fifty hackney coaches, for each of which no more than twelve horses were to be kept. In the year 1652 their number had increased to two hundred; in 1654 there were three hundred, for which six hundred horses were employed; in 1694 they were limited to seven hundred, and in 1715 to eight hundred[1].

Hackney coaches were first established in Edinburgh in 1673. Their number was twenty; but as the situation of the city was unfavourable for carriages, it fell in 1752 to fourteen, and in 1778 to nine, and the number of sedans increased.

Fiacres were introduced at Warsaw, for the first time, in 1778. In Copenhagen there are a hundred hackney coaches[2].

In Madrid there are from four to five thousand gentlemen's carriages[3]; in Vienna three thousand, and two hundred hackney coaches.

At Amsterdam coaches with wheels were in the year 1663 forbidden, in order to save the expensive pavement of the streets; for coaches there, even in summer, are placed upon sledges, as those at Petersburgh are in winter. The tax upon carriages in Holland has from time to time been raised, yet the number has increased; and some years ago the coach horses in the Seven United Provinces amounted to twenty-five thousand.

When Prince Repnin made his entrance into Constantinople in 1775, he had with him eighty coaches, and two hundred livery servants.

[Since the former edition of this work, published in 1814, public conveyances have undergone considerable changes. Stage-coaches, which in this country had arrived at such a degree of perfection, and which, till within a few years, passed through and connected almost every small town in the United Kingdom, have now nearly disappeared in consequence of the introduction of railroads. It is also rare in

[1] Anderson's Hist. of Commerce.
[2] Haubers Beschr. von Copenhagen, p. 173.
[3] Twiss's Travels through Spain and Portugal.

London to meet with a solitary hackney coach, this class of vehicles being almost entirely superseded by the lighter one-horsed cabriolets which were first introduced as public conveyances in the year 1823. The number of hackney coaches and cabriolets now plying for hire in the streets of London amounts to 2650, of which probably not more than 250 are two-horsed coaches.

That very useful form of public conveyance, the omnibus, which is at present met with in nearly every large town in Europe, originated in Paris in 1827. In the latter part of 1831 and the beginning of 1832, omnibuses began to ply in the streets of London. Those running from Paddington to the Bank were the earliest. Carriages, however, of a similar form were used in England as Long Stages more than forty years ago, but were discontinued as they were not found profitable. They were in most request at holiday time, by schoolmasters in the neighbourhood of London; and some even of the present generation will remember their joyous pranks on journeying home in these capacious machines.

There are now about 900 omnibuses running in London and its immediate vicinity. The line from Paddington to the Bank is served by two companies, the London Conveyance Company, and the Paddington Association, which have mutually agreed to run forty omnibuses each. An idea of the utility of these conveyances may be formed from the fact that the receipts of each of the eighty carriages on the above line averages 1000*l.* per annum, in sixpences.

Omnibuses began to run in Amsterdam in 1839.]

WATER-CLOCKS, CLEPSYDRAS.

We are well assured that the ancients had machines by which, through the help of water, they were able to measure time[1].

[1] [Sextus Empiricus (Adv. Math. cap. 21) says that the Chaldæans divided the zodiac into 12 equal parts, as they supposed, by allowing water to run out of a small orifice during the whole revolution of a star, and dividing the fluid into 12 equal parts, the time answering to each part being taken for that of the passage of a sign over the horizon.]

The invention of them is by Vitruvius[1] ascribed to Ctesibius of Alexandria, who lived under Ptolemy Euergetes, or about the year 245 before the Christian æra[2]. They were introduced at Rome by P. Cornelius Scipio Nasica, in the year 594 after the building of the city, or about 157 years before the birth of Christ. How these water-clocks were constructed, or whether they were different from the clepsydras, I shall not inquire. If under the latter name we understand those measurers of time which were used in courts of justice, the clepsydra is a Grecian invention, first adopted at Rome under the third consulship of Pompey[3]. The most common kinds of these water-clocks all, however, corresponded in this, that the water issued drop by drop through a hole of the vessel, and fell into another, in which a light body that floated marked the height of the water as it rose, and, by these means, the time that had elapsed. They all had this failing in common, that the water at first flowed out rapidly, and afterwards more slowly, so that they required much care and regulation[4].

That ingenious machine, which we have at present under the name of a water-clock, was invented in the seventeenth century. The precise time seems to be uncertain; but had it been before the year 1643[5], Kircher, who mentions all the machines of this kind then known, would in all probability have taken notice of it. It consists of a cylinder divided into several small cells, and suspended by a thread fixed to its axis in a frame on which the hour distances, found by trial, are marked out. As the water flows from the one cell into the other, it changes very slowly the centre of gravity of the

[1] Lib. ix. c. 9.

[2] [Some mode of measuring time by the reflux of water, however rude it might be, was used at Athens before the time of Ctesibius, as we see by various passages in Demosthenes.]

[3] Auctor Dialog. de Caus. Cor. Eloq. 38.—The orators were confined to a certain time; and hence Cicero says, *latrare ad clepsydram.*

[4] Some account of the writers who have spoken of the water-clocks of the ancients may be found in Fabricii Bibliograph. Antiquaria, p. 1011. They were formerly used for astronomical observations. The authors who treat of them in this respect are mentioned in Riccioli Almagest. Novo, i. p. 117.

[5] In that year Kircher's Ars Umbræ et Lucis was published for the first time. In the edition of 1671, several kinds of water-clocks are described. p. 698.

cylinder, and puts it in motion[1]; much like the quicksilver puppets invented by the Chinese[2].

These machines must have been very scarce in France in 1691; for Graverol at that time gave a figure and description of the external parts of one, but promised to give the internal construction as soon as he should become acquainted with it[3]. This was the only one then in Nismes. He says, also, that they were invented a little before by an Italian Jesuit, who resided at Bologna, but were brought to perfection by Taliaisson, professor of law at Toulouse, and a young clergyman named De l'Isle.

Alexander says more than once that this machine was invented at Sens in Burgundy, in 1690, by Dom Charles Vailly, a Benedictine of the brotherhood of St. Maur, and that he brought it to perfection by the assistance of a pewterer there, named Regnard. This account is in some measure confirmed by Ozanam; for he says expressly, that the first water-clocks were brought from Burgundy to Paris in 1693, and he describes one which was made of tin at Sens. Dom Charles Vailly was born at Paris in 1646, and died in 1726; he was celebrated on account of his mathematical knowledge, though he is known by no works, as he burned all his manuscripts[4].

Alexander, however, who was of the same order, seems to have ascribed to his brother Benedictine an honour to which he was not entitled; for Dominic Martinelli, an Italian of Spoletto, published at Venice, in 1663, a treatise written expressly on these water-clocks, which Ozanam got translated

[1] A particular account of these water-clocks is to be found in Ozanam, Recréations Math. et Physiques [republished in Hutton's Mathematical Recreations, ii. 40]. Bion on Mathematical Instruments.

[2] Muschenbroek, Philos. Natur. i. p. 143.

[3] Journal des Sçavans, 1691.

[4] This monk may be considered as the restorer of the clepsydra, or clock which measures time by the fall of a certain quantity of water confined in a cylindric vessel. These clocks were in use among ancient nations. They are said to have been invented at the time when the Ptolemies reigned in Egypt. Dom Vailly, who applied himself particularly to practical mathematics, having remarked the faults of these clocks, bestowed much labour in order to bring them to perfection; and by a number of experiments, combinations, and calculations, he was at length able to carry them to that which they have attained at present. At the time of their arrival they were very much in vogue in France.—Hist. Littéraire de la de Congr. St. Maur, ordre de S. Bénoit. Bruxelles, 1770, 4to, p. 478.

into French by one of his friends, and caused to be printed with his additions[1]. This translator says that water-clocks were known in France twenty years earlier than Ozanam had imagined. It appears therefore that they were invented in Italy about the middle of the seventeenth century, and that Vailly, perhaps, may have first made them known in France[2].

It may perhaps afford some pleasure to those who are fond of the history of the arts, to know that Salmon, an ingenious pewterer at Chartres in France, has given very full and ample directions how to construct and use this machine[3]. He is of opinion that the invention is scarcely a century old; and that these water-clocks, which are now common, were first made for sale and brought into use among the people in the country, by a pewterer at Sens in Burgundy. What this artist affirms, that they can be constructed of no metal so easily, so accurately, and to last so long as of tin, is perfectly true. I have however in my possession one of brass, which is well constructed; but it suffers a little from acids. Among the newest improvements to this machine may be reckoned an alarum, which consists of a bell and small wheels, like those of a clock that strikes the hours, screwed to the top of the frame in which the cylinder is suspended. The axis of the cylinder, at the hour when one is desirous of being wakened, pushes down a small crank, which, by letting fall a weight, puts the alarum in motion. A dial-plate with a handle is also placed sometimes over the frame.

[A very ingenious application of the principle of the clepsydra, for the purpose of measuring accurately very small intervals of time, is due to the late Captain H. Kater. Mercury is allowed to flow from a small orifice in the bottom of a vessel, kept constantly filled to a certain height. At the moment of noting any event, the stream is interrupted and turned aside into a receiver, into which it continues to run till the moment of noting any other event, when the intercepting cause is suddenly removed. The stream then flows in its

[1] Ozanam, ii. p. 475.

[2] Alexander will not admit this to be the case. "It is possible," says he, "that two persons of penetrating genius may have discovered the same thing."

[3] Art du potier d'étain, par Salmon. Paris, 1788, fol. p. 131.

original course. The weight of mercury in the receiver, compared with the weight of that which passes through the orifice in a given time, observed by the clock, gives the interval between the events.]

TOURMALINE.

The ancients, though ignorant of electricity, were acquainted with the nature of amber, and knew that when rubbed it had the power of attracting light bodies. In like manner they might have been acquainted with the tourmaline, and might have known that it also, when heated, attracted light bodies, and again repelled them; for had they only bethought themselves, in order to search out the hidden properties of this stone (which on account of its colour and hardness is very remarkable), to put it into the fire, they would have then seen it sport with the ashes. Some learned men have thought they found traces of the properties of this stone, in what the ancients tell us respecting the *lyncurium*, *theamedes*, and *carbunculus*. The fruit of my researches respecting this subject I shall here lay before the reader. All that we find in the ancients to enable us to characterize the lyncurium is, that it was a very hard stone, which could with difficulty be cut; that seals were formed of it; that it was transparent, and of a fiery colour, almost like that of yellow amber; that it attracted light bodies, such as chaff, shavings of wood, leaves, feathers, and bits of thin iron and copper leaf, in the same manner as amber; that the ancients procured it from Æthiopia, but that in the time of Pliny no stone was known under that name[1].

This information proves, in my opinion, that the lyncurium cannot be the belemnites, as some old commentators and Woodward have affirmed; for the latter has not the celebrated hardness and transparency of the former, neither has it the property of attracting light bodies, nor is it fit for being cut

[1] Theophrast. De Lapidibus, edit. Heinsii, fol. p. 395, and Plin. lib. xxxvii. c. 3, and lib. viii. c. 38.

into seals. That opinion probably has arisen in the following manner:—the ancients supposed that the lyncurium was the crystallized urine of the animal which we call the lynx. As some belemnites contain bituminous particles which give them an affinity to the swine-stone, naturalists, when they have rubbed or heated yellow and somewhat transparent pieces of this fossil, have imagined that they smelt the fabulous origin of the lyncurium.

Less ridiculous is the opinion of some old and modern writers, that the lyncurium was a species of amber. Theophrastus, however, the ablest and most accurate mineralogist of the ancients, would certainly have remarked this and not have separated the lyncurium from amber. Besides, the latter has not the hardness of the former, nor can it be said that it is difficult to be cut; for at present it is often made into various toys with much ingenuity. The opinion of Pliny is here of little weight; for it is founded, as ours must be, on the information of Theophrastus.

Epiphanius, who considered the Bible as a system of mineralogy, but could not find the lyncurium in it, supposes that it may have been the hyacinth[1]. However ridiculous the cause of this conjecture may be, it must be allowed that it is not entirely destitute of probability; and I say with John de Laet, "The description of the lyncurium does not ill agree with the hyacinth of the moderns[2]." If we consider its attracting of small bodies in the same light as that power which our hyacinth has in common with all stones of the glassy species, I cannot see anything to controvert this opinion, and to induce us to believe the lyncurium and the tourmaline to be the same. The grounds which Watson produces for this supposition, are more in favour of the hyacinth than the tourmaline[3]. Had Theophrastus been acquainted with the latter, he would certainly have remarked that it did not acquire its attractive power till it was heated. At present, at least, no tourmaline is known to attract until it is heated; though it would not appear very wonderful if a stone like the magnet should retain its virtue for a long time.

The duke of Noya Caraffa believes the theamedes of the

[1] Epiphanius De XII Gemmis.
[2] J. de Laet De Gemmis. 1647, 8vo, p. 155.
[3] Phil. Trans. vol. li. l. p. 394.

ancients to have been the tourmaline[1]. Of that stone we are told, by Pliny, only that it possessed a power contrary to the power of the magnet; that is, that it did not attract but repel iron. But this only proves, that it had then been remarked that the magnet repelled the negative pole of a piece of magnetic iron. This account has been thus explained by Boot[2]. To induce us to consider the theamedes as the tourmaline, Pliny ought to have said that it attracted iron and then repelled it.

With much greater probability may we consider as the tourmaline a precious stone, classed by Pliny among the numerous varieties of the carbuncle[3]; for however perplexed and unintelligible his account of the carbuncles may be, and however much the readings in the different copies may vary, we still know that he describes a stone which was very hard; which was of a purple, that is a dark violet colour, and used for seals; and which, when heated by the beams of the sun, or by friction, attracted chaff and other light bodies. Had Pliny told us that it at first attracted and then repelled them, no doubt would remain; but he does not say so, nor do his transcribers Solinus and Isidorus[4].

A much later account of a stone that, when rubbed, is, like the magnet, endued with an attractive power is to be found in a passage of John Serapion, the Arabian, pointed out to me by Professor Bütner[5]. This stone indeed cannot with

[1] Recueil de Mem. sur la Tourmaline, par Æpinus. Petersb. 1762, 8vo, p. 122.

[2] Gemm. et Lapidum Historia. 1647, 8vo, p. 441, 450.

[3] Plin. lib. xxxvii. c. 7.

[4] India produces also the lychnites, the splendour of which is heightened when seen by the light of lamps; and on this account it has been so called by the Greeks. It is of two colours; either a bright purple, or a clear red, and if pure is thoroughly transparent. When heated by the rays of the sun, or by friction, it attracts chaff and shavings of paper. It obstinately resists the art of the engraver.—Solinus, c. lii. p. 59. Traj. 1689, fol.

[5] "Hager albuzedi is a red stone, but less so than the hyacinth, the redness of which is more agreeable to the eye, as there is no obscurity in it The mines where this stone is found are in the East. When taken from the mine it is opake; but when divested of its outer coat by a lapidary, its goodness is discovered, and it becomes transparent. When this stone has been strongly rubbed against the hair of the head it attracts chaff, as the magnet does iron."—Serapionis Lib. de simplicibus medicinis. Argent. 1531, fol. p. 263.

much probability be taken for the tourmaline, as all precious stones, when heated, have the same property; but it is worthy of remark, that, like the lyncurium of the ancients, it belongs to the hyacinths, the colour of which many of the real tourmalines have; and among those of the island of Ceylon there are, perhaps, some which ought to be classed among the hyacinths, rather than among the schorls.

The real tourmaline was first brought from Ceylon, and made known by the Dutch, about the end of the seventeenth or beginning of the eighteenth century. It is commonly believed that the first account of it ever published is that to be found in the Memoirs of the Academy of Sciences at Paris for the year 1717; but it appears that fuller and more accurate descriptions of the properties of that stone were given in German works ten years before. The earliest information that I know respecting it is in a book now almost and justly forgotten, entitled Curious Speculations during Sleepless Nights[1]. In a passage, where the author, speaking of hard and glassy bodies which attract light substances, affirms that this property is not magnetic, he says, "The ingenious Dr. Daumius, chief physician to the Polish and Saxon troops on the Rhine, told me, that in the year 1703 the Dutch first brought from Ceylon in the East Indies a precious stone called tourmaline, or turmale, and named also *trip*, which had the property, that it not only attracted the ashes from the warm or burning coals, as the magnet does iron, but also repelled them again, which was very amusing; for as soon as a small quantity of ashes leaped upon it, and appeared as if endeavouring to writhe themselves by force into the stone, they in a little sprang from it again, as if about to make a new effort; and on this account it was by the Dutch called the *ashes-drawer*. The colour of it was an orange-red heightened by a fire colour. When the turf coals were cold, it did not produce these effects, and it required no care like the magnet. I have considered whether it would not attract and repel the ashes of other burning coals as well as those of turf; and I have no doubt, that, if heated, it would attract other things besides ashes."

[1] Curiöse Speculationes bey Schlaf-losen Nächten, 8vo, Chemnitz, 1707. The author's name appears to be expressed by the initials I. G. S. This work consists of forty-eight dialogues, each twelve of which have a distinct title.

This whole passage has been inserted word for word, without variation or addition, and without telling the source from which taken, in a book perhaps equally forgotten, called Observationes curioso-physicæ, or Remarks and Observations on the great Wonders of the World, by Felix Maurer, physician[1]. This thick volume is entirely compiled from a number of works, the names of which are not mentioned.

In the Catalogue of the collection of natural curiosities belonging to Paul Hermann, which were sold at Leyden in June 1711, I find, among the precious stones, *Chrysolithus Turmale Zeylon.* Though no description is added, it cannot be doubted that our tourmaline is meant. From this however we learn that the name together with the stone came to us from Ceylon, as Watson has remarked. We learn further, that the stone was at first considered as a chrysolite, and perhaps it may be mentioned under this name in the old accounts of Ceylon. Hermann, whose service to botany is well known, was in that island from 1670 to 1677; and it might be presumed, from his spirit of inquiry, that, had he known this stone, he would somewhere or other in his works have taken notice of its properties: but I find no mention of it either in his Cynosura Materiæ Medicæ, or in Musæum Zeylonicum.

In the year 1719 the Academy of Sciences at Paris announced in their memoirs for 1717, that in the latter year M. Lemery had laid before them a stone found in a river in the island of Ceylon, which attracted and repelled light bodies[2]. It is there called a small magnet, though some difference between the two stones was admitted; but the German natu-

[1] Frankf. 1713, 8vo.

[2] I shall here lay before the reader the whole passage, taken from Histoire de l'Académie for 1717, p. 7:—"Here we have a small magnet. It is a stone found in a river of the island of Ceylon. It is of the size of a denier, flat, orbicular, about the tenth part of an inch in thickness, of a brown colour, smooth and shining, without smell and without taste, which attracts and afterwards repels small light bodies, such as ashes, filings of iron, and bits of paper. It was shown by M. Lemery. It is not common, and that which he had cost twenty-five livres (about twenty shillings sterling). When a needle has been touched with a loadstone, the south pole of the loadstone attracts the north pole of the needle, and repels its south pole: thus it attracts or repels different parts of the same body, according as they are presented to it, and it always attracts or repels the same. But the stone of Ceylon attracts, and then repels in the like manner, the same small body presented to it: in this it is very different from the loadstone. It would seem that it has a vortex. . . ."

ralist before-mentioned, denies that the tourmaline is endowed with magnetic virtue. It is however very remarkable, that though it is said, in the Memoirs of the Academy, that it has the power of attracting and repelling, no mention is made that it acquires that property, only after it has been heated, which is expressly remarked by the German. Those therefore who wish to ascribe to the ancients a knowledge of the tourmaline may say, If the editor of the Memoirs of the French Academy could forget this circumstance, is it not highly probable that Theophrastus might have forgot it in describing the lyncurium; Pliny, in describing the carbuncle; and Serapion, in describing his hyacinth?

After this period the tourmaline must have been very scarce in Europe; for when Muschenbroek made his well-known experiments with the loadstone, and spared no labour to carry them to the utmost extent, he was not acquainted with the nature of the tourmaline, which, according to the account given of it by the Academy at Paris, he considered as a magnet, as he himself says in the preface to his first dissertation, published in 1724.

About the year 1740 however some German naturalists made experiments with this stone, in order to discover the real cause of its attractive property. These may be seen, under the article *Trip*, in the well-known Dictionary of Natural History which is often printed with Hübner's preface; but I do not know to whom the honour belongs of having first investigated the properties of this stone. As the above dictionary is common, I shall give here only a very short extract from it:—"This stone was brought to Holland by some persons who had travelled in India, from the island of Ceylon, where it is found pretty frequently among the fine sand near Columbo, and sold to the German Jews. These caused it to be cut thinner, and the price of it soon rose to eight and ten Dutch florins. It has been since much dearer; but at present it is cheaper. It attracts not only ashes, but also metallic calces: it however attracts more easily and with greater force those which have been formed by means of sal-ammoniac, or the spirit of that salt. It acquires its attractive power only after it has been moderately heated; for when cold or heated to a greater degree it produces no effect, which the author

ascribes to its being united with martial sulphur. The chrysolites and other precious stones of the island do not possess the same property." As the author quotes the Laboratorium Zeylonicum, I consulted it, but found no information in it respecting the tourmaline. The first person who thought of explaining the property of the tourmaline by electricity was the great Linnæus, who in the preface to his Flora Zeylanica[1], where he enumerates the productions of the island, calls it the electrical stone; but at that time, as he himself afterwards told me, he had not seen it.

What Linnæus only conjectured, Æpinus proved at Berlin in 1757 by accurate observation and experiments, when endeavouring with Wilke to investigate the secret of negative and positive electricity. The history of their discoveries I shall here omit, as a better account of them than I could give has been published in the Transactions of the Swedish Academy by Wilke.

[The discovery by Huygens, in 1678, of the polarization of light by double refraction, laid the foundation of a much more important application of the tourmaline; for MM. Biot and Seebeck, in their subsequent experiments, discovered that certain yellowish tourmalines, that is, those which are yellowish by refracted light, possessed the remarkable property of absorbing or checking one of the rays of a beam of polarized light, and transmitting the others. This discovery led to the use of tourmalines in most experiments which were subsequently made with polarized light. For this purpose, the tourmaline, which generally crystallizes in the form of a long prism, is cut lengthwise, that is, parallel to the axis of the prism, into plates about the 30th of an inch thick.

The invention of Mr. Nichol of a method of destroying one of the rays of a polarized beam in a crystal of calcareous spar, has however in later times entirely replaced the use of the

[1] "I must not omit to mention that the rivers contain the electric stone, which is of the size of a halfpenny, flat, orbicular, shining, smooth, of a brown colour, one-tenth of an inch in thickness, without smell and without taste, and which attracts light bodies, such as ashes, filings of iron, shavings of paper, &c., and afterwards repels them. A wonderful and singular property, discovered and observed in this stone alone, when neither heated by motion nor by friction."

tourmaline in optical science, the colour of the tourmaline being a disadvantage which is entirely removed in the use of Nichol's prism[1].]

SPEAKING-TRUMPET

Instruments by which the voice could be so strengthened as to be heard at a much greater distance than would otherwise have been possible, were known in the earliest ages; for of all musical instruments, wind instruments were first invented, and their use in war to give the signal of battle, we find

[1 Light is called polarized, which, having been once reflected or refracted, is incapable of being again reflected or refracted in certain positions of the second medium. Ordinarily, light which has been reflected from a pane of glass or any other substance, may be a second time reflected from another surface, and will also freely pass through transparent bodies. But if a ray of light be reflected from a pane of glass at an angle of 57°, it is rendered totally incapable of reflexion from the surface of another pane in some positions, whilst it will be completely reflected by it in others. If a plate of tourmaline, cut in the manner described above, or a Nichol's prism be held between the eye and a candle, and turned slowly round in its own plane, no change will take place in the image of the candle; but if the plate or prism be fixed in a vertical position, on interposing another of the same kind between the former and the eye, parallel to the first, and turning it round slowly in its own plane, the image of the candle will be found to vanish and re-appear alternately at each quarter turn of the plate, varying through all degrees of brightness down to total or almost total evanescence, and then increasing again by the same degrees as it had before decreased. These changes depend upon the relative positions of the plates; when the longitudinal sections of the two plates are parallel, the brightness of the image is at its maximum; and when the axes of the sections cross at right angles, the image of the candle vanishes. Thus the light, in passing through the first plate of tourmaline, has acquired a property totally different from the ordinary light of the candle; the latter would penetrate the second plate equally well in all directions, whereas the altered light will only pass through it in particular positions, and is altogether incapable of penetrating it in others. The light is polarized by passing through the first plate or prism. Thus, one of the properties of polarized light is proved to be the incapability of passing through a plate of tourmaline perpendicular to it in certain positions, and its ready transmission in other positions at right angles to the former.]

mentioned in Job[1]. It had been remarked, even in Pliny's time, that the least touch of a beam of wood could be heard when the ear was applied to the other end[2]. It was known likewise that the larger trumpets emitted a louder and stronger sound. The Grecians had a wind instrument with the bellowing noise of which the people who were placed to guard the vineyards frightened away the wild animals[3]. All these wind instruments however were little in comparison with the monstrous trumpets of the ancient Chinese, a kind of speaking-trumpets, or instruments by which words could not only be heard at the greatest distance possible, but could be also understood[4]. This invention belongs to the 17th century, though some think that traces of it are to be found among the ancient Grecians.

Kircher, as far as I have been able to learn, was the first person who made known, from a very ancient manuscript of Aristotle, De Secretis ad Alexandrum Magnum, preserved in the Vatican, that Alexander had a prodigious large horn with which he could assemble his army at the distance of a hundred stadia, or eight Italian miles. It was, according to the manuscript, five cubits in diameter; and Kircher, who gives a figure of it, which he says he found in the manuscript, thinks that, on account of its size, it must have been suspended from a beam by a ring. This horn has by many been considered as the oldest speaking-trumpet[5], but in my opinion without reason. Aristotelis Secretum Secretorum ad Alexandrum Magnum I have never had an opportunity to see. It appears to have been printed only once, and is, like all the other works ascribed to that philosopher, extremely scarce; for they have all had the fate of being little regarded after it became the unanimous opinion of the learned that they were forged. These works, however, are old; some of them indeed very old: and, if some one would take the trouble to fix their antiquity, they might be used with advantage on many occasions. Mor-

[1] Goguet. i. p. 326. [2] Plin. lib. xvi. c. 38, p. 32.

[3] Septalii Comm. in Aristotelis Problem. Lugd. 1632, fol. p. 206. There is also a passage to the same purpose in Seneca, Epist. 108.

[4] See Anciennes Relations des Indes et de la Chine, de deux voyageurs Mahometans, qui y allèrent dans le neuvième siècle. Par Renaudot. Paris, 1718, 8vo, p. 25.

[5] Ars magna lucis et umbræ. Amst. 1671, fol. p. 102. Kircher repeats this account with some new circumstances in his Phonurgia, p. 132.

hof had in his possession the edition of that book published by Alexander Achillinus, a physician at Bologna, in 1516, which is a Latin translation from the Arabic[1]. If we compare what is said there and by Kircher, we may make the following conclusion :—

In the first place, it is certain that the book itself, as well as the whole account, is not the production of Aristotle, for in all the writers who relate the actions of Alexander we do not find the least mention of such a horn. Secondly, it is not expressly said in that work that Alexander spoke through this horn, but only that he assembled his soldiers by it, which in past times was done by the sound of a trumpet, and at present is done both by trumpets and drums. It appears also that the author of the book, perhaps an Arabian, intended to give the reader an idea of a horn that had an uncommonly strong and loud sound. Thirdly, Kircher's account and figure of the horn do not agree with that which Morhof found in the edition of Achillinus[2]. Lastly, none of these descriptions are such that an instrument to serve as a speaking-trumpet could be constructed from them.

Wolf and other mathematicians are of opinion that the most advantageous form of a speaking-trumpet would be found with more certainty by experience than by theory. It may then be asked, whether any one ever caused such an instrument to be made from these descriptions. Kircher, who attempted things much more improbable, says he never tried it. Duhamel however relates that a Frenchman tried it, and discovered the real instrument[3]; but this information is of little weight,

[1] Morhofii Diss. de vitro per vocis sonum rupto, in Dissertationibus Academicis. Hamburgi 1669, 4to, p. 381.

[2] Morhof quotes the following passage :—"With this brazen horn, constructed with wonderful art, Alexander the Great called together his army at the distance of sixty miles. On account of its inestimable workmanship and monstrous size, it was under the management of sixty men. Many kinds of sonorous metals were combined in the composition of it."

[3] "Among many things which the celebrated D'Alance caused to be made for this purpose, the trumpet ascribed to Alexander, and with which he called together his army, ought not to be omitted. As the figure of it was represented in an old manuscript in the Vatican library, and had been described by Bettini, that learned man was desirous of trying whether it could be proved by experience, and the attempt succeeded; for that kind of trumpet, if it does not excel, seems undoubtedly to equal the other instruments constructed for that end."

as it is much to be doubted that this Frenchman caused it to be made sufficiently exact according to the ancient description. I am as little acquainted with Bettini as Morhof; but I suspect that Duhamel meant Mar. Bettini, who, without making the smallest mention of Alexander's horn, proposes only a tube, the one end of which should be applied to the mouth of a person who speaks, and the other to the ear of one who is dull of hearing[1]. This was rather an ear-trumpet than a speaking-trumpet, and it is certain that the former was invented before the latter.

What we read in Porta, and what many think alludes to a speaking-trumpet, alludes evidently to an ear-trumpet only. That author infers, very justly, from the form of the ear, and particularly from that of the ears of those animals which are quick of hearing, that to hear at a distance one must apply to the ear a kind of wide funnel, as people to strengthen the sight use spectacles[2]. He asserts also, with equal truth, that one, through a long tube, can convey a whisper to the ear of another person at a very great distance[3]; an experiment which he himself made at the distance of two hundred paces. Schwenter, who wrote before the speaking-trumpet was known, proposes, from the hint of Porta, an ear-trumpet, one end of which should be applied to the ear[4].

Sir Samuel Morland, an Englishman, and the jesuit Kircher, have in later times contended respecting the invention of the speaking-trumpet. The former, in 1671, published a particular description of one, after he had made many experiments upon it the year preceding. This instrument, shaped like a wide-mouthed trumpet, he caused first to be constructed

[1] Bettini Apiaria univ. Philosophiæ Mathemat. Bonon. 1642, fol. p. 38.

[2] Magia Natural. lib. xx. c. 5.

[3] "To communicate anything to one's friends by means of a tube. This can be done with a tube made of earthenware, though one of lead is better, or of any other substance, but very close, that the voice may not be weakened; for whatever you speak at the one end, the words issue perfect and entire as from the mouth of the speaker, and are conveyed to the ears of the other, which, in my opinion, may be done for some miles. The voice, neither broken nor dispersed, is carried entire to the greatest distance. We tried it at the distance of two hundred paces, not having convenience for a greater, and the words were heard as clearly and distinctly as if they had come from the mouth of the speaker."—Lib. xvi. c. 12.

[4] Mathematische Erquickstunden, i. p. 243.

of glass, and afterwards of copper, with various alterations, and performed several experiments with it in presence of the king (Charles II.), prince Rupert, and other persons, who were astonished at its effects[1].

As an account of this discovery was soon spread all over Europe, Kircher asserted that he had constructed speaking-trumpets before Sir Samuel Morland, and supported his assertion by referring to his former writings, and by the testimony of other authors. I shall first take notice of the former. His Ars Magna Lucis et Umbræ was first printed in 1643. I at least conclude so, because, in the preface to his Phonurgia, printed in 1673, he says that work had been published thirty years before. The second edition is of 1671, in which I find only the already-quoted passage respecting Alexander's horn, and the figure of a tube, which, like that proposed by Bettini, should be applied to the ear of a person who hears, and to the mouth of the speaker. The Musurgia, printed in 1650, contains better grounds for supporting the assertion of Kircher. In the second part he describes how a funnel can be placed in a building in such a manner, that a person in an apartment where the narrow end is introduced can hear what is spoken without the building, or in another apartment, where the wide end may be. To this description a figure is added, and the author acknowledges he was led to that idea by the construction of a well-known building of Dionysius[2]. He does

[1] An Account of the Speaking-trumpet, as it hath been contrived and published by Sir Samuel Morland, knight and baronet, together with its use both at sea and land. London, 1671. An extract from it may be seen in the Phil. Trans., No. 78, p. 3056.

[2] Among the antiquities of Syracuse in Sicily, one beholds with wonder chambers and galleries which are hewn out in the solid rock, and particularly a grotto, from which arises a winding passage, that becomes upwards still narrower. Ancient tradition says that this was a prison, which the celebrated tyrant Dionysius caused to be built for state prisoners, that in an apartment of his palace, which stood over the narrow end of the passage, he might hear everything the prisoners said, or what plots they formed against him. This grotto therefore is called *Orechio di Dionysio*, or *la grotta della favella*; *auris Dionysii*, the ear of Dionysius. Many travellers and others formerly imagined that this passage was an ingenious imitation of that part of the human ear called the helix, which was first remarked by Alcmaon the Pythagorean. This is the account given by Kircher, who was there in the year 1638. See his Phonurgia (published 1673), p. 82, where there is a figure of it. In later times, however, this grotto has been examined with more skill and acuteness by people less

not however say expressly that he had ever tried the experiment; but in the last page of the preface to the Phonurgia, he pretends that so early as the year 1649 he had caused such a machine to be fixed up in the Jesuits' college. But, supposing this to be true, it can only be said that he then approached very near to the invention of the speaking-trumpet,

subject to prejudice, and since that period the supposed wonder has been lessened. The rock consists of limestone, at least I conclude so from what is said by Brydone, who found it everywhere full of cracks and fissures. The stones of which Syracuse was built were hewn from the rock; and hence have been formed these chambers or openings, like those found in the neighbourhood of other ancient and modern cities, such as Rome, Naples, and Maestricht. Many of these, in the course of time, have been employed as prisons, or used as burying-vaults. The above-mentioned passage, which has excited so much wonder, is not properly spiral, and is of such a figure that it may have been produced either by accident or through the whim of the workmen employed to hew out the stones. The double echo which Kircher assures us he heard in the grotto was not remarked by Schott, who was there in 1646, as he expressly says, in opposition to his brother jesuit, in his Magia Naturalis. In the accounts still remaining of Dionysius we find mention of an astonishing prison, which is well described by Cicero in his fifth oration against Verres: "You have all heard of," says he, "and most of you know the prison (lautumias) of Syracuse. It is an immense and magnificent work, executed by kings and tyrants; the whole is sunk to a wonderful depth in the rock, and has been entirely cut out by the labour of many hands. No place so secured against an escape; no place so enclosed on all sides; no place so safe for confining prisoners can be either planned out or constructed." But it cannot be proved, and according to D'Orville's opinion it is improbable, that this grotto was the work of that tyrant, who, as Plutarch tells us in his Life of Dion, employed very different means to learn the intention of dangerous persons. "The common people attacked the tyrant's friends, and seized those whom they called his emissaries (προσαγώγιδας), worthless men, detested by the gods. These went about the city, mixed with the citizens, and, prying into everything, gave an account to the tyrant of what they thought and what expressions they made use of." It was merely for its strength, and the labour employed in building it, and not on account of its ingenious construction, that the ancients admired the prison of the tyrant. At present the upper end of the winding passage is closed up; and it is so narrow, that some years ago the captain of an English vessel found great difficulty to clamber up it. It cannot, however, be denied that this grotto may have been used for the service ascribed to it; and I can readily believe that it may have led Kircher to the invention of the ear-trumpet. See the Travels of P. de la Valle, Ray, and Brydone; Delle antiche Siracuse, da G. Bonanni, &c., 2 vols. fol. Palermo 1717. Dan. Bartolo del suono e de' tremori harmonici, Bonon. 1680, who examined this grotto as a naturalist. D'Orville, Sicula. Amst. 1764, pp. 182, 194.

by an instrument, which, in reality, however, was calculated to strengthen the hearing, and not the voice; and therefore only the half is true of what he advanced in his preface in 1673, that twenty years before he had described in his Musurgia the trumpet invented in England.

In the Phonurgia, however, written after Morland's publication was everywhere known, Kircher certainly treats of the speaking-trumpet, and says that, from the similarity of the progress of sound to that of the rays of light, he was led to the idea of conveying the former, in the same manner as the latter, to a great distance, by means of an instrument. For this purpose, about twenty-four years before, he had caused to be constructed, in the Jesuits' college at Rome, an ear-trumpet, through which the porter could communicate anything he had to say to him when he was in his apartment in the upper story. This apparatus attracted the notice of many strangers, who were astonished at its effect. He here represents it as a proper speaking-trumpet, and adds, that it excited much surprise, on account of the uncommon strength which it gave to the voice. For this reason he was very desirous of trying to what distance words could be distinctly conveyed by such a tube; and an opportunity occurred of doing this the same year that he wrote his Phonurgia. From a convent, situated on the top of a mountain, he assembled twelve hundred persons to divine service, at the distance of from two to five Italian miles, and read the Litany through it. Soon after, the emperor caused a tube to be made according to Kircher's description, by which, without elevating the voice, he could be understood from Ebersdorf to Neugebeu. But though Kircher came so near to the invention of the speaking-trumpet, it does not appear certain by his works that he attempted or constructed it before Sir Samuel Morland. I shall now examine the evidences he adduces in his favour.

The most important of these is Schott, because he published his Magia Naturalis[1] in 1657, before the invention of

[1] This machine was invented by Kircher, in imitation of the ear of Dionysius; nor is it a vain and empty speculation, for the machine produces an infallible effect. Kircher caused to be made at Rome, of tin plate, a very large and straight tube, like a funnel, and placed it in an apartment next to his chamber, in such a manner that the large end projected into the garden of the college, and the less entered his chamber.

Sir Samuel Morland. All that is to be found in this work, however, relates alone to the ear-trumpet, a figure of which is added from the Musurgia; but we learn, with certainty, that Kircher then had the before-mentioned funnel or tube in his apartment. It is also not improbable that he had tried to answer the porter from his apartment, and that he had thereby remarked that the voice was strengthened; for it is not proved by Schott that he at that time was acquainted with and had in his possession a portable speaking-trumpet.

Another author by whom Kircher endeavours to support his claim is Harsdorfer; who, however, speaks only of tubes to be closely applied to the mouth and to the ear, and who refers to the Musurgia, without mentioning the real speaking-trumpet, though the second part of his Mathematical Recreations was first printed in 1677, and the third in 1692. Besides these testimonies, Kircher quotes also Eschinard concerning sound[1]. With that work I am not acquainted; but as the information it contains is taken from the Musurgia, it is of as little importance as that of Derham[2], who refuses the invention to his countryman, and gives it to Kircher. When I unite all the evidence in favour of Kircher, it appears to be certain that he made known and employed the ear-trumpet earlier than the portable speaking-trumpet; that he, however, approached very near to the invention of the latter, but did not cause one to be constructed before Sir Samuel Morland, to whom the honour belongs of having first brought it to that state as to be of real use. Such, at least, is the manner in which this dispute is decided by the Jesuit De Lanis[3].

When Morland's invention was made known in France, it

When the porter of the college had occasion to call him to the gate, that he might not be obliged always to go up stairs, or to bawl out, he went to the broad end of the funnel, and communicated what he wished to Kircher. —Schotti Magia Universalis, ii. p. 156.

[1] Eschinardi Discursus de Sono Pneumatico, p. 10.

[2] Physico-theology.

[3] Our Kircher, in his Phonurgia, justly claims that invention, as it was several years ago exhibited by him in the Jesuits' college at Rome, and an account of it printed. That this is true I myself was an eye-witness; though I must acknowledge that no one before the above-mentioned Englishman ever applied this speaking instrument, at least in so perfect a manner, to that use for which it was afterwards employed.—Magisterium Naturæ et Artis. Brixiæ, 1684–92 .fol. ii. p. 436.

was pretended that Salar, an Augustine monk, had seven or eight years before caused such tubes or trumpets to be made, in order to strengthen the voice of a weak bass-singer; but he himself acknowledges that he never had an idea of speaking with them at a distance [1].

This instrument was soon made for sale at Nuremberg in Germany, particularly by that well-known artist Grundler, mentioned by Becher, who imagined that two persons, by means of a speaking-trumpet and an ear-trumpet, could converse together at a great distance, without any one in the neighbourhood, or in the intermediate space, hearing what they said.

Of those who employed their ingenuity in improving this instrument I shall mention the following. Cassegrain, known on account of his optical instruments, published some hints for that purpose in 1672 [2]; as did Sturm [3], Conyers [4], Hase and others afterwards. The last who investigated the theory of the speaking-trumpet was Lambert [5]; according to whose ideas the figure of a shortened cone, if not the best, is at least as good as any other that might be employed.

[It would appear, however, from the experiments of Hassenfratz (Journ. de Phys., t. xxvi.) that neither the shape of the instrument nor the material of which it is composed is of much consequence. He ascertained the power of the trumpet by fixing a small watch in the mouth-piece, and observing the distance at which the beats ceased to be audible, and thus found that the effects were precisely the same with a trumpet of tinned iron, whether used in its naked form, or tightly bound round with linen to prevent vibration, or when lined with woollen cloth whereby reflexion was entirely prevented; he also found that the range of a cylindrical trumpet was as great as that of a conical one.

Leslie supposes the effect of the trumpet to be owing to the more condensed and vigorous impulsion given to the air from its lateral flow being checked. He observes, "that the tube, by its length and narrowness, detains the efflux of air, and

[1] Journal des Scavans, tome iii.
[2] Ibid. p. 131.
[3] J. A. Sturm, Collegium Experimentale, ii. p. 146.
[4] Philosophical Transactions.
[5] Mémoires de l'Acad. des Sciences à Berlin, 1763, p. 97.

has the same effect as if it diminished the volubility of that fluid, or increased its density. The organs of articulation strike with concentrated force, and the pulses, so vigorously thus excited, are, from the reflected form of the aperture, finally enabled to escape and to spread themselves along the atmosphere[1]."]

ANANAS.—PINE-APPLE.

To discover the excellence of the ananas required no great skill; it recommended itself so much by its taste, smell, and colour, as to attract the notice of the first Europeans who visited Brazil; and we find it praised in the earliest writers on America, who give an account of it, as well as of tobacco, maize, and other productions of the new world.

Gonçalo Hernandez de Oviedo is, as far as I know, the first person who described and delineated the ananas. This author was born at Madrid in 1478, went to America in 1513, and in 1535 was governor of St. Domingo. In the last-mentioned year his General History of America was printed at Seville. At that time three kinds were known, which in America were called *yayama*, *boniama*, and *yayagua*, but by the Spaniards *pinas*. Attempts had then been made to send the fruit to Spain by pulling it before it was ripe; but it had always become spoilt in the course of the voyage. Oviedo had tried also to send slips or young shoots to Europe, but these also died by the way. He however entertained hopes that means would be found to rear the ananas in Spain, in which maize or Turkish corn had been brought to maturity, provided it could be transported with sufficient expedition[2].

[1] Experimental Inquiry into the Nature, &c. of Heat, p. 225.

[2] La Historia General de las Indias. Sevilla, 1535, fol. lib. xvii. c. 13. [An earlier notice of the pine-apple had been given by Andræa Navagero in his letter to Rannusio, dated from Seville, May 12, 1526. He says, "I have also seen a most beautiful fruit, the name of which I do not recollect: I have eaten of it, for it was imported fresh. It has the taste of the quince, together with that of the peach, with some resemblance also of the melon: it is fragrant, and is truly of most delicious flavour."—Lettere di xiii Huomini Illustri.]

Geronimo Benzono, a Milanese, who resided in Mexico from 1541 to 1555, caused, on his return, his History of the New World to be printed, for the first time, at Venice in 1568. In this work he highly extols the pinas, and says he believes that no fruit on the earth can be more pleasant; sick persons, who loathed all other food, might relish it.

After him, Andrew Thevet, a French monk, who was in Brazil from 1555 to 1556, described and delineated this plant under the name of *nanas*. The art of preserving the fruit with sugar was at that time known [1].

John de Lery, who went to Brazil in 1557 as chaplain to a Huguenot colony, in the account of his voyage first used the word *ananas*, which probably took its rise from the *nanas* of Thevet [2].

In the middle of the sixteenth century Franc. Hernandes, a naturalist, undertook an expensive, and almost useless voyage to Mexico. It cost Philip II. king of Spain 60,000 ducats, and the observations he collected, for which, at the time Acosta was in America, 1200 figures were ready, were never completely printed; and in what are printed one can scarcely distinguish those of the original author from the additions of strangers. He has, however, given a somewhat better figure of the ananas, which he calls *matzatli* or *pinea Indica* [3].

Christopher Acosto, in his Treatise of the drugs and medicines of the East Indies, printed in 1578, calls this plant the ananas. He says it was brought from Santa Cruz to the West Indies, and that it was afterwards transplanted to the East Indies and China, where it was at that time common. The latter part of this account is confirmed by J. Hugo de Linschotten, who was in the East Indies from 1594 to 1595 [4].

Attempts were very early made, as Oviedo assures us, to

[1] Les Singularitez de la France Antarctique, autrement nommée Amerique. Par André Thevet. Anvers, 1558.

[2] Voyage faict en la terre du Brésil, autrement dite Amerique. Par J. de Lery. Genève, 1580, 8vo, p. 188.

[3] Rerum Med. novæ Hispaniæ Thesaurus. Rome, 1651. fol.

[4] The accounts given by Acosta and Linschotten may be seen in Bauhini Histor. Plantarum, iii. p. 95. Kircher in his China Illustrata says, "That fruit which the Americans and people of the East Indies, among whom it is common, call the ananas, and which grows also in great abundance in the provinces of Quantung, Chiamsi, and Fokien, is supposed to have been brought from Peru to China."

transplant the ananas into Europe; and as in the beginning of the seventeenth century it was reckoned among the marks of royal magnificence to have orange-trees in expensive hot-houses, it was hoped that this fruit could be brought to maturity also in the artificial climate of these buildings. These attempts, however, were everywhere unsuccessful; no fruit was produced, or it did not ripen, because, perhaps, this favourite exotic was treated with too much care. It is not certainly known who in Europe first had the pleasure of seeing ananas ripen in his garden; but it appears that several enjoyed that satisfaction at the same time in the beginning of the last century.

The German gardens in which the ananas was first brought to maturity appear to have been the following. First, that of Baron de Munchausen, at Schwobber, not far from Hameln, which on account of the botanical knowledge of its proprietor, and the abundance of plants it contains, is well-known to all those who are fond of botany. In the beginning of the last century it belonged to Otto de Munchausen, who, perhaps, was the first person who erected large buildings for the express purpose of raising that fruit, and who had the noble satisfaction of making known their advantageous construction. With this view he sent a description and plan of his ananas-houses to J. Christopher Volkamer, a merchant of Nuremberg, who inserted them in his continuation of the Nuremberg Hesperides, printed there in 1714, and by these means rendered the attainment of this fruit common. This Baron de Munchausen is the same who has been celebrated by Leibnitz: "All the travellers in the world," says that great man, "could not have given us, by their relations, what we are indebted for to a gentleman of this country, who cultivates with success the ananas, three leagues from Hanover, almost on the banks of the Weser, and who has found out the method of multiplying them, so that we may, perhaps, have them one day as plentiful, of our own growth, as the Portuguese oranges, though there will, in all appearance, be some deficiency in the taste[1]." As the Baron Munchausen's garden at Schwobber was in the absence of the proprietor, as Volkamer says, under the care

[1] See Leibnitz, Nouveaux Essais sur l'Entendement Humain (Œuv. Phil.), p. 256, Amst. 1765, 4to.

of J. F. Berner, canon of the cathedral of St. Boniface, he probably may have had some share in rendering this service to horticulture.

This fruit was produced also in the garden of Dr. Volkamer at Nuremberg, and in that of Dr. F. Kaltschmid at Breslau, almost about the same time. The latter was so fortunate as to bring it to maturity so early as 1702, and he sent some of it then for the first time to the imperial court. At Frankfort on the Maine it was first produced in 1702[1]; and at Cassel in 1715, by the skill of Wurstorfs, the head gardener.

Holland procured the first ripe ananas from the garden of De la Court, whom Miller calls Le Cour, in the neighbourhood of Leyden. As a great many plants were sold out of this garden to foreigners, and as the English had theirs first from it, many are of opinion that Europe is indebted for the first possession of this fruit to De la Court, and his gardener William de Vinck[2].

I shall here take occasion to mention a circumstance which belongs also to the history of gardening. Before the cultivation of the ananas was introduced, the Dutch had begun to employ tanner's bark for making forcing-beds. From them the English learned this improvement, and the first forcing-beds in England were made at Blackheath in Kent, in 1688, and employed for rearing orange-trees; but about the year 1719, much later than in Holland, ananas became more common, and forcing-beds were in much greater use[3].

This plant, the history of which I have given, received from Plumier[4], who first distinguished its characters, the name of *Bromelia*[5], after the Swedish naturalist, whose remembrance deserves to be here revived. Olof Bromelius was born in 1639, at Oerebro, where his father carried on trade. He studied

[1] Lersner, Chronik, ii. p. 824.

[2] Miller's Gardener's Dictionary, i. p. 132. Lueder, Wartung der Küchengewächse. Lubeck, 1780, 8vo, p. 248.

[3] Miller, ii. p. 824. Lueder, p. 39. That putrid bark forms an excellent manure, had been before remarked by Lauremberg, in Horticultura, p. 52.

[4] Nova Plantarum Americanarum Genera. Parisiis 1708, 4to, p. 46.

[5] [The plants producing the pine-apple have been separated by Prof. Lindley under the name *Ananassa* from the allied genus *Bromelia*, after which the Natural Order BROMELIACEÆ takes its name.]

physic at Upsal, disputed there in 1667 de Pleuritide, and in 1668 taught botany at Stockholm. In 1672 he was physician to the embassy to England, and afterwards to that to Holland, where, in 1673, he received the degree of doctor at Leyden, and wrote a dissertation De Lumbricis. On his return to his native country, in 1674, he became a member of the college of physicians at Stockholm; but in 1691 he was city physician to Gottenburg, and provincial physician in Elsburg and Bahuslan, in which situation he died in the year 1705. His botanical writings are Lupologia, and Chloris Gothica[1]. His son, Magnus von Bromel, is the author of Lithographia Suecana.

[Within the few last years, large numbers of pine-apples have been imported into this country from the Bahamas, where they are grown as turnips are grown in our fields. They are sold comparatively speaking at an extremely moderate price, and those that have become somewhat spoilt by the long carriage are hawked about the streets of London at a halfpenny or penny per slice. They are however vastly inferior in flavour to the pines cultivated in our hot-houses, but it is to be expected, from the considerable demand, that greater care will be bestowed on their cultivation, and the markets of London be regularly supplied with a much improved kind.]

SYMPATHETIC INK.

If we give this name to any fluid, which when written with, will remain invisible till after a certain operation, such liquids were known in very early periods. Among the methods, with which Ovid teaches young women to deceive their guardians, when they write to their lovers[2], he mentions that of writing with new milk, and of making the writing legible by coal-dust or soot. Ausonius proposes the same means to Paulinus[3]; but his

[1] Halleri Bibl. Botan. i. p. 640. [2] De Arte Amandi, lib. iii. v. 629.
[3] Ausonii Epist. xxiii. v. 21. The poet afterwards teaches other methods of secret writing, and Gellius, lib. xvii. cap. 9, mentions the like.

commentators seem not to have fully understood his meaning; for *favilla* is not to be explained by *favilla non modice calida*, as Vinetus has explained it, but by *fuligo*. That word is often employed by the poets in the same sense. As a proof of it, Columella, speaking of the method, not altogether ineffectual, and even still used, of preserving plants from insects by soot, calls it *nigra favilla*; and afterwards, when mentioning the same method, free from poetical fetters, he says *fuliginem quæ supra focos tectis inhæret*[1]. It may be easily perceived, that instead of milk any other colourless and glutinous juice might be employed, as it would equally hold fast the black powder strewed over it. Pliny, therefore, recommends the milky sap of certain plants for the like purpose[2].

There are several metallic solutions perfectly colourless, or, at least, without any strong tint, which being used for writing, the letters will not appear until the paper be washed over with another colourless solution, or exposed to the vapour of it; but among all these there is none which excites more astonishment, than that which consists of a solution of lead in acetic acid, and which by sulphuretted hydrogen gas becomes black, even at a considerable distance. This ink, which may be employed by conjurers, proves the subtlety of this gas, and the porosity of bodies; as the change or colouring takes place, even when the writing is placed on the other side of a thin wall.

This effect presented itself perhaps accidentally to some chemist; but the discovery is not of great antiquity. Wecker, who compiled his book De Secretis from Porta, Cardan, and several old writers, and printed it for the first time in 1582, and gave a third edition in 1592, must have been unacquainted with it; else he certainly would not have omitted it in the fourteenth book, where he mentions all the methods of secret writing. Neither would it have been unnoticed by Caneparius, whose book De Atramentis was printed at Venice, for the first time, in 1619.

The first person who, as far as I have been able to learn, gave a receipt for preparing this ink, was Peter Borel, in Historiarum et Observationum Medico-physic. Centuriæ quatuor. In this work, which was printed for the first time in 1653, and a second time in 1657, at Paris, and of which there were

[1] Colum. De Re Rust. x. 354. and xi. 3, 60.
[2] Plin. lib. xxvi. cap. 8. p. 490.

several editions afterwards, the author calls it a magnetic water, which acts at a distance[1]. After the occult qualities of the schoolmen were exploded, it was customary to ascribe phænomena, the causes of which were unknown, and particularly those the causes of which seemed to operate without any visible agency, to magnetic effluvia; as the tourmaline was at first considered to be a kind of magnet. Others concealed their ignorance under what they called sympathy, and in latter times attraction and electricity have been employed for the like purpose. Borel, who made it his business to collect new observations that were kept secret, learned the method of preparing this magnetic water from an ingenious apothecary of Montpelier, and in return taught him some other secrets. Otto Tachen, a German chemist[2], afterwards thought of the same experiment, which he explains much better, without the assistance of magnetism or sympathy. The receipt for making these liquids, under the name of sympathetic ink, I find first given by Le Mort[3], and that name has been still retained[4].

[1] The sixth observation of the second century is as follows: *Magnetic waters which act at a distance.* An astonishing effect, indeed, is produced by the contest of the following waters, which are thus made. Let quicklime be quenched in common water, and while quenching, let some orpiment be added to it (this however ought to be done by placing warm ashes under it for a whole day), and let the liquor be filtered, and preserved in a glass bottle well corked. Then boil litharge of gold well pounded, for half an hour with vinegar in a brass vessel, and filter the whole through paper, and preserve it also in a bottle closely corked. If you write any thing with this last water with a clean pen, the writing will be invisible when dry; but if it be washed over with the first water it will become instantly black. In this, however, there is nothing astonishing; but this is wonderful, that though sheets of paper without number, and even a board be placed between the invisible writing and the second liquid, it will have the same effect, and turn the writing black, penetrating the wood and paper without leaving any traces of its action, which is certainly surprising; but a fetid smell, occasioned by the mutual action of the liquids, deters many from making the experiment. I am, however, of opinion, that I could improve this secret by a more refined chemical preparation, so that it should perform its effect through a wall. This secret I received, in exchange for others, from J. Brosson, a learned and ingenious apothecary of Montpelier.

[2] Tachenii Hippocraticæ Medicinæ Clavis, p. 236. 1669.

[3] Collectanea Chymica Leydensia, edidit Morley. Lugd. Bat. 1684, 4to, p. 97.

[4] For an account of various kinds of secret writing see Halle, Magie oder Zauberkräfte der Natur. Berlin, 1783, 8vo, v. i. p. 138.

Another remarkable kind of sympathetic ink is that prepared from cobalt, the writing of which disappears in the cold, but appears again of a beautiful green colour, as often as one chooses, after being exposed to a moderate degree of heat.

The invention of this ink is generally ascribed to a Frenchman named Hellot. He was, indeed, the first person who, after trying experiments with it, made it publicly known, but he was not the inventor; and he himself acknowledges that a German artist of Stolberg first showed him a reddish salt, which, when exposed to heat, became blue, and which he assured him was made out of Schneeberg cobalt, with aqua regia[1]. This account induced Hellot to prepare salts and ink from various minerals impregnated with cobalt; but A. Gesner proved, long after, that this ink is produced by cobalt only, and not by marcasite[2].

When Hellot's experiments were made known in Germany, it was affirmed that Professor H. F. Teichmeyer, at Jena, had prepared the same ink six years before, and shown it to his scholars, in the course of his lectures, under the name of sympathetic ink[3]. It appears, however, that it was invented, even before Teichmeyer, in the beginning of the last century by a German lady. This is confirmed by Pot, who says that the authoress of a book printed in 1705, which he quotes under the unintelligible title of D. J. W. in clave, had given a proper receipt for preparing the above-mentioned red salt, and the ink produced by it[4]. If it be true that Theophrastus Paracelsus, by means of this invention, could represent a garden in winter, it must be undoubtedly older[5].

[1] Hist. et Mém. de l'Acad. des Sciences à Paris, 1737, pp. 101 and 228.

[2] Historia Cadmiæ fossilis, sive Cobalti. Berl. 1744.

[3] This account, together with Teichmeyer's receipt for preparing it, may be found in Commercium Litterarium Norimbergense, 1737, p. 91.

[4] "Copiosius minera bismuthi tam ab aqua forti quam ab aqua regia dissolvitur, restante pulvere albo corroso; solutio in aqua forti roseum colorem sistit, quæ si sali in aqua soluto, secundum præscriptum D. J. W. in clave, affundatur, abstrahatur, ex residuo extrahitur sal roseum, quod pulverisari et cum spiritu vini extrahi potest: adeoque hæc autrix jam anno 1705 publice totum processum et fundamentum sic dicti atramenti sympathetici, quod a calore viridescit, evulgavit."—Pot, Observ. Chym. collectio prima. Berolini, 1739, p. 163.

[5] So thinks Gesner in Selecta Physico-œconomica, or Sammlung von allerhand zur Naturgeschichte gehörigen Begebenheiten. Stutgard, vii. p. 22.

[In consequence of the progress of modern chemistry and the discovery of a vast number of new chemical compounds, sympathetic inks may be made in an almost endless number and variety. The principal may be classed in the following manner:—1, *such as when dried upon paper being invisible, on moistening with another liquid become again evident*: of this kind there are a vast number; among which we may mention a solution of a soluble salt of lead, or bismuth, for writing, and a solution of sulphuretted hydrogen for washing over; the writing then appears black; or green vitriol for writing and prussiate of potash for washing over, when the writing becomes blue[1]; 2, *such as are rendered evident by being sifted over with some powder*, as the milk with soot described above; 3, *those which become visible by heat*, such as characters in dilute sulphuric acid, lemon-juice, solutions of the nitrate and chloride of cobalt, and of chloride of copper; the two former become black or brown, the latter are rendered green, the colouring disappearing subsequently when allowed to cool in a moist place. Amusing pictures are sometimes made with these sympathetic inks, particularly those composed of cobalt; for if a landscape be drawn to represent winter, the vegetation being covered with a solution of cobalt, on holding the paper to the fire, all those portions covered with the solution appear of a bright green, and thus completely change the character of the scene.]

[1] [

Inks formed of solutions of the following salts,	*and washed with solutions of*	*become*
Muriate of antimony,	tincture of galls,	yellow.
Green vitriol,	tincture of galls,	black.
Nitrate of cobalt,	oxalic acid,	blue.
Subacetate of lead,	hydriodic acid,	yellow.
Arseniate of potash,	nitrate of copper,	green.
Nitrate of copper,	prussiate of potash,	brown.
Solution of gold,	muriate of tin,	purple.
Perchloride of mercury,	hydrochlorate of tin,	black.]

DIVING-BELL.

The first divers learned their art by early and adventurous experience, in trying to continue under water as long as possible without breathing; and, indeed, it must be allowed that some of them carried it to very great perfection. This art, however, excites little surprise; for, like running, throwing, and other bodily dexterities, it requires only practice; but it is certain that those nations called by us uncultivated and savage excel in it the Europeans[1], who, through refinement and luxury, have become more delicate, and less fit for such laborious exercises.

In remote ages, divers were kept in ships to assist in raising anchors[2], and goods thrown overboard in times of danger[3]; and, by the laws of the Rhodians, they were allowed a share of the wreck, proportioned to the depth to which they had gone in search of it[4]. In war, they were often employed to destroy the works and ships of the enemy. When Alexander was besieging Tyre, divers swam off from the city, under water, to a great distance, and with long hooks tore to pieces the mole with which the besiegers were endeavouring to block up the harbour[5]. The pearls of the Greek and Roman ladies were fished up by divers at the great hazard of their lives;

[1] Instances of the dexterity of the savages in diving and swimming may be seen in J. Kraft, Sitten der Wilden, Kopenhagen, 1766, 8vo, p. 39. To which may be added the account given by Maffæus of the Brasilians: "They are," says he, "wonderfully skilled in the art of diving, and can remain sometimes for hours under water, with their eyes open, in order to search for any thing at the bottom."—Hist. Indic. lib. ii.

[2] Lucanus, iii. 697.

[3] Livius, xliv. c. 10. Manilii Astronom. v. 449.

[4] A Latin translation of these laws may be found in Marquard de Jure Mercatorum, p. 338. "If gold or silver, or any other article be brought up from the depth of eight cubits, the person who saves it shall receive one-third. If from fifteen cubits, the person who saves it shall, on account of the danger of the depth, receive one-half. If goods are cast up by the waves towards the shore, and found sunk at the depth of one cubit, the person who carries them out safe shall receive a tenth part." See also Scheffer De Militia Navali, Upsaliæ, 1654, 4to, p. 110.

[5] Q. Curtius, iv. c. 3. The same account is given by Arrian, De Expedit. Alexandri, lib. ii. p. 138. We are told by Thucydides, in his seventh book, that the Syracusans did the same thing.

and by the like means are procured at present those which are purchased as ornaments by our fair.

I do not know whether observations have ever been collected respecting the time that divers can continue under water. Anatomists once believed that persons in whom the oval opening of the heart (*foramen ovale*) was not closed up, could live longer than others without breathing, and could therefore be expert divers. Haller[1], however, and others, have controverted this opinion; as people who had that opening have been soon suffocated, and as animals which have it not can live a long time under water: besides, when that opening is perceptible in grown persons, it is so small as not to be sufficient for that purpose, especially as the *ductus arteriosus* is scarcely ever found open.

The divers of Astracan, employed in the fishery there, can remain only seven minutes under water[2]. The divers in Holland seem to have been more expert. An observer, during the time they were under water, was obliged to breathe at least ten times[3]. Those who collect pearl-shells in the East Indies can remain under water a quarter of an hour, though some are of opinion that it is possible to continue longer; and Mersenne mentions a diver, named John Barrinus, who could dive under water for six hours[4]. How far this may be true I shall leave others to judge.

[The various statements regarding the length of time during which divers can remain under water, unaided by apparatus for renewing the supply of atmospheric air, are not borne out by the experience of those who have carefully observed and noted these phænomena. The average time which human

[1] Boerhaave, Prælectiones Academicæ, edit. Halleri, Göttingæ, 1774. 8vo, v. ii. p. 472–474. Halleri Elementa Physiologiæ, iii. p. 252, and viii. 2, p. 14.

[2] "The divers of Astracan stepped from the warm bath into the water, in which they could not continue above seven minutes, and were brought back from the water, cold and benumbed, to the warm bath, from which they were obliged to return to the water again. This change from heat to cold they repeat five times a day, until at length the blood flows from their nose and ears, and they are carried back quite senseless."—Gmelin's Reise durch Russland, ii. p. 199.

[3] Acta Philosophica Societatis in Anglia, auctore Oldenburgio. Lipsiæ, 1675, 4to, p. 724.

[4] Scheeps-bouw beschreven door Nic. Witsen. Amsterdam, 1671, fol. p. 288.

beings can remain in the water under these conditions, is one and a half or two minutes[1]; extraordinary cases are attested where five and even six minutes have elapsed, but these are exceedingly rare instances and far beyond the average; no instance of a longer time than this is recorded on credible authority. Some interesting remarks on this point were made not long since by a member of the Asiatic Society to Dr. Faraday. The lungs in their natural state are charged with a large quantity of impure air; this being a portion of the carbonic acid gas which is formed during respiration, but which, after each expiration, remains lodged in the involved passages of the pulmonary tubes. By breathing hard for a short time, as a person does after violent exercise, this impure air is expelled, and its place is supplied by pure atmospheric air, by which a person will be enabled to hold his breath much longer than without such precaution. Dr. Faraday states, that although he could only hold his breath, after breathing in the ordinary way, for about three-fourths of a minute, and that with great difficulty, he felt no inconvenience, after making eight or ten forced respirations to clear the lungs, until the mouth and nostrils had been closed more than a minute and a half; and that he continued to hold breath to the end of the second minute. A knowledge of this fact may enable a diver to remain under water at least twice as long as he otherwise could do. It is suggested that possibly the exertion of swimming may have the effect of occasioning the lungs to be cleared, so that persons accustomed to diving may unconsciously avail themselves of this preparatory measure.]

It is certain, however, that men began very early to contrive means for supplying divers with air under the water, and of thereby enabling them to remain under it much longer. For this purpose the diving-bell, *campana urinatoria*, was invented. Those who had no idea of this machine, might have easily been led to it by the following experiment. If a drinking-glass inverted be immersed in water, in such a manner that the surface of the water may rise equally around the edge of the glass, it will be found that the glass does not become filled with water, even when pressed down to the greatest depth; for where there is air no other body can enter, and

[1] [See the account of the Ceylon pearl fishery in Percival's Ceylon.]

by the above precaution the air cannot be expelled by the water. In like manner, if a bell of metal be constructed under which the diver can stand on a stool suspended from it so that the edge of the bell may reach to about his knee, the upper part of his body will be secured from water, and he can, even at the bottom of the sea, breathe the air enclosed in the bell.

The invention of this bell is generally assigned to the sixteenth century, and I am of opinion that it was little known before that period. We read, however, that even in the time of Aristotle divers used a kind of kettle to enable them to continue longer under water; but the manner in which it was employed is not clearly described.

The oldest information we have respecting the use of the diving-bell in Europe is that of John Taisnier, quoted by Schott[1]. The former, who was born at Hainault in 1509, had a place at court under Charles V., whom he attended on his voyage to Africa. He relates in what manner he saw at Toledo, in the presence of the emperor and several thousand spectators, two Greeks let themselves down under water, in a large inverted kettle, with a burning light, and rise up again without being wet. It appears that this art was then new to the emperor and the Spaniards, and that the Greeks were

[1] "Were the ignorant vulgar told that one could descend to the bottom of the Rhine, in the midst of the water, without wetting one's clothes, or any part of one's body, and even carry a lighted candle to the bottom of the water, they would consider it as altogether ridiculous and impossible. This, however, I saw done at Toledo, in Spain, in the year 1538, before the emperor Charles V. and almost ten thousand spectators. The experiment was made by two Greeks, who taking a very large kettle, suspended from ropes with the mouth downwards, fixed beams and planks in the middle of its concavity, upon which they placed themselves, together with a candle. The kettle was equipoised by means of lead fixed round its mouth, so that when let down towards the water no part of its circumference should touch the water sooner than another, else the water might easily have overcome the air included in it, and have converted it into moist vapour. If a vessel thus prepared be let down gently, and with due care, to the water, the included air with great force makes way for itself through the resisting fluid. Thus the men enclosed in it remain dry, in the midst of the water, for a little while, until, in the course of time, the included air becomes weakened by repeated aspiration, and is at length resolved into gross vapours, being consumed by the greater moisture of the water: but if the vessel be gently drawn up, the men continue dry, and the candle is found burning."—Taisneri Opuscula de celerrimo motu, quoted by Schott in his Technica Curiosa, lib. vi. c. 9, p. 393.

induced to make the experiment in order to prove the possibility of it. After this period the use of the diving-bell seems to have become still better known. It is described more than once in the works of Lord Bacon, who explains its effects, and remarks that it was invented to facilitate labour under the water[1].

In the latter part of the seventeenth century the diving-bell was sometimes employed in great undertakings. When the English, in the year 1588, dispersed the Spanish fleet called the Invincible Armada, part of the ships went to the bottom near the Isle of Mull, on the western coast of Scotland; and some of these, according to the account of the Spanish prisoners, contained great riches. This information excited, from time to time, the avarice of speculators, and gave rise to several attempts to procure part of the lost treasure. In the year 1665, a person was so fortunate as to bring up some cannon, which, however, were not sufficient to defray the expenses. Of these attempts, and the kind of diving-bell used, an account has been given by a Scotsman named Sinclair[2]; but Paschius[3], Leupold[4] and others falsely ascribe the invention of this machine to that learned man. He himself does not lay claim to this honour; but says only, that he conversed with the artist and measured the machine.

Some years after attempts of the like kind were renewed. William Phipps, the son of a blacksmith, born in America in 1650, and who had been brought up as a ship-carpenter at Boston, formed a project for searching and unloading a rich Spanish ship sunk on the coast of Hispaniola, and represented

[1] "Excellent use may be made of this vessel, which is employed sometimes in labouring under water on sunk ships, to enable the divers to continue longer under water, and to breathe, in turns, for a little while. It was constructed in this manner. A hollow vessel was made of metal, which was let down equally to the surface of the water, and thus carried with it to the bottom of the sea the whole air it contained. It stood upon three feet, like a tripod, which were in length somewhat less than the height of a man; so that the diver, when he was no longer able to contain his breath, could put his head into the vessel, and, having breathed, return again to his work."—Novum Organum, lib. ii. § 50. Bacon relates the same thing in his Phænomena Universi.

[2] G. Sinclari Ars nova et magna gravitatis et levitatis. Rot. 1669, 4to, p. 220.

[3] Paschii Inventa nov-antiqua. Lipsiæ, 1700, 4to, p. 650.

[4] Theatri Statici universalis pars tertia. Lipsiæ, 1726, fol. p. 242.

his plan in such a plausible manner, that king Charles II. gave him a ship, and furnished him with every thing necessary for the undertaking. He set sail in the year 1683; but, being unsuccessful, returned again in great poverty, though with a firm conviction of the possibility of his scheme. He endeavoured, therefore, to procure another vessel from James II., who was then on the throne; but as he failed in this, he tried to find the means of executing his design by the support of private persons, and, according to the prevailing practice, opened for that purpose a subscription. At first he was laughed at; but at length the duke of Albemarle, son of the celebrated General Monk, took part in it, and advanced a considerable sum to enable him to make the necessary preparations for a new voyage. Phipps soon collected the remainder; and in 1687 set sail in a ship of two hundred tons burthen to try his fortune once more, having previously engaged to divide the profit according to the twenty shares of which the subscription consisted. At first, all his labour proved fruitless; but at last, when his patience was almost entirely exhausted, he was so lucky as to bring up, from the depth of six or seven fathoms, so much treasure, that he returned to England with the value of two hundred thousand pounds sterling. Of this sum he himself got about sixteen, others say twenty thousand, and the duke ninety thousand pounds. After he came back, some persons endeavoured to persuade the king to seize both the ship and the cargo, under a pretence that Phipps, when he solicited for his Majesty's permission, had not given accurate information respecting the business. But the king answered, with much greatness of mind, that he knew Phipps to be an honest man, and that he and his friends should share the whole among them, had he returned with double the value. His Majesty even conferred upon him the honour of knighthood, to show how much he was satisfied with his conduct. This Phipps was afterwards high sheriff of New England, and died at London, greatly respected, in 1693. This affair was attended with such good consequences to the duke of Albemarle, that he obtained from the king the governorship of Jamaica, in order to try his fortune with other ships sunk in that neighbourhood. But whether it was that the gold had been already taken from the one before mentioned, or that, when the vessel

went to pieces, the sea had dispersed the cargo, it is certain that nothing further was found worth the labour of searching for[1].

In England, however, several companies were formed, and obtained exclusive privileges of fishing up goods on certain coasts, by means of divers. The most considerable of these was that which, in 1688, tried its success at the Isle of Mull, and at the head of which was the earl of Argyle. The divers went down to the depth of sixty feet under water, remained there sometimes a whole hour, and brought up gold chains, money, and other articles, which, however, when collected, were of very little importance[2]. Without giving more examples of the use of the diving-bell, I shall now mention some of those who, in later times, have endeavoured to improve it. That this machine was very little known in the first half of the sixteenth century, I conclude from the following circumstance. To the oldest edition of Vegetius on the art of war, there are added, by the editor, some figures, of which no explanation is given in the book. Among these is represented a method of catching fish with the hands, at the bottom of the sea. The apparatus for this purpose consists of a cap, which is fitted so closely to the head of the diver that no water can make its way between; and from the cap there ascends a long leather pipe, the opening of which floats on the surface of the water. Had the person who drew these figures been acquainted with the diving-bell, he would certainly have delineated it rather than this useless apparatus[3]. Of the old figures of a diving machine, that which approaches nearest to the diving-bell is in a book on fortification, by Lorini; who describes a square box bound round with iron, which is furnished with windows, and has a stool affixed to it

[1] This account is taken from the History of the British Empire in America, by J. Wynne. London, 1770, 2 vols. 8vo, i. p. 131, and from Campbell's Lives of the Admirals.

[2] Martin's Description of the Western Islands. The second edition. London, 1716, 8vo, p. 253.—Campbell's Political Survey of Britain. London, 1774, 2 vols. 4to, p. 604.

[3] These figures are to be found in the following editions of Vegetius:—Lutetiæ apud C. Wechelum, 1532, fol. p. 180. Fegetius, vier Bücher von der Rytterschafft. Erfurt, Hans. Knappen, 1511, fol. These figures are inserted also in Leupold's Theatrum Pontificale, p. 11, tab. ii. fig. 6.

for the diver. This more ingenious contrivance appears, however, to be older than that Italian; at least he does not pretend to be the inventor of it[1].

In the year 1617, Francis Kessler gave a description of his water-armour[2], intended also for diving, but which cannot really be used for that purpose[3]. In the year 1671, Witsen taught, in a better manner than any of his predecessors, the construction and use of the diving-bell[4]; but he is much mistaken when he says that it was invented at Amsterdam. In 1679 appeared, for the first time, Borelli's well-known work De Motu Animalium[5], in which he not only described the diving-bell, but also proposed another, the impracticability of which was shown by James Bernoulli[6]. When Sturm published his Collegium Curiosum, in 1678, he proposed some hints for the improvement of this machine, on which remarks were made in the Journal des Sçavans (Jan. 1678). None, however, have carried their researches further for this purpose than Dr. Halley, and Triewald a Swede.

The bell which Edmund Halley, secretary to the Royal Society, caused to be made, was three feet broad at the top, five feet at the bottom, and eight feet in height; forming a cavity of sixty-three cubic feet. It was covered with lead; and was so heavy that it sunk to the bottom, even when entirely empty. Around the lower edge, weights were disposed in such a manner that it should always sink in a perpendicular direction, and never remain in an oblique position. In the top was fixed a piece of strong glass to admit the light from above, and likewise a valve to give a passage to the air corrupted by the breath. Around the whole circumference of the bottom was placed a seat, on which the divers sat; and a stool, fixed to ropes, hung below, on which they could stand in order to work. The whole machine was suspended from a cross beam fastened to the mast of a ship, so that it could be easily lowered down into the water and again drawn up. That the bell might be supplied with fresh air under the water,

[1] Le Fortificationi di Bounaiuto Lorini. Venct. 1609, fol. p. 232.
[2] Fran. Kessleri Secreta. Oppenheim, 1617, 8vo.
[3] Bartholini Acta Hafn. 1676, p. i. obs. 17. [4] Scheeps-bouw, ut supra.
[5] See vol. i. p. 222, edit. Hag. Com. 1743.
[6] Acta Eruditorum, 1683, Decemb. p. 553. Jac. Bernoulli Opera.

large vessels filled with air, and which had an opening below through which the water compressed the included air, were let down by ropes. In the top of these vessels were leather pipes, besmeared with oil, through which the diver introduced air from the vessels into the bell; and as soon as a vessel was emptied, it was drawn up, on a signal made by the diver, and another let down. The foul air in the bell, being the warmest and lightest, rose to the top of the machine, where it was suffered to escape through the valve before mentioned. By these means the bell could be continually supplied with fresh air in such abundance, that Halley, and four other persons, remained under water, at the depth of ten fathoms, an hour and a half, without suffering the least injury, and could, with equal security, have continued longer, or even as long as they might have wished. This precaution, however, is necessary, that the bell be let down at first very slowly, that the divers may be gradually accustomed to inspire the compressed air; and at every twelve fathoms the bell must be held fast, in order to expel the water which has rushed in, by letting fresh air into it. By such apparatus, Halley was enabled to make the bottom of the sea, within the circumference of the bell, so dry that the sand or mud did not rise above his shoe. Through the window, in the top, so much light was admitted, that when the sea was still and the waves did not roll, he could see perfectly well to read and write under the water. When the empty air-vessels were drawn up, he sent up with them his orders, written with an iron spike on a plate of lead, and could thus let those above know when he wished to be removed with the bell to another place. In bad weather, and when the sea was rough, it was as dark under the bell as at night; he then kindled a light; but a burning candle consumed as much air as a man. The only inconvenience of which Halley complained was, that, in going down, he felt a pain in his ears, as if a sharp quill had been thrust into them. This pain returned every time the bell was let down to a greater depth, but soon went off again. A diver thought to prevent this pain by putting chewed paper into both his ears; but the bits of paper were forced in so far by the air, that a surgeon found great difficulty to extract them.

Another improvement of the diving-bell was effected by the well-known Triewald, a Swede, in 1732. His bell, which was

much smaller and more commodious, was made of copper, tinned in the inside. On the top there were panes of glass, which, for the greater security, were fixed in a frame of the same metal. The stool below was placed in such a manner, that the head only of the diver, when he stood upon it, rose above the surface of the water in the bell. This situation is much better than when the whole body is raised above the water in the bell, because near the surface of the water the air is much cooler and fitter to breathe in than at the top of the machine. That the diver also might remain conveniently in the upper part of the bell, Triewald arranged his apparatus so that when the diver had breathed as long as possible in the upper air, he found at the side of the bell a spiral pipe, through which he could draw in the lower cool air which was over the surface of the water. To the upper end of this copper pipe was affixed a pliable leather one, with an ivory mouth-piece, which the diver put into his mouth, and could thus inspire fresh air, in whatever position his body might be[1].

[In 1776, Mr. Spalding of Edinburgh made some improvements in Dr. Halley's diving-bell, for which he was rewarded by the Society of Arts. His diving-bell was made of wood, and was so light, that, with the divers and the weights attached to its rim, it would not sink; the weight necessary to counteract its buoyancy being added in the form of a large balance-weight, suspended from its centre by a rope, which was so mounted on pulleys that the divers could either draw the balance-weight up to the mouth of the bell or allow it to fall a considerable depth below it. Thus by letting the weight down to the bottom, the divers could, as it were, anchor the bell at any required level, or prevent its further descent if they perceived a rock or part of a wreck beneath it, which might otherwise overturn it. Also, by hauling in the rope while the weight was at the bottom, the persons in the bell might lower themselves at pleasure. Another improvement consisted in the addition of a horizontal partition near the top of the bell, which divided off a chamber, that might, by suitable openings and valves, be filled either with water or with air from the lower part of the bell, so as to alter the specific

[1] Phil. Trans. 1736.—Martin Triewald's Konst at lefwa under watnet. Stockholm, 1741, 4to.

gravity of the whole machine, and thereby cause it to ascend or descend at pleasure. The bell was supplied with air by an apparatus resembling that of Dr. Halley, and ropes stretched across the bell were used instead of seats and platforms for standing on. Thus the persons in the diving-bell were enabled, in case of accident, to raise themselves to the surface without any assistance from above, and it was rendered so perfectly manageable, that it might be removed to a considerable distance from the point at which it descended; its outward motion and its return to the vessel for the purpose of being hauled up, being assisted by a long boat, which carried the signal lines and the tackle for working the air-barrels.

Mr. John Farey, junior, made an improvement in Spalding's apparatus[1]. The upper chamber of the diving-bell is very strong and air-tight, without any openings for the admission of water. Two pumps are fixed in the partition, by which air may be forced into the upper chamber, whenever, during a pause in the descent, the lower chamber or the cavity of the bell is replenished with air. By this means, the upper chamber is made a reservoir of condensed air, from which the bell may be replenished with air, when it is desired to increase its buoyancy, by forcing out the water from the lower part. Hence also, the buoyancy of the bell may be at any time diminished, by pumping some of the air from it into the upper chamber, whereby the water will be allowed to enter to a greater height; and as this is effected without wasting the air, there is no danger of diminishing the buoyancy of the machine to a degree which would prevent it from rising, in case the suspending rope or chain should break.

Smeaton first employed the diving-bell in civil engineering operations in repairing the foundations of Hexham bridge in 1779. The bell was made of wood, and was supplied with air by means of a forcing-pump, which was fixed to the top, and threw in a gallon of air at a time; the river being shallow, the top of the bell was not covered with water[2]. In 1788 he used a cast-iron one in repairing Ramsgate harbour; a forcing-pump in a boat supplied air through a flexible tube. Since that time it has been frequently used by Rennie and others in

[1] Brewster's Edinburgh Encyclopædia, Art. Diving-bell.
[2] Reports of the late John Smeaton, F.R.S., vol. iii. p. 279.

submarine operations, recovering property from wrecks, blasting, &c. Mr. Rennie has moreover constructed apparatus for moving the bell in any direction.

In addition to the various forms of diving-bell, different water- and air-tight dresses have been invented to enable divers to remain in the water and perform various operations. Thus, Dr. Halley invented a leaden cap which covered the diver's head; it had glass before it, and contained as much air as was sufficient for two minutes, and had affixed to it a thick pliable pipe, with the other end fastened to the bell, and which, at the cap, was furnished with a valve to convey fresh air to the diver from the bell. This pipe, which the diver was obliged to wind round his arm, served him also as a guide to find his way back to the bell[1].

Mr. Martin states that a gentleman at Newton-Bushel, in Devonshire, invented an apparatus consisting of a large case of strong leather, holding about half a hogshead of air, made perfectly water-tight, and adapted to the legs and arms, with a glass in the anterior part, so that when the case was put on, he could walk about very easily at the bottom of the sea, and go into the cabin and other parts of a ship in a wreck, and deliver out the goods; and that he practised this method for forty years, and thereby acquired a large fortune and equal fame[2].

M. Klingert also invented a similar kind of apparatus, and described it in a pamphlet published at Breslau in 1798. The armour was made of tin-plate, in the form of a cylinder, with a round end to enclose the head and body; also, a leather jacket with short sleeves, and a pair of water-tight drawers of the same, buttoned on the metal part, where they joined, and were made tight by brass hoops. Two distinct flexible pipes terminated in the helmet, and rose to the surface of the water; one was for inhaling, and terminated in an ivory mouth-piece, the other was for the escape of foul air. The body was kept down by weights.

Another method of supplying air to the apparatus was used by Mr. Tonkin in 1804. This consisted in the application of a bellows or pump, until the elastic force of the air was equal

[1] Phil. Trans. 1717 and 1721. The art of living under water, by Halley.
[2] Martin's Philosophia Britannica, vol. iii. p. 180.

to the pressure of the water, the foul air being allowed to escape into the water through a valve, or conducted to the surface by a pipe[1].]

COLOURED GLASS.—ARTIFICIAL GEMS.

It is probable that there was no great interval between the discovery of the art of making glass, and that of giving it different colours. When the substance of which it is formed contains, by accident, any metallic particles, the glass assumes some tint; and this happens oftener than is wished; nay, a considerable degree of foresight is necessary to produce glass perfectly colourless; and I am of opinion that this skill has not been attained till a late period in the progress of the art. Even in Pliny's time the highest value was set upon glass entirely free from colour, and transparent, or, as it was called, crystal[2]. From the different colours which glass acquired of itself, it was easy to conceive the idea of giving it the tinge of some precious stone: and this art, in ancient times, was carried to a very great extent. Proofs of this may be found in Pliny, who, besides others, mentions artificial hyacinths, sapphires, and that black glass which approached very near to the obsidian stone, and which in more than one place he calls *gemmæ vitreæ*[3]. Trebellius Pollio relates in how whimsical a manner Gallienus punished a cheat who had sold to his wife

[1] For further information on this important subject the reader is referred to the article Diving-bell in the Encyclopædia Britannica and its Supplement, also the Encyclopædia Metropolitana, Brewster's Edinburgh and the Penny Cyclopædia, Halley's papers in the Phil. Trans. for 1716 and 1721, Treiwald's in the same for 1736, Healy in the Philosophical Magazine, vol. xv., and Leopold's Theatrum Machinarum Hydraulicarum.

[2] Lib. xxxvi. c. 26.

[3] Lib. xxxv. c. 26. and lib. xxxvii. c. 9. The *lapis obsidianus*, which Obsidius first found in Ethiopia, and made known, is undoubtedly the same as that vulcanic glass which is sometimes called Icelandic agate, *pumex vitreus*, and by the Spaniards, who brought it from America and California, named *galinace.*

a piece of glass for a jewel[1]: and Tertullian ridicules the folly of paying as dear for coloured glass as for real pearls. The glass-houses at Alexandria were celebrated among the ancients for the skill and ingenuity of the workmen employed in them. From these, the Romans, who did not acquire a knowledge of that art till a late period, procured for a long time all their glass ware. The learned author of Recherches sur les Égyptiens et les Chinois, in the end of his first volume, relates more of these glass-houses than I know where to find in the works of the ancients; but it is certain that coloured glass was made even in those early ages. The emperor Adrian received as a present from an Egyptian priest, several glass cups which sparkled with colours of every kind, and which, as costly wares, he ordered to be used only on grand festivals[2]. Strabo tells us, that a glass-maker in Alexandria informed him that an earth was found in Egypt, without which the valuable coloured glass could not be made[3].

Seneca, in his ninetieth epistle, in which he judges too philosophically, that is, with too little knowledge of the world, in regard to the value of labour, mentions one Democritus who had discovered the art of making artificial emeralds[4]; but in my opinion this discovery consisted in giving a green colour by cementation to the natural rock crystal: and this art I imagine was treated of in that book, the name of which Pliny, through an over-anxious care lest the deception should become common, does not mention[5]. For colouring crystal and glass, so as to resemble stones, Porta[6], Neri[7], and others have, in modern times, given directions which are, however, not much used, because the crystal is thereby liable to acquire

[1] Historiæ Augustæ Scriptores, in vita Gallieni, cap. 12.

[2] Ib. in Vopisc. vita Saturnini, c. 8.

[3] Strabo, Amst. 1707, fol. lib. xvi. p. 1099.—Some consider the glass earth here mentioned as a mineral alkali that was really found in Egypt, and which served to make glass; but, as the author speaks expressly of coloured glass, I do not think that the above salt, without which no glass was then made, is what is meant; but rather a metallic oxide, such perhaps as ochre or manganese.

[4] Sen. Op. Lipsii, p. 579.

[5] Hist. Nat. lib. xxxvii. c. 12. A passage in Diodorus Siculus, lib. ii. c. 52, alludes, in my opinion, to this method of colouring by cementation.

[6] Magia Naturalis. Franc. 1591, 8vo, p. 275.

[7] Kunkel's Ars Vitraria. Nur. 1743, 4to, pp. 98, 101.

so many flaws that it cannot be easily cut afterwards, though, as Neri assures us, these by attention may sometimes be avoided.

It is worthy of remark, that in some collections of antiquities at Rome, there are pieces of coloured glass which were once used as jewels. In the Museum Victorium, for example, there are shown a chrysolite and an emerald, both of which are so well executed, that they are not only perfectly transparent and coloured throughout, but neither externally nor internally have the smallest blemish, which certainly could not be guarded against without great care and skill.

What materials the ancients used for colouring glass, has not been told to us by any of their writers. It is, however, certain that metallic oxides only can be employed for that purpose, because these pigments withstand the heat of the glass furnaces; and it is highly probable that ferruginous earth, if not the sole, was at least the principal substance, by which not only all shades of red, violet, and yellow, but even a blue colour, could be communicated, as Professor Gmelin has shown[1]. Respecting the red, of which only I mean here to speak, there is the less doubt, as, at present, sometimes an artificial, and sometimes a natural, iron ochre is often employed for that purpose. For common works this is sufficient; but when pure clear glass, coloured strongly throughout with a beautiful lively red, free from flaws, and in somewhat large pieces, is required, iron is not fit, because its colour, by the continued heat necessary for making glass, either disappears or becomes dirty and almost blackish[2].

In the last century, some artists in Germany first fell upon the method of employing gold instead of iron, and of thereby making artificial rubies, which when they were well set could deceive the eye of a connoisseur, unless he tried them with a diamond or a file. The usual method was to dissolve the gold in aqua regia, and to precipitate it by a solution of tin, when it assumed the form of a purple-coloured powder. This substance, which must be mixed with the best frit, is called the precipitate of Cassius, gold-purple, or mineral-purple[3].

[1] Comment. Soc. Scient. Gotting. ii. p. 41.

[2] Montamy von den Farben zum Porzellan- und Email-malen. Leipsic, 1767, 8vo, p. 82. Fontanieu, p. 16.

[3] [The extensive use of this substance in colouring glass and porcelain

This Cassius, from whom it takes its name, was called Andrew, and because both the father and the son had the same christian name, they have been often confounded with each other. The father was secretary to the duke of Schleswig, and is not known as a man of letters; but the son is celebrated as the inventor or preparer of the gold-purple, and of a bezoar-essence. He took the degree of doctor at Leyden, in 1632, practised physic at Hamburg, and was appointed physician in ordinary to the bishop of Lubec. As far as I know, he never published anything respecting his art; but this service was rendered to the public by his son, who was born at Hamburg, and resided as a physician at Lubec. He was the author of a well-known treatise, now exceedingly scarce, entitled Thoughts concerning that last and most perfect work of nature, and chief of metals, gold, its wonderful properties,

has rendered its best and most œconomical preparation a subject of interest both to the chemist and the manufacturer. Although the determination of its true chemical composition has presented obstacles almost insuperable, still many important points with regard to its manufacture have been elucidated. It has been found that the tin salt used in precipitating it must contain both the binoxide and protoxide of tin in certain proportions, and it has been also discovered that the degree of dilution both of the gold and tin solutions exerts a very perceptible influence on the beauty of the preparation. Capaun has examined this latter point with great attention, by testing all the different products as to their power of colouring glass.

The first point to be attained is the preparation of a solution of sesquioxide of tin; and for this purpose Bolley proposes to employ the double compound of bichloride of tin with sal-ammoniac (pink salt). This salt is not altered by exposure to the atmosphere, and contains a fixed and known quantity of bichloride of tin, and when boiled with metallic tin it takes up so much as will form the protochloride; as the exact quantity of the bichloride is known, it is very easy to use exactly such a quantity of tin as will serve to form the sesquichloride. 100 parts of the pink salt require for this purpose 10·7 parts of metallic tin.

Capaun recommends dissolving 1·34 gr. of gold in aqua regia, an excess being carefully avoided, and diluting the solution with 480 grs. of water. 10 grs. of pink salt are mixed with 1·07 gr. of tin filings and 40 grs. of water, and the whole boiled till the tin is dissolved. 140 grs. of water are then added to this, and the solution gradually mixed with the gold liquor, slightly warmed, until no more precipitation ensues. The precipitate washed and dried weighs 4·92 grs. and is of a dark brown colour.

M. Figuier states, as the results of his investigations, that the purple of Cassius is a perfectly definite combination of protoxide of gold and of stannic acid, or peroxide of tin, the proof of which is, that it is instantly produced when protoxide of gold and peroxide of tin are placed in contact.]

generation, affections, effects, and fitness for the operations of art; illustrated by experiments[1].

From this work it will be easily understood why the author does not give himself out as the inventor of the gold-purple[2], which he is commonly supposed to be, at which Lewis is much astonished. It is seen also by it that Leibnitz calls him improperly a physician at Hamburg, having probably confounded the father and son together[3]. Upon the whole, it is not proved that any of the Cassius's was the inventor of the above precipitate, else it would certainly not have been omitted[4] in this treatise; and mention of gold-purple is to be found in the works of several old chemists[5].

Something of this kind has, doubtless, been meant by the old chemists, when they talk of red lions, the purple soul of gold, and the golden mantle; but what they wished to conceal under these metaphors, I am not able to conjecture. In the year 1606, when Libavius published his Alchemy, the art of making ruby-glass must have been unknown. He indeed quotes an old receipt for making rubies; and conjectures, that because the real stones of the same name are found in the neighbourhood of gold mines, they may have acquired their colour from that metal; and that by means of art, glass might be coloured by a solution of gold[6]. The later chemists, however, and particularly Achard, found no traces of gold, but of iron, in that precious stone[7].

Neri, who lived almost at the same time as Libavius[8], was better acquainted with the gold-purple, though his receipt is

[1] The original title runs thus:—De extremo illo et perfectissimo naturæ opificio ac principe terrenorum sidere, auro, et admiranda ejus natura, generatione, affectionibus, effectis, atque ad operationes artis habitudine, cogitata; experimentis illustrata. Hamburgi, 1685, 8vo.

[2] Joh. Molleri Cimbria Literata. Havniæ, 1774, fol. i. p. 88.

[3] Miscellanea Berolinensia, i. p. 94.

[4] The author shows only, in a brief manner, in how many ways this precipitate can be used; but he makes no mention of employing it in colouring glass.

[5] I cannot, however, affirm that the *vasa murrhina* of the ancients were a kind of porcelain coloured with this salt of gold. This is only a mere conjecture.

[6] Alchymia Andr. Libavii. Franc. 1606, fol. ii. tract. i. c. 34.

[7] See Gotting. Gel. Anzeigen, 1778, p. 177.

[8] It is well known that Neri's works are translated into Kunkel's Ars Vitraria, the edition of which, published at Nuremberg in 1743, I have in

very defective. According to his directions, the gold solution must be evaporated, and the residue suffered to remain over the fire until it becomes of a purple colour. One may readily believe that this colour will be produced; but glass will scarcely be coloured equally through by this powder, and perhaps some of the gold particles will show themselves in it. Kunkel affirms, and not without reason, that something more is necessary to make rubies by means of gold; but he has not thought proper to tell us what it is[1].

Glauber, who wrote his Philosophical Furnace[2] about the middle of the seventeenth century, appears to have made several experiments with the gold-purple. He dissolved the metal in aqua regia; precipitated it by liquor of flint, and melted into glass the precipitate, which contained in it abundance of vitreous earth[3].

None, however, in the seventeenth century, understood better the use and preparation of gold-purple than John Kunkel, who, after being ennobled by Charles XI., king of Sweden, assumed the name of Löwenstiern. He himself tells us, that he made artificial rubies in great abundance, and sold them by weight, at a high price. He says, he made for the elector of Cologne a cup of ruby glass, weighing not less than twenty-four pounds, which was a full inch in thickness, and of an equally beautiful colour throughout. He employed himself most on this art after he engaged in the service of Frederic William, elector of Brandenburg, in the year 1679. At that time he was inspector of the glass-houses at Potsdam; and, in order that the art of making ruby-glass might be brought to perfection, the elector expended 1600 ducats. A cup with a cover, of this manufacture, is still preserved at Berlin. Kunkel, however, has nowhere given a full account of this art. He has only

my possession. The time Neri lived is not mentioned in the Dictionary of Learned Men; but it appears, from the above edition of Kunkel, that he was at Florence in 1601, and at Antwerp in 1609. The oldest Italian edition of his works I have ever seen is L'arte vetraria—del R. R. Antonio Neri, Fiorentino. In Venctia, 1663. The first edition, however, must be older. [It is Florence, Giunti, 1612.—Ed.]

[1] Neri, b. vii. c. 129, pp. 157 and 174.

[2] Amst. 1651, vol. iv. p. 78. Lewis says that Furnus Philosophicus was printed as early as 1648.

[3] Glauber first made known liquor of flint, and recommended it for several uses. See Ettmulleri Opera, Gen. 1736, 4 vol. fol. ii. p. 170.

left in his works a few scattered remarks, which Lewis has collected[1].

In the year 1684, earlier than Cassius, John Christian Orschal wrote his well-known work, Sol sine veste[2], in which he treats, more intelligibly than any one before him, of the manner of making ruby-glass. He, however, confesses that Cassius first taught him to precipitate gold by means of tin; that Cassius traded in glass coloured with this precipitate, and that a good deal of coloured glass was then made at Freysingen, but that the art was kept very secret. As Orschal deserves that his fate should be better known, I shall here mention the following few particulars respecting him. About the year 1682 he was at Dresden, in the service of John Henry Rudolf, from whom he learnt many chemical processes, and particularly amalgamation, by which he gained money afterwards in Bohemia. After this he was employed at the mines in Hesse; but he brought great trouble upon himself by polygamy and other irregularities, and died in a monastery in Poland.

Christopher Grummet, who was Kunkel's assistant, wrote, in opposition to Orschal, his known treatise, Sol non sine veste, which was printed at Rothenburg, in 1685[3]. In like manner, an anonymous author printed against Orschal, at Cologne, in 1684, another work, in duodecimo, entitled Apelles post tabulam observans maculas in Sole sine veste. The dispute, however, was not so much concerning the use of gold-purple, as the cause of the red colour, and the vitrification of gold.

It is worthy of remark, that Kunkel affirms he could give to glass a perfect ruby-red colour without gold; which Orschal and most chemists have however doubted. It is nevertheless said, that Krüger, who was inspector of the glass-houses at Potsdam, under Frederic William king of Prussia, discovered earlier the art of making ruby-glass without gold, and that a

[1] Lewis, Zusammenhang der Künste. Zür. 1764, 2 vols. 8vo, i. p. 279.

[2] The first edition was printed at Augsburg, in duodecimo, and the same year at Amsterdam. It has been often printed since, as in 1739, in 3 vols. 4to, without name or place.

[3] A French translation of Orschal and Grummet is added to l'Art de la Verrérie de Neri, Merret et Kunkel. Paris, 1752, 4to. The editor is the Baron de Holbach.

cup and cover of cut glass made in this manner is still preserved at Berlin.

Painting on glass and in enamel, and the preparation of coloured materials for mosaic work, may, in certain respects, be considered as branches of the art of colouring glass; and in all these a beautiful red is the most difficult, the dearest, and the scarcest. When the old master-pieces of painting on glass are examined, it is found either that the panes have on one side a transparent red varnish burnt into them, or that the pieces which are stained through and through, are thinner than those coloured in the other manner[1]. It is therefore extremely probable that the old artists, as they did not know how to give to thick pieces a beautiful transparent red colour, employed only iron, or manganese, which pigment, as already observed, easily becomes in a strong heat blackish and muddy[2]. Enamel-painters, however, were for a long time obliged to be contented with it. A red colour in mosaic work is attended with less difficulty, because no transparency, nay rather opacity, is required. At Rome those pieces are valued most which have the beautiful shining red colour of the finest sealing-wax. We are told by Ferber that such pieces were at one time made only by a man named Mathioli, and out of a kind of copper dross; at present (1792), there are several artists in that city who prepare these materials, but they are not able to give them a perfect high colour[3].

[Of late years the interesting art of painting on glass has attracted considerable attention; lovers of the fine arts, antiquaries, and chemists, have contributed to its perfection, and have sought to ascertain by what methods their predecessors were able to give those beautiful and brilliant tints to their productions, many of which have been so wantonly destroyed

[1] See Peter le Vieil's Kunst auf Glas zu malen, Nuremberg 1779, 4to, ii. p. 25. This singular performance must, in regard to history, particularly that of the ancients, be read with precaution. Seldom has the author perused the works which he quotes; sometimes one cannot find in them what he assures us he found, and very often he misrepresents their words.

[2] In what the art of Abraham Helmback, a Nuremberg artist, consisted, I do not know. Doppelmayer, in his Account of the Mathematicians and Artists of Nuremberg, printed in 1730, says that he fortunately revived, in 1717, according to experiments made in a glass-house, the old red glass; the proper method of preparing which had been long lost.

[3] Ferber's Briefe aus Welschland. Prague, 1773, 8vo, p. 114.

by the barbarity of the last century[1]. One of the most ingenious essays that has been written on the subject, is that published by an anonymous correspondent in the Philosophical Magazine for December 1836, which we subjoin in elucidation of our present knowledge on the subject.

On the Art of Glass-Painting. By a Correspondent.

It is a singular fact, that the art of glass-painting, practised with such success during the former ages from one end of Europe to the other, should gradually have fallen into such disuse, that in the beginning of the last century it came to be generally considered as a lost art. In the course of the eighteenth century, however, the art again began to attract attention, and many attempts were made to revive it. It was soon found by modern artists, that by employing the processes always in use among enamel-painters, the works of the old painters on glass might in most respects be successfully imitated; but they were totally unable to produce any imitation whatever of that glowing red which sheds such incomparable brilliancy over the ancient windows that still adorn so many of our churches[2]. For this splendid colour they possessed no substitute, until a property, peculiar to silver alone among all the metals, was discovered, which will presently be described.

[1] The devastations to which the productions of this beautiful art have been subjected are deeply to be regretted. It appears from the interesting Account of Durham Cathedral, published by the Rev. James Raine, that there was much fine stained glass in the fifteen windows of the Nine Altars which

"shed their many-colour'd light
Through the rich robes of eremites and saints;"

until the year 1795, when "their richly painted glass and mullions were swept away, and the present plain windows inserted in their place. The glass lay for a long time afterwards in baskets on the floor; and when the greater part of it had been purloined the remainder was locked up in the Galilee." And in 1802 a beautiful ancient structure, the Great Vestry, "was, for no apparent reason, demolished, and the richly painted glass which decorated its windows was either destroyed by the workmen or afterwards purloined." The exquisite Galilee itself had been condemned, but was saved by a happy chance.

[2] In 1774 the French Academy published Le Vieil's treatise on Glass-painting. He possessed no colour approaching to red, except the brick-red or rather rust-coloured enamel subsequently mentioned in the text, derived from iron.

The art of enamelling on glass differs little from the well-known art of enamelling on other substances. The colouring materials (which are exclusively metallic) are prepared by being ground up with a *flux*, that is, a very fusible glass, composed of silex, flint-glass, lead, and borax: the colour with its flux is then mixed with volatile oil, and laid on with the brush. The pane of glass thus enamelled is then exposed to a dull red heat, just sufficient to soften and unite together the particles of the flux, by which means the colour is perfectly fixed on the glass. Treated in this way, gold yields a purple, gold and silver mixed a rose-colour, iron a brick-red, cobalt a blue[1]; mixtures of iron, copper and manganese, brown and black. Copper, which yields the green in common enamel-painting[2], is not found to produce a fine colour when applied in the same way to glass, and viewed by transmitted light; for a green therefore recourse is often had to glass coloured blue on one side and yellow on the other. To obtain a yellow, silver is employed, which, either in the metallic or in any other form, possesses the singular property of imparting a transparent stain, when exposed to a low red heat in contact with glass. This stain is either yellow, orange, or red, according to circumstances. For this purpose no flux is used: the prepared silver is merely ground up with ochre or clay, and applied in a thick layer upon the glass. When removed from the furnace the silver is found not at all adhering to the glass; it is easily scraped off, leaving a transparent stain, which penetrates to a certain depth. If a large proportion of ochre has been employed, the stain is yellow; if a small proportion, it is orange-coloured; and by repeated exposure to the fire, without any additional colouring matter, the orange may be converted into red. This conversion of orange into red is, I believe, a matter of much nicety, in which experience only can ensure success. Till within a few years this was the only bright red in use among modern glass-painters; and though the best specimens certainly produce a fine effect, yet it will seldom bear comparison with the red employed in such profusion by the old artists.

[1] It appears by a boast of Suger, abbot of St. Denis, which has been preserved, that the ancient glass-painters pretended to employ sapphires among their materials; hence, perhaps, the origin of the term *Zaffres*, under which the oxide of cobalt is still known in commerce.

[2] Oxide of chromium is now substituted for the copper.

Besides the enamels and stains above described, artists, whenever the subject will allow of it, make use of panes coloured throughout their substance in the glass-house melting-pot, because the perfect transparency of such glass gives a brilliancy of effect, which enamel-colouring, always more or less opake, cannot equal. It was to a glass of this kind that the old glass-painters owed their splendid red. This in fact is the only point in which the modern and ancient processes differ, and this is the only part of the art which was ever really lost. Instead of blowing plates of solid red, the old glass-makers used to *flash* a thin layer of red over a substratum of plain glass. Their process must have been to melt side by side in the glass-house a pot of plain and a pot of red glass: then the workman, by dipping his rod first into the plain and then into the red glass pot, obtained a lump of plain glass covered with a coating of red, which, by dexterous management in blowing and whirling, he extended into a plate, exhibiting on its surface a very thin stratum of the desired colour[1]. In this state the glass came into the hands of the glass-painter, and answered most of his purposes, except when the subject required the representation of white or other colours on a red ground: in this case it became necessary to employ a machine like the lapidary's wheel, partially to grind away the coloured surface till the white substratum appeared.

The material employed by the old glass-makers to tinge their glass red was the protoxide of copper, but on the discontinuance of the art of glass-painting the dependent manufacture of red glass of course ceased, and all knowledge of the art became so entirely extinct, that the notion generally prevailed that the colour in question was derived from gold[2]. It is not

[1] That such was the method in use, an attentive examination of old specimens affords sufficient evidence. One piece that I possess exhibits large bubbles in the midst of the red stratum; another consists of a stratum of red inclosed between two colourless strata: both circumstances plainly point out the only means by which such an arrangement could be produced.

[2] In 1793, the French government actually collected a quantity of old red glass, with the view of extracting the gold by which it was supposed to be coloured! Le Vieil was himself a glass-painter employed in the repair of ancient windows, and the descendant of glass-painters, yet so little was he aware of the true nature of the glass, that he even fancied he could detect the marks of the brush with which he imagined the red stratum had been laid on!

a little remarkable that the knowledge of the copper-red should have been so entirely lost, though printed receipts have always existed detailing the whole process. Baptista Porta (born about 1540) gives a receipt in his Magia Naturalis, noticing at the same time the difficulty of success. Several receipts are found in the compilations of Neri, Merret and Kunckel, from whence they have been copied into our Encyclopædias[1]. None of these receipts however state to what purposes the red glass was applied, nor do they make any mention of the *flashing*. The difficulty of the art consists in the proneness of the copper to pass from the state of protoxide into that of peroxide, in which latter state it tinges glass green. In order to preserve it in the state of protoxide, these receipts prescribe various deoxygenating substances to be stirred into the melted glass, such as smiths' clinkers, tartar, soot, rotten wood, and cinnabar.

One curious circumstance deserves to be noticed, which is, that glass containing copper when removed from the melting-pot sometimes only exhibits a faint greenish tinge, yet in this state nothing more than simple exposure to a gentle heat is requisite to throw out a brilliant red. This change of colour is very remarkable, as it is obvious that no change of oxygenation can possibly take place during the *recuisson*.

The art of tinging glass by protoxide of copper and flashing it on crown-glass, has of late years been revived by the Tyne Company in England, at Choisy in France[2], and in Suabia in Germany, and in 1827 the Academy of Arts at Berlin gave a premium for an imperfect receipt. To what extent modern glass-painters make use of these new glasses I am ignorant; the specimens that I have seen were so strongly coloured as to be in parts almost opake, but this is a defect which might no doubt be easily remedied[3].

[1] [M. Langlois names the following writers: "Neri en 1612, Handicquer de Blancourt en 1667, Kunkel en 1679, Le Vieil en 1774, et plusieurs autres écrivains à diverses époques, decrivaient ces procédés." (p. 192.) He fixes the restoration of the art in France at about the year 1800, when Brongniart, who had the direction of the Sèvres porcelain manufacture, worked with Méraud at the preparation of vitrifiable colours, p. 194. Among modern artists he particularly mentions Dihl, Schilt, Mortelègue, Robert, Leelair, Collins, and Willement.]

[2] Bulletin de la Société d'Encouragement pour l'Industrie Nationale, 1826.

[3] Though it is difficult to produce the copper-glass uniformly coloured,

I shall now conclude these observations by a few notices respecting glass tinged by fusion with gold, which, though never brought into general use among glass-painters, has I know been employed in one or two instances, flashed both on crown- and on flint-glass. Not long after the time when the art of making the copper-red glass was lost, Kunkel appears to have discovered that gold melted with flint-glass was capable of imparting to it a beautiful ruby colour. As he derived much profit from the invention, he kept his method secret, and his successors have done the same to the present day. The art, however, has been practised ever since for the purpose of imitating precious stones, &c., and the glass used to be sold at Birmingham for a high price under the name of *Jew's glass*. The rose-coloured scent-bottles, &c., now commonly made, are composed of plain glass flashed or coated with a very thin layer of the glass in question. I have myself made numerous experiments on this subject, and have been completely, and at last uniformly, successful, in producing glass of a fine crimson colour. One cause why so many persons have failed in the same attempt[1], I suspect is that they have used too large a proportion of gold; for it is a fact, that an additional quantity of gold, beyond a certain point, far from deepening the colour, actually destroys it altogether. Another cause probably is, that they have not employed a sufficient degree of heat in the fusion. I have found that a degree of heat, which I judged sufficient to melt cast-iron, is not strong enough to injure the colour. It would appear, that in order to receive the colour, it is necessary that the glass should contain a proportion either of lead, or of some other metallic glass. I have found bismuth, zinc, and antimony to answer the purpose, but have in vain attempted to impart any tinge of this colour to crown-glass alone.

Glass containing gold exhibits the same singular change of

it is easy to obtain streaks and patches of a fine transparent red. For this purpose it is sufficient to fuse together 100 parts of crown-glass with one of oxide of copper, putting a lump of tin into the bottom of the crucible. Metallic iron employed in the same way as the tin throws out a bright scarlet, but perfectly opake.

[1] "Dr. Lewis states that he once produced a potfull of glass of beautiful colour, yet was never able to succeed a second time, though he took infinite pains, and tried a multitude of experiments with that view." Commerce of Arts, p. 177.

colour on being exposed to a gentle heat, as has been already noticed with respect to glass containing copper[1]. The former when taken from the crucible is generally of a pale rose-colour, but sometimes colourless as water, and does not assume its ruby colour till it has been exposed to a low red-heat, either under a muffle or in the lamp. Great care must be taken in this operation, for a slight excess of fire destroys the colour, leaving the glass of a dingy brown, but with a blue transparency like that of gold-leaf. These changes of colour have been vaguely attributed to change of oxygenation in the gold; but it is obviously impossible that mere exposure to a gentle heat can effect any chemical change in the interior of a solid mass of glass, which has already undergone a heat far more intense. In fact I have found that metallic gold gives the red colour as well as the oxide, and it appears scarcely to admit of a doubt, that in a metal so easily reduced, the whole of the oxygen must be expelled long before the glass has reached its melting-point. It has long been known that silver yields its colour to glass while in the metallic state, and everything leads one to suppose that the case is the same as to gold.

There is still one other substance by means of which I find it is possible to give a red colour to glass, and that is a compound of tin, chromic acid, and lime; but my trials do not lead me to suppose that glass thus coloured will ever be brought into use.

With respect to the production of artificial gems, they are now made abundantly of almost every shade of colour, closely approximating to those which occur in nature, excepting in hardness and refractive power. They are formed by fusing what is called a base with various metallic oxides. The base varies in composition: thus, M. Fontanieu makes his by fusing silica with carbonate of potash, carbonate of lead and borax. M. Donault Wieland's consists of silica, potash, borax, oxide of

[1] [At the recent meeting of the British Association for the Advancement of Science, held at Cambridge (June 1845), M. Splittgerber exhibited specimens of glass into the composition of which gold entered as a chloride. These specimens were white, but upon gently heating them in the flame of a spirit-lamp, they became a deep-red. If again the same reddened glass is exposed to the heat of an oxygen blowpipe, it loses nearly all its colours, a slight pinkiness only remaining.]

lead, and sometimes arsenious acid. Hence the base differs but little in composition from glass. By fusing the base with metallic oxides, the former acquires various tints. Thus with oxide of antimony the oriental topaz is prepared; with oxide of manganese and a little purple of cassius, the amethyst; with antimony and a very small quantity of cobalt, the beryl; with horn silver (chloride of silver), the diamond and opal: the oriental ruby is prepared from the base, the purple of cassius, peroxide of iron, golden sulphuret of antimony, manganese calcined with nitre and rock crystal.]

SEALING-WAX.

Writers on diplomatics mention, besides metals, five other substances on which impressions were made, or with which letters and public acts were sealed, viz. *terra sigillaris*, cement, paste, common wax, and sealing-wax[1]. The *terra sigillaris* was used by the Egyptians, and appears to have been the first substance employed for sealing[2]. The Egyptian priests bound to the horns of the cattle fit for sacrifice a piece of paper; stuck upon it some sealing-earth, on which they made an impression with their seal; and such cattle only could be offered up as victims[3]

Lucian speaks of a fortune-teller who ordered those who came to consult him to write down on a bit of paper the questions they wished to ask, to fold it up, and to seal it with clay, or any other substance of the like kind[4]. Such earth seems to have been employed in sealing by the Byzantine emperors: for we are told that at the second council of Nice, a certain person defended the worship of images by saying, no one believed that those who received written orders from the emperor

[1] Gattereri Elem. Artis Diplom. 1765, 4to, p. 285.

[2] It is singular that Pliny denies that the Egyptians used seals, lib. xxiii. c. 1. Herodotus however, and others, prove the contrary; and Moses speaks of the seal-rings of the Egyptians. See Goguet.

[3] Herodot. lib. ii. c. 38.

[4] Lucian. in Pseudomant.

and venerated the seal, worshiped on that account the sealing-earth, the paper, or the lead [1].

Cicero relates that Verres having seen in the hands of one of his servants a letter written to him from Agrigentum, and having observed on it an impression in sealing-earth (*cretula*), he was so pleased with it that he caused the seal-ring with which it was made to be taken from the possessor [2]. The same orator, in his defence of Flaccus, produced an attestation sent from Asia, and proved its authenticity by its being sealed with Asiatic sealing-earth; with which, said he to the auditors, as you daily see, all public and private letters in Asia are sealed: and he showed on the other hand that the testimony brought by the accuser was false, because it was sealed with wax, and for that reason could not have come from Asia [3]. The scholiast Servius relates, that a sibyl received a promise from Apollo, that she should live as long as she did not see the earth of the island Erythræa where she resided; that she therefore quitted the place, and retired to Cumæ, where she became old and decrepid; but that having received a letter sealed with Erythræan earth (*creta*), when she saw the seal she instantly expired [4].

No one however will suppose that this earth was the same as that to which we at present give the name of *creta*, chalk; for if it was a natural earth it must have been of that kind called potters' clay, as that clay is capable of receiving an impression and of retaining it after it is hardened by drying. That the Romans, under the indefinite name of *creta*, often

[1] Act. iv. ap. Bin. tom. iii. Concil. part. i. p. 356. Whether the γῆ σημαντρὶς, however, of Herodotus and the πηλὸς of Lucian and of the Byzantine be the same kind of earth, can be determined with as little certainty as whether the *creta*, called by some Roman authors a sealing-earth, be different from both.

[2] Orat. in Verrem, iv. c. 9. In the passage referred to, some instead of *cretula* read *cerula*. I shall here take occasion to remark also, that in the Acts of the Council of Nice before-mentioned, instead of πηλὸν some read κηρόν: but I do not see a sufficient reason for this alteration, as in the before-quoted passage of Lucian it is expressly said, that people sealed κηρῷ ἢ πηλῷ. Reiske himself, who proposes that amendment, says that πηλὸν may be retained. Stephanus, however, does not give that meaning to this word in his Lexicon. Pollux and Hesychius tell us, that the Athenians called sealing-earth also ῥύπον.

[3] Orat. pro Flacco, c. 16.

[4] Serv. ad lib. vi. Æneid. p. 1037.

understood a kind of potters' earth, can be proved by many passages of their writers. Columella speaks of a kind of chalk of which wine-jars and dishes were made[1]. Virgil calls it tough[2]; and the ancient writers on agriculture give the same name to marl which was employed to manure land[3]. Notwithstanding all these authorities, I do not clearly comprehend how letters could be sealed with potters' clay, as it does not adhere with sufficient force either to linen, of which in ancient times the covers of letters were made, or to parchment; as it must be laid on very thick to have a distinct impression; as it is long in drying, and is again easily softened by moisture; and, at any rate, if conveyed by post at present, it would be crumbled into dust in going only from Hamburg to Altona. I can readily believe that the Roman messengers employed more skill and attention to preserve the letters committed to their care than are employed by our postmen; but the distance from Asia to Rome is much greater than that from Hamburg to Altona.

But may there not be as little foundation for the ancient expression *creta Asiatica*, Asiatic earth, as for the modern expression, *cera Hispanica*, Spanish wax? May not the former have signified a kind of coarse artificial cement? These questions might be answered by those who have had an opportunity of examining or only seeing the *sigilla cretacea* in collections of antiquities. We are assured that such are still preserved; at least we find in Ficoroni[4] the representation of six impressions which, as he tells us, consisted of that earth. In that author however I find nothing to clear up my doubts; he says only that some of these seals were white; others of a gray colour, like ashes; others red, and others brown. They seem all to have been enclosed in leaden cases. Could it be proved that each letter was wrapped round with a thread, and that the thread, as in the seals affixed to diplomas, was drawn through the covering of the seal, the difficulty which I think occurs in the use of these earths, as mentioned by the ancients,

[1] Lib. xii. c. 43.

[2] Georg. i. v. 179.

[3] Creta fossica, qua stercorantur agri.—Varro, i. 7. 8. It appears also that the πηλὸς of the Greeks signified a kind of potters' earth. Those who do not choose to rely upon our dictionaries, need only to read the ancient Greek writers on husbandry, who speak of ἀῤῥαγεῖ πηλῷ ἀργιλλώδει. See Geopon. x. c. 75. 12, and ix. c. 10. 4.

[4] I piombi antichi. Roma 1740, 4to, p. 16.

would entirely disappear[1]. It seems to me remarkable that neither Theophrastus nor Pliny says anything of the Asiatic *creta*, or speaks at all of sealing-earth; though they have carefully enumerated all those kinds of earth which were worth notice on account of any use.

In Europe, as far as I know, wax has been everywhere used for sealing since the earliest ages. Writers on diplomatics, however, are not agreed whether yellow or white wax was first employed; but it appears that the former, on account of its low price, must have been first and principally used, at least by private persons. It is probable also, that the seals of diplomas were more durable when they consisted of yellow wax; for it is certain that white wax is rendered more brittle and much less durable by the process of bleaching. Many seals also may at present be considered white which were at first yellow; for not only does wax highly bleached resume in time a dirty yellow colour, but yellow wax also in the course of years loses so much of its colour as to become almost like white wax. This perhaps may account for the oldest seals appearing to be of white, and the more modern of yellow wax. These however are conjectures which I submit with deference to the determination of those versed in diplomatics.

In the course of time wax was coloured red; and a good deal later, at least in Germany, but not before the fourteenth century, it was coloured green, and sometimes black. I find it remarked that blue wax never appears on diplomas; and I may indeed say it is impossible it should appear, for the art of giving a blue colour to wax has never yet been discovered; and in old books, such as that of Wecker, we find no receipt for that purpose. Later authors have pretended to give directions how to communicate that colour to wax, but they are altogether false; for vegetable dyes when united with wax become greenish, so that the wax almost resembles the hipstone; and earthy colours do not combine with it, but in melting fall again to the bottom. A seal of blue wax, not coloured blue merely on the outer surface, would be as great a rarity in the arts as in diplomatics, and would afford matter

[1] Heineccius and others think that the *amphoræ vitreæ diligenter gypsatæ*, in Petronius, were sealed; but it is much more probable that they were only daubed over or closed with gypsum, for the same reason that we pitch our casks.

of speculation for our chemists; but I can give them no hopes that such a thing can ever be produced[1]. The emperor Charles V. in the year 1524 granted to Dr. Stockamar of Nuremberg, the privilege of using blue wax in seals;—a favour like that conferred in 1704 on the manufactories in the principality of Halberstadt and the county of Reinstein, to make indigo from minerals. It was certainly as difficult for the doctor to find blue wax for seals as for the proprietors of these manufactories to discover indigo in the earth[2].

Much later are impressions made on paste or dough, which perhaps could not be employed on the ancient parchment or the linen covers of letters, though in Pliny's time the paper then in use was joined together with flour paste[3]. Proper diplomas were never sealed with wafers; and in the matchless diplomatic collection of H. Gatterer there are no wafer-seals much above two hundred years old. From that collection I have now in my possession one of these seals, around the impression of which is the following inscription, *Secretum civium in Ulma*, 1474; but it is only a new copy of a very old impression. Kings, however, before the invention of sealing-wax, were accustomed to seal their letters with this paste[4].

Heineccius and others relate that *maltha* also was employed for seals. This word signifies a kind of cement, formed chiefly of inflammable substances, and used to make reservoirs, pipes, &c. water-tight. Directions how to prepare it may be found in the writers on agriculture, Pliny, Festus and others. The latter tells how to make it of a composition of pitch and wax[5]: but neither in that author nor in any other have I found proofs that letters were sealed with it, or that seals of it were affixed to diplomas: for the words of Pollux, "cera qua tabella judicum obliniebatur[6]," will admit of a different explanation. If maltha has been in reality used for seals, that mixture may be considered as the first or oldest sealing-wax, as what of it is still preserved has been composed of resinous substances.

[1] [Blue wax may now be seen in every wax-chandler's shop; it is coloured blue by means of indigo.]

[2] Heineccii Syntagma de Vet. Sigillis, 1719, p. 55.

[3] Plin. lib. xxii. c. 25.

[4] Trotz, Not. in Prim. Scribendi Origine, p. 73, 74.

[5] P. Festi de Verb. Sig. lib. xx. Hesychius calls this cement *μεμαλάγμενον κηρόν*.—Plin. lib. xxxvi. c. 24.

[6] Lib. viii. c. 4.

Some writers assert[1], upon the authority of Lebeuf[2], that sealing-wax was invented about the year 1640 by a Frenchman named Rousseau; but that author refers his readers to Papillon[3], who refers again to Pomet[4], so that the last appears to be the first person who broached that opinion. According to his account, Francis Rousseau, born not far from Auxerre, and who travelled a long time in Persia, Pegu and other parts of the East Indies, and in 1692 resided in St. Domingo, was the inventor of sealing-wax. Having, while he lived at Paris as a merchant, during the latter years of the reign of Louis XIII., who died in 1643, lost all his property by a fire, he bethought himself of preparing sealing-wax from shell-lac, as he had seen it prepared in India, in order to maintain his wife and five children. A lady of the name of Longueville made this wax known at court, and caused Louis XIII. to use it, after which it was purchased and used throughout all Paris. By this article, Rousseau, before the expiration of a year, gained 50,000 livres. It acquired the name of *cire d'Espagne*, Spanish wax, because at that time a kind of lac, which was only once melted and coloured a little red, was called Portugal wax, *cire de Portugal*[5].

That sealing-wax was either very little or not at all known in Germany in the beginning of the sixteenth century, may be concluded from its not being mentioned either by Porta or Wecker; though in the works of both these authors there are various receipts respecting common wax, and little-known methods of writing and sealing[6]. The former says, that to open letters in such a manner as not to be perceived, the wax

[1] Nouveau Traité de Diplomatique. Paris, 1759, 4to, iv. p. 33.
[2] Mémoires conc. l'Histoire d'Auxerre. Par. 1743, ii. p. 517.
[3] Bibliothèque des Auteurs de Bourgogne, 2 vols. fol. ii. p. 217.
[4] Histoire Générale des Drogues. Paris, 1735.
[5] This Rousseau appears also in the History of Cochineal, as he sent to Pomet a paper on that subject, which was contradicted by the well-known Plumier in the Journal des Scavans for 1694. He is mentioned also by Labat, who says he saw him at Rochelle; but at that time he must have been nearly a hundred years of age.
[6] Von Murr, in his learned Beschreibung der Merkwürdigkeiten in Nürnberg, Nurnb. 1778, 8vo, p. 702, says that Spanish wax was not invented, or at least not known, before the year 1559. This appears also from a manuscript of the same year, which contains various receipts in the arts and medicine. There are some in it for making the common white sealing-wax green or red.

seal must be heated a little, and must be then carefully separated from the letter by a horse's hair; and when the letter has been read and folded up, the seal must be again dexterously fastened to it. This manœuvre, as the writers on diplomatics remark, has been often made use of to forge public acts; and they have therefore given directions how to discover such frauds[1]. The above method of opening letters, however, can be applied only to common wax, and not to sealing-wax: had the latter been used in Wecker's time he would have mentioned this limitation[2].

Whether sealing-wax was used earlier in the East Indies than in Europe, as the French think, I cannot with certainty determine. Tavernier[3], however, seems to say that the lac produced in the kingdom of Assam is employed there not only for lackering, but also for making Spanish sealing-wax. I must confess also that I do not know whether the Turks and other eastern nations use it in general. In the collection of natural curiosities belonging to our university there are two sticks of sealing-wax which Professor Butner procured from Constantinople, under the name of Turkish wax. They are angular, bent like a bow, are neither stamped nor glazed, and are of a dark but pure red colour. Two other sticks which came from the East Indies are straight, glazed, made somewhat thin at both ends, have no stamp, and are of a darker and dirtier red colour. All these four sticks seem to be lighter than ours, and I perceive that by rubbing they do not acquire so soon nor so strong an electrical quality as our German wax of moderate fineness. But whether the first were made in Turkey and the latter in the East Indies, or whether the whole four were made in Europe, is not known. That sealing-wax however was made and used in Germany a hundred years before Rousseau's time, and that the merit of that Frenchman consisted probably only in this, that he first made it in

[1] See Chronicon Godvicense, p. 102.

[2] Wecker gives directions also to make an impression with calcined gypsum, and a solution of gum or isinglass. Porta knew that this could be done to greater perfection with amalgam of quicksilver; an art employed even at present.

[3] Tavernier, in his Travels, says that in Surat lac is melted and formed into sticks like sealing-wax. Compare with this Dapper's Asia, Nuremberg, 1681, fol. p. 237.

France, or made the first good wax, will appear in the course of what follows.

The oldest known seal of our common sealing-wax is that found by M. Roos, on a letter written from London, Aug. 3rd, 1554, to the rheingrave Philip Francis von Daun, by his agent in England, Gerrard Hermann[1]. The colour of the wax is a dark-red; it is very shining, and the impression bears the initials of the writer's name G.H. The next seal, in the order of time, is one of the year 1561, on a letter written to the council of Gorlitz at Breslau. This letter was found among the ancient records of Gorlitz by Dr. Anton, and is three times sealed with beautiful red wax[2]. Among the archives of the before-mentioned family M. Roos found two other letters of the year 1566, both addressed to the rheingrave Frederick von Daun, from Orchamp in Picardy, by his steward Charles de Pousol; the one dated September the 2nd, and the other September the 7th. Another letter, written by the same person to the same rheingrave, but dated Paris January 22nd, 1567, is likewise sealed with red wax, which is of a higher colour, and appears to be of a coarser quality. As the oldest seals of this kind came from France and England, M. Roos conjectures that the invention, as the name seems to indicate, belongs to the Spaniards. This conjecture appears to me however improbable, especially as sealing-wax was used at Breslau so early as 1561; but this matter can be best determined perhaps by the Spanish literati. It is much to be lamented that John Fenn, in his Original letters of the last half of the fifteenth century[3], when he gives an account of the size and shape of the seals, does not inform us of what substances they are composed. Respecting a letter of the year 1455, he says only, "The seal is of red wax;" by which is to be understood, undoubtedly, common wax.

Among the records of the landgraviate of Cassel, M. Ledderhose found two letters of Count Louis of Nassau to the land-

[1] Bruchstücke betreffend die Pflichten eines Staatsdieners; aus den Handlungen des Raths Dreitz, nebst Bemerkungen vom ältesten Gebrauche des Spanischen Siegelwachses, Frankf. 1785, 4to, p. 86; where the use of these antiquarian researches is illustrated by examples worthy of notice.

[2] Historische Untersuchungen gesammelt von J. G. Meusel, i. 3, p. 240.

[3] Original Letters of the Paston Family, temp. Henry VI. i.p. 21, and p. 87 and 92.

grave William IV., one of which, dated March the 3rd, 1563, is sealed with red wax, and the other, dated November 7th, the same year, is sealed with black wax[1]. M. Neuberger, private keeper of the archives at Weimar, found among the records of that duchy a letter sealed with red wax, and written at Paris, May the 15th, 1571, by a French nobleman named Vulcob, who the year before had been ambassador from the king of France to the court of Weimar. It is worthy of remark, that the same person had sealed nine letters of a prior date with common wax, and that the tenth is sealed with Spanish wax. P. L. Spiess, principal keeper of the records at Plessenburg, who gave rise to this research by his queries, saw a letter of the year 1574 sealed with red sealing-wax, and another of the year 1620 sealed with black sealing-wax. He found also in an old expense-book of 1616, that Spanish wax, expressly, and other materials for writing were ordered from a manufacturer of sealing-wax at Nuremberg, for the personal use of Christian margrave of Brandenburg[2].

The oldest mention of sealing-wax which I have hitherto observed in printed books is in the work of Garcia ab Orto[3], where the author remarks, speaking of lac, that those sticks used for sealing letters were made of it. This book was first printed in 1563, about which time it appears that the use of sealing-wax was very common among the Portuguese.

The oldest printed receipt for making sealing-wax was found by Von Murr, in a work by Samuel Zimmerman, citizen of Augsburg, printed in 1579[4]. The copy which I have from the library of our university is signed at the end by the author himself. His receipts for making red and green sealing-wax I shall here transcribe.

"To make hard sealing-wax, called Spanish wax, with which if letters be sealed they cannot be opened without breaking the seal:—Take beautiful clear resin, the whitest you can procure, and melt it over a slow coal fire. When it is properly melted, take it from the fire, and for every pound of resin add two ounces of vermilion pounded very fine, stirring it about.

[1] Meusel's Geschichtforscher. Halle, 8vo, vi. p. 270. [2] Ibid. iv. p. 251.

[3] Aromatum et Simplicium aliquot Historia, Garcia ab Horto auctore. Antverpiæ 1574, 8vo, p. 33.

[4] Neu Titularbuch,—sambt etlichen hinzugethanen Gehaimnüssen und Künsten, das Lesen und die Schreiberey betreffendt. 4to, 1579, p. 112.

Then let the whole cool, or pour it into cold water. Thus you will have beautiful red sealing-wax.

" If you are desirous of having black wax, add lamp-black to it. With smalt or azure you may make it blue; with white-lead white, and with orpiment yellow.

" If instead of resin you melt purified turpentine in a glass vessel, and give it any colour you choose, you will have a harder kind of sealing-wax, and not so brittle as the former."

What appears to me worthy of remark in these receipts for sealing-wax is, that there is no mention in them of shell-lac, which at present is the principal ingredient, at least in that of the best quality; and that Zimmerman's sealing-wax approaches very near to that which in diplomatics is called *maltha*. One may also conclude therefore that this invention was not brought from the East Indies.

The expression Spanish wax is of little more import than the words Spanish-green, Spanish-flies, Spanish-grass, Spanish-reed, and several others, as it was formerly customary to give to all new things, particularly those which excited wonder, the appellation of Spanish; and in the like manner many foreign or new articles have been called Turkish; such as Turkish wheat, Turkish paper, &c.

Respecting the antiquity of wafers, M. Spiess has made an observation[1] which may lead to further researches, that the oldest seal with a red wafer he has ever yet found, is on a letter written by D. Krapf at Spires in the year 1624, to the government at Bayreuth. M. Spiess has found also that some years after, Forstenhäusser, the Brandenburg factor at Nuremberg, sent such wafers to a bailiff at Osternohe. It appears however that wafers were not used during the whole of the seventeenth century in the chancery of Brandenburg, but only by private persons, and by these even seldom; because, as Spiess says, people were fonder of Spanish wax. The first wafers with which the chancery of Bayreuth began to make seals were, according to an expense account of the year 1705, sent from Nuremberg. The use of wax however was still continued; and among the Plassenburg archives there is a rescript of 1722, sealed with proper wax. The use of wax must have been continued longer in the duchy of Weimar; for in the Electa Juris Publici there is an order of the year 1716, by

[1] Archivische Nebenarbeiten und Nachrichten. Halle, 1785, 4to, ii. p. 3.

which the introduction of wafers in law matters is forbidden and the use of wax commanded. This order however was abolished by duke Ernest Augustus in 1742, and wafers again introduced.

CORN-MILLS.

If under this name we comprehend all those machines, however rude, employed for pounding or grinding corn, these are of the highest antiquity. We read in the Scriptures, that Abraham caused cakes to be baked for his guests of the finest meal; and that the manna was ground like corn. The earliest instrument used for this purpose seems to have been the mortar; which was retained a long time even after the invention of mills properly so called, because these perhaps at first were not attended with much superior advantage[1]. It appears that in the course of time the mortar was made rigid and the pestle notched, at least at the bottom; by which means the grain was rather grated than pounded. A passage of Pliny[2], not yet sufficiently cleared up, makes this conjecture probable. When a handle was added to the top of the pestle, that it might be more easily driven round in a circle, the mortar was converted into a hand-mill. Such a mill was called *mola trusatilis, versatilis, manuaria*[3], and was very little different from those used at present by apothecaries, painters, potters and other artists, for grinding coarse bodies, such as colours, glass, chalk, &c. We have reason to suppose that in every family there

[1] Hesiod, Opera et Dies, 421.—It appears that both the mortar and pestle were then made of wood, and that the former was three feet in height; but, to speak the truth, Hesiod does not expressly say that this mortar was for the purpose of pounding corn. The mortar was called ὕπερος, pila; the pestle ὕπερος, or ὕπερον, pistillus or pistillum; to pound, μάσσειν, pinsere, which word, as well as *pinsor*, was afterwards retained when mills came to be used.—Plin. lib. xviii. c. 3.

[2] Plin. xviii. 10. ii. p. 111. This passage Gesner has endeavoured to explain, in his Index to the Scriptores Rei Rusticæ, p. 59, to which he gives the too-dignified title of Lexicon Rusticum.

[3] Gellius, iii. c. 3.

was a mill of this kind. Moses forbade them to be taken in pawn; for that, says he, is the same thing as to take a man's life to pledge. Michaelis, on this passage, observes that a man could not then grind, and consequently could not bake bread for the daily use of his family[1]. Grinding was at first the employment of the women, and particularly of the female slaves, as it is at present among uncivilised nations, and must therefore have required little strength[2]; but afterwards the mills were driven by bondsmen, around whose necks was placed a circular machine of wood, so that these poor wretches could not put their hands to their mouths, or eat of the meal.

In the course of time shafts were added to the mill that it might be driven by cattle, which were, as at present, blindfolded[3]. The first cattle-mills, *molæ jumentariæ*, had perhaps only a heavy pestle like the hand-mills[4]; but it must have been soon remarked that the labour would be more speedily accomplished if, instead of the pestle, a large heavy cylindrical stone should be employed. I am of opinion, however, that the first cattle-mills had not a spout or a trough as ours have at present; at least the hand-mills which Tournefort[5] saw at Nicaria, and which consisted of two stones, had neither; but the meal which issued from between the stones, through an opening made in the upper one, fell upon a board or table, on which the lower stone, that was two feet in diameter, rested.

The upper mill-stone was called *meta*, or *turbo*; and the lower one *catillus*. *Meta* signified also a cone with a blunt apex[6]; and it has on that account been conjectured that corn

[1] Deuteronomy, ch. xxiv. v. 6.

[2] When Moses threatened Pharaoh with the destruction of the first-born in the land of Egypt, he said, "All the first-born shall die, from the first-born of Pharaoh that sitteth on the throne, even unto the first-born of the maid-servant that is behind the mill."—Genesis, ch. xi. v. 5. See Homeri Odyss. vii. 103, and xx. 105.

[3] Apulei Metamorph. lib. ix.

[4] The oldest cattle-mills have, in my opinion, resembled the oil-mills represented in plate 25th of Sonnerat, Voyages aux Indes, &c., i. Zurich, 1783, 4to. To the pestle of a mortar made fast to a stake driven into the earth, is affixed a shaft to which two oxen are yoked. The oxen are driven by a man, and another stands at the mortar to push the seed under the pestle. Sonnerat says, that with an Indian hand-mill two men can grind no more than sixty pounds of meal in a day; while one of our mills, under the direction of one man, can grind more than a thousand.

[5] Voyage du Lévant, 4to, p. 155.

[6] A haycock was called *meta fœni*. Colum. ii. 19. Plin. xxvii. 28.

was at first rubbed into meal by rolling over it a conical stone flatted at the end, in the same manner as painters at present make use of a grinding-stone; and it is believed that the same name was afterwards given to the upper mill-stone. This conjecture is not improbable, as some rude nations still bruise their corn by grinding-stones. I do not, however, remember any passage in the ancients that mentions this mode of grinding; and I am of opinion, that the pestle of the hand-mill, for which the upper mill-stone was substituted, may, on account of its figure, have been also called *meta*. Niebuhr[1] found in Arabia, besides hand-mills, some grinding-stones, which differed from those used by us in their consisting not of a flat, but of an oblong hollow stone, or trough, with a pestle, which was not conical, but shaped like a spindle, thick in the middle and pointed at both ends. In this stone the corn, after being soaked in water, was ground to meal and then baked into cakes.

Respecting the figure and construction of the ancient hand-mills, I expected to find some information from engraved stones, and other remains of antiquity; but my researches would have proved fruitless, had not Professor Diez, to whose memory and erudition I am much indebted, pointed out to me the only figure of one remaining. I say the only one remaining with the more confidence, as Heyne tells us also that he remembers no other. Anthony Francis Gori[2] has described a red jasper, on which is engraved the naked figure of a man, who in his left-hand holds a sheaf of corn, and in his right a machine that in all probability is a hand-mill. Gori considers the figure as a representation of the god Eunostus, who, as Suidas says, was the god of mills. The machine, which Eunostus seems to exhibit, or to be surveying himself, is, as far as one can distinguish (for the stone is scarcely half an inch in size), shaped like a chest, narrow at the top, and wide at the bottom. It stands upon a table, and in the bottom there is a perpendicular pipe from which the meal, represented also by the artist, appears to be issuing. Above, the chest or body of the mill has either a top with an aperture, or perhaps a basket sunk

[1] Niebuhr's Déscription de l'Arabie. A figure of both stones is represented in the first plate, fig. H.

[2] Memorie di varia erudizione della Societa Colombaria Fiorentina. Livorno, 1752, 4to, vol. ii. p. 207.

into it, from which the corn falls into the mill. On one side, nearly about the middle of it, there projects a broken shank, which, without overstraining the imagination, may be considered as a handle, or that part of the mill which some called *molile*. Though this figure is small, and though it conveys very little idea of the internal construction, one may, however, conclude from it, that the roller, whether it was of wood or of iron, smooth or notched, did not stand perpendicularly, like those of our coffee-mills, but lay horizontally; which gives us reason to conjecture a construction more ingenious than that of the first invention. The axis of the handle had, perhaps, within the body of the mill, a crown-wheel, that turned a spindle, to the lower end of the perpendicular axis of which the roller was fixed. Should this be admitted, it must be allowed also, that the hand-mills of the ancients had not so much a resemblance to the before-mentioned colour-mills as to the philosophical mills of our chemists; and Langelott consequently will not be the real inventor of the latter. On the other side, opposite to that where the handle is, there arise from the mill of Eunostus two shafts, which Gori considers as those of a besom and a shovel, two instruments used in grinding; but as the interior part cannot be seen, it appears to me doubtful whether these may not be parts of the mill itself.

The remains of a pair of old Roman mill-stones were found in the beginning of the last century at Adel in Yorkshire, a description of which was given by Thornsby[1], in the Philosophical Transactions. One of the stones was twenty inches in breadth; thicker in the middle than at the edges, and consequently convex on one side. The other was of the same form, but had that thickness at the edges which the other had in the middle, and some traces of notching could be observed upon it.

I shall not here collect all those passages of the ancients which speak of hand- and cattle-mills, because they have been already collected by others, and afford very little information[2].

[1] No. 282, p. 1285, and in the abridgement by Jones, 1700—20, vol. ii. p. 38.

[2] Joh. Heringii Tractatus de Molendinis eorumque jure. Franc. 1663, 4to. A very confused book, which requires a very patient reader. F. L. Goetzius De Pistrinis Veterum. Cygneæ 1730, 8vo. Extracted chiefly from the

Neither shall I inquire to what Ceres the Grecians ascribed the invention of mills[1]; who Milantes was, to whom that honour has been given by Stephanus Byzantinus[2]; or how those mills were constructed which were first built by Myletes the son of Lelex, king of Laconia[3]. Such researches would be attended with little advantage. I shall proceed therefore to the invention of water-mills.

These appear to have been introduced in the time of Mithridates, Julius Cæsar, and Cicero. Because Strabo[4] relates that there was a water-mill near the residence of Mithridates, some have ascribed the honour of the invention to him; but nothing more can with certainty be concluded from this circumstance, than that water-mills were at that period known, at least in Asia. We are told by Pomponius Sabinus, in his remarks upon a poem of Virgil called Moretus, that the first mill seen at Rome was erected on the Tiber, a little before the time of Augustus; but of this he produces no proof. As he has taken the greater part of his remarks from the illustrations of Servius, and must have had a much completer copy of that author than any that has been printed, he may have derived this information from the same source[5]. The most certain proof that Rome had water-mills in the time of Augustus is

former, equally confused, and filled with quotations from authors who afford very little insight into the history or knowledge of mills. Traité de la Police, par De la Mare.—G. H. Ayrer, De Molarum Initiis; et Prolusio de Molarum Progressibus, Gottiu. 1772.—C. L. Hoheiselii Diss. de Molis Manualibus Veterum. Gedani 1728.—Pancirollus, edit. Salmuth. ii. p. 294.—Histoire de la vie privée des Francois, par Le Grand d'Aussy. Paris, 1782, i. p. 33.—See Fabricii Bibliographia Antiq. Hamburgi, 1760, p. 1002.

[1] Plin. lib. vii. c. 56. [2] Stephan. De Urbibus, v. *μυλαντία*.

[3] Pausanias, iii. c. 20. edit. Kuhnii, p. 260.

[4] Strabo, lib. xii. edit. Almelov. p. 834. In the Greek stands the words *ὑδραλέτης*, perhaps an *ἅπαξ λεγόμενον*, which the scholiasts have explained by a water-mill. In many of the later translations of Strabo that word is wanting.

[5] This Pomponius Sabinus, author of a Commentary on the works of Virgil, is called also Julius Pomponius Lætus, though in a letter he denies that he is the author. He died in 1496. A good account of him may be found in Fabricii Biblioth. Med. et Infimæ Latinitatis, iv. p. 594. There are several editions of his Commentary, the first printed at Basil, 1544. The one I have before me is contained in Vergilii Opera, cum Variorum Commentariis, studio L. Lucii. Basiliæ (1613), fol. Where the poet gives an ingenious description of a hand-mill, Pomponius adds, "Usus molarum ad manum in Cappadocia inventus; inde inventus usus earum ad ventum

the description which has been given of them by Vitruvius (lib. x. 10). We learn from this passage, that the ancients had wheels for raising water, which were driven by being trod upon by men. That condemnation to these machines was a punishment, appears from Artemidorus, lib. i. c. 50, and Sueton. Vita Tiber. cap. 51. And the pretty epigram of Antipater; "Cease your work, ye maids, ye who laboured in the mill; sleep now, and let the birds sing to the ruddy morning; for Ceres has commanded the water-nymphs to perform your task: these, obedient to her call, throw themselves on the wheel, force round the axle-tree, and by these means the heavy mill." This Antipater[1], as Salmasius with great probability asserts, lived in the time of Cicero. Palladius[2] also speaks with equal clearness of water-mills, which he advises to be built on possessions that have running water, in order to grind corn without men or cattle.

There are also other passages of the ancients which are commonly supposed, but without certain grounds, to allude to water-mills. Among these is the following verse of Lucretius[3]:

Ut fluvios versare rotas atque haustra videmus.

It appears also that the water-wheels to which Heliogabalus caused some of his friends and parasites to be bound[4], cannot be considered as mills. These, as well as the *haustra* of Lucretius, were machines for raising water, like those mentioned in the before-quoted passage of Vitruvius[5]. It is however

et ad equos. Paulo ante Augustum molæ aquis actæ Romæ in Tiberi primum factæ, tempore Græcorum, eum fornices diruissent."

[1] This Greek epigram was first made known by Salmasius, in his Annotations on the Life of Heliogabalus by Lampridius. See Historiæ Augustæ Scriptores; ed. C. Salmasius, Par. 1620, fol. p. 193. It is to be found also in Mémoires de l'Académie des Inscriptions, ii. p. 315, and in Analecta Veterum Græcorum, edit. Brunk. ii. p. 119, epig. 39.

[2] Pallad. in Script. De Re Rustica, lib. i. 42, edit. Gesn.

[3] Lucret. v. 517. Compare Salmas. ad Solin. p. 416.

[4] Hist. Aug. Scr. Lamprid. in Vita Heliogabali.

[5] Among the doubtful passages is one of Pliny, lib. xviii. c. 10. "Major pars Italiæ ruido utitur pilo; rotis etiam, quas aqua verset obiter, et molat." So reads Hardouin: but the French translator of Pliny divides these words otherwise, and reads thus: "Major pars Italiæ ruido utitur pilo, rotis etiam quas aqua verset; obiter et molit;" which he translates as follows; "Dans la majeure partie de l'Italie, on se sert d'un pilon raboteux, ou de roues que l'eau fait tourner; et par fois aussi on y emploie la meule." This explana-

evident that there were water-mills at Rome at this period; and it affords matter of surprise that we do not find mention oftener made of them, and that they did not entirely banish the use of the laborious hand- and cattle-mills. That this was not the case, and that the latter were very numerous for some time after, may be concluded from various circumstances. When Caligula, about twenty-three years after the death of Augustus, took away all the horses and cattle from the mills, in order to transport effects of every kind which he had seized, there arose a scarcity of bread at Rome; from which Beroaldus justly infers that water-mills must have been then very rare[1]. Nay, more than three hundred years after Augustus, cattle-mills were so common at Rome, that their number amounted to three hundred[2]. Mention of them, and of the hand-mills always occurs, therefore, for a long time after in the laws. The Jurist Paulus, who lived about the year 240, particularizing the bequest of a baker, mentions *asina molendaria* and *mola*, a mill-ass and a mill[3]. In the year 319 Constantine ordered that all the slaves condemned to the mills should be brought from Sardinia to Rome[4]. Such orders respecting mill-slaves occur also under Valentinian[5]. When by the introduction of Christianity, however, the morals of men became improved, slaves were less frequent; and Ausonius, who lived under Theodosius the Great, about the end of the third century, expressly says, that in his time the practice had ceased of condemning criminals to slavery, and of causing mills to be driven by men.

Public water-mills, however, appear for the first time under Honorius and Arcadius; and the oldest laws which mention

tion is in my opinion very proper; Pliny is not speaking here of the labour of grinding corn, but that of freeing it from the husks, or of converting it into grits. For this purpose a mortar was used, the pestle of which could be so managed that the grain remained whole; but water-wheels were sometimes employed also. I agree with Le Prince (Journal des Scavans, 1779, Septem.), who thinks that Pliny here certainly speaks of a water-mill.

[1] Sueton. Vita Calig. cap. 39.

[2] Petr. Victor. De Regionibus urbis Romæ.

[3] Digestorum lib. xxxiii. tit. 7, 18, Cum de lanienis.

[4] Cod. Theodos. lib. ix. tit. 40, 3, or l. 3, Quicunque. C. Th. de pœnis.

[5] Cod. Theodos. lib. xiv. tit. 3, 7, or l. 7. Post quinquennii, C. Th. de pistoribus. We are told in 1778 that there are no other mills in Sardinia than such as are driven by asses. See Fran. Cetti, Quadrupedi di Sardegna. Sessati, 1778, 8vo.

them, about the year 398, show clearly that they were then a new establishment, which it was necessary to secure by the support of government; and the orders for that purpose were renewed and made more severe by Zeno towards the end of the fifth century[1]. It is worthy of remark, that in the whole code of Justinian one does not find the least mention of wooden pales or posts. which occur in all the new laws; and which, when there were several mills situated in a line on the same stream, occasioned so many disputes. The mills at Rome were erected on those canals which conveyed water to the city; and because these were employed in several arts, and for various purposes, it was ordered that by dividing the water the mills should be always kept going. The greater part of them lay under Mount Janiculum[2]; but, as they were driven by so small a quantity of water, they probably executed very little work; and for this reason, but chiefly on account of the great number of slaves, and the cheap rate at which they were maintained, these noble machines were not so much used, nor were so soon brought to perfection as they might have been. It appears, however, that after the abolition of slavery they were much improved and more employed; and to this a particular incident seems in some measure to have contributed.

When Vitiges, king of the Goths, besieged Belisarius in Rome, in the year 536, and caused the fourteen large expensive aqueducts to be stopped, the city was subjected to great distress; not through the want of water in general, because it was secured against that inconvenience by the Tiber; but by the loss of that water which the baths required, and, above all, of that necessary to drive the mills, which were all situated on these canals. Horses and cattle, which might have been employed in grinding, were not to be found: but Belisarius fell upon the ingenious contrivance of placing boats upon the Tiber, on which he erected mills that were driven by the current. This experiment was attended with complete success; and as many mills of this kind as were necessary were constructed. To destroy these, the besiegers threw into the stream logs of wood and dead bodies, which floated down the river

[1] Cod. Theodos. lib. xiv. tit. 15, 4; and Cod. Justin. lib. xi. tit. 42, 10. Many things relating to the same subject may be found in Cassiodorus.

[2] Procopius, Gothicorum lib. i. c. 9. Fabretti Diss. de aquis et aquæductibus vet. Romæ, p. 176. Grævii Thesaur. Antiq. Rom. iv. p. 1677.

into the city; but the besieged, by making use of booms, to stop them, were enabled to drag them out before they could do any mischief[1]. This seems to be the invention of floating-mills, at least I know of no other. It is certain that by these means the use of water-mills became very much extended; for floating-mills can be constructed almost upon any stream, without forming an artificial fall; they can be stationed at the most convenient places, and they rise and fall of themselves with the water. They are however attended with these inconveniences, that they require to be strongly secured; that they often block up the stream too much, and move slowly; and that they frequently stop when the water is too high, or when it is frozen.

After this improvement the use of water-mills was never laid aside or forgotten: they were soon made known all over Europe; and were it worth the trouble, one might quote passages in which they are mentioned in every century. The Roman, Salic, and other laws[2] provided security for these

[1] The account of Procopius, in the first book of the War of the Goths, deserves to be here given at length:—"When these aqueducts were cut off by the enemy, as the mills were stopped for want of water, and as cattle could not be found to drive them, the Romans, closely besieged, were deprived of every kind of food (for with the utmost care they could scarcely find provender for their horses). Belisarius however being a man of great ingenuity devised a remedy for this distress. Below the bridge which reaches to the walls of Janiculum, he extended ropes well-fastened, and stretched across the river from both banks. To these he affixed two boats of equal size, at the distance of two feet from each other, where the current flowed with the greatest velocity under the arch of the bridge, and placing large mill-stones in one of the boats, suspended in the middle space a machine by which they were turned. He constructed at certain intervals on the river, other machines of the like kind, which being put in motion by the force of the water that ran below them, drove as many mills as were necessary to grind provisions for the city," &c.

[2] "Si quis ingenuus annonam in molino furaverit...Si quis sclusam de farinario alieno ruperit....Si quis ferramentum de molino alieno furaverit...."—Leges Francorum Salicæ, edit. Eccardi, Francof. et Lipsiæ 1720, fol. p. 51. *Sclusa* is translated *sluice*, and there is no doubt that the French word *escluse* is derived from it. All these words come from *schliessen* to shut up, or the Low Saxon *schluten*: but by that word in these laws we can hardly understand those expensive works which we at present call sluices, but probably wickets and what else belonged to the dam. Lex Wisigothorum, lib. viii. tit. 4, 30, may serve further to illustrate this subject: "De confringentibus molina et conclusiones aquarum. Si quis molina violenter effre-

mills, which they call *molina* or *farinaria*; and define a punishment for those who destroy the sluices, or steal the mill-irons (*ferramentum*). But there were water-mills in Germany and France a hundred years before the Salic laws were formed. Ausonius, who lived about the year 379, mentions some which were then still remaining on a small stream that falls into the Moselle, and which were noticed also by Fortunatus[1], in the fifth century. Gregory of Tours, who wrote towards the end of the sixth century, speaks of a water-mill which was situated near the town of Dijon; and of another which a certain abbot caused to be built for the benefit of his convent[2]. Brito, who in the beginning of the thirteenth century wrote in verse an account of the actions of Philip Augustus king of France[3], relates how by the piercing of a dam the mills near Gournay (*castrum Gornacum* or *Cornacum*) were destroyed, to the great detriment of the besieged. In the first crusade, at the end of the eleventh century, the Germans burned in Bulgaria seven mills which were situated below a bridge on a small rivulet, and which seem to have been floating-mills[4]. In deeds of the twelfth and thirteenth century, water-mills are often called *aquimollia*, *aquimoli*, *aquismoli*, *aquimolæ*[5]. Petrus Damiani, one of the fathers of the eleventh century, says, "Sicut aquimolum nequaquam potest sine gurgitis inundantia frumenta permolere, ita, &c.[6]"

At Venice and other places, there were mills which righted

gerit, quod fregit intra triginta dies reparare cogatur.—Eadem et de stagnis, quæ sunt circa molina conclusiones aquarum, præcipimus custodire." The *sclusæ* are here called *conclusiones aquarum*, to which belong also the mounds or dykes. See Corpus Juris Germanici Antiqui, ed. Georgisch. Halæ 1738, 4to, p. 2097. Gregory of Tours calls them *exclusas*. But what is *ferramentum*? The iron-work of our mills cannot be so easily stolen as to render it necessary to secure them by particular laws.

[1] Auson. Mosella, v. 362. Fortunati Carmina, Moguntiæ 1617, 4to, p. 83.

[2] Gregorii Turonensis Opera, Paris, 1699, fol. Hist. lib. iii. 19, p. 126. Ibid. Vita Patrum, 18, p. 1242.

[3] Gul. Britonis Philippidos libri xii. lib. vi. v. 220.

[4] Chronicon Hierosolymitanum, edit. a Reineccio. Helms. 1584, 4to, lib. i. c. 10.

[5] See Carpentieri Gloss. Nov. ad Scriptores medii, ævi, (Supp. ad Ducang.) Paris, 1766, fol. vol. i. p. 266. In a chronicle written in the year 1290, a floating-mill is called *molendinum navale*, also *navencum*; and in another chronicle of 1301, *molendinum pendens*.

[6] Damiani Opera, ed. Cajetani. Paris, 1743, fol. i. p. 105, lib. vi. epist. 23.

themselves by the ebbing and flowing of the tide, and which every six hours changed the position of the wheels. Zanetti[1] has shown, from some old charters, that such mills existed about the year 1044; and with still more certainty in 1078, 1079, and 1107. In one charter are the words: *Super toto ipso aquimolo molendini posito in palude juxta campo alto*; where the expression *aquimolum molendini* deserves to be particularly remarked, as it perhaps indicates that the mill in question was a proper grinding-mill. Should this conjecture be well-founded, it would prove that so early as the eleventh century water-mills were used not only for grinding corn, but for many other purposes.

It appears that hand- and cattle-mills were everywhere still retained at private houses a long time after the erection of water-mills. We read in the Life of St. Benedict, that he had a mill with an ass, to grind corn for himself and his colleagues. Among the legendary tales of St. Bertin, there is one of a woman who, because she ground corn on a fast-day, lost the use of her arm; and of another whose hand stuck to the handle, because she undertook the same work at an unseasonable time. More wonders of this kind are to be found at later periods in the Popish mythology. Such small mills remained long in the convents; and it was considered as a great merit in many ecclesiastics, that they ground their own corn in order to make bread. The real cause of this was, that as the convents were entirely independent of every person without their walls, they wished to supply all their wants themselves as far as possible; and as these lazy ecclesiastics had, besides, too little labour and exercise, they employed grinding as an amusement, and to enable them to digest better their ill-deserved food. Sulpicius Severus[2] gives an account of the mode of living of an Eastern monk in the beginning of the fifth century, and says expressly that he ground his own corn. Gregory of Tours mentions an abbot who eased his monks of their labour at the hand-mill, by erecting a water-mill. It deserves here to be remarked, that in the sixth century malefactors in France were condemned to the mill, as is proved by the history of Septimina the nurse of Childebert[3].

[1] Dell' Origine di alcune Arti Principali Appresso i Veneziani. Ven. 1758, 4to, p. 71.

[2] Dialog. i. 2.

[3] Histor. Francorum, lib. ix. 38, p. 462.

The entrusting of that violent element water to support and drive mills constructed with great art, displayed no little share of boldness; but it was still more adventurous to employ the no less violent but much more untractable, and always changeable wind for the same purpose. Though the strength and direction of the wind cannot be any way altered, it has however been found possible to devise means by which a building can be moved in such a manner that it shall be exposed to neither more nor less wind than is necessary, let it come from what quarter it may.

It is very improbable, or much rather false, that the Romans had wind-mills, though Pomponius Sabinus affirms so, but without any proof[1]. Vitruvius[2], where he speaks of all moving forces, mentions also the wind; but he does not say a word of wind-mills; nor are they noticed either by Seneca[3] or Chrysostom[4], who have both spoken of the advantages of the wind. I consider as false also, the account given by an old Bohemian annalist[5], who says that before the year 718 there were none but wind-mills in Bohemia, and that water-mills were then introduced for the first time. I am of opinion that the author meant to have written *hand- and cattle-mills* instead of *wind-mills*.

It has been often asserted that these mills were first invented in the East, and introduced into Europe by the crusaders; but this also is improbable; for mills of this kind are not at all, or very seldom, found in the East. There are none of them in Persia, Palestine, or Arabia, and even water-mills are there uncommon, and constructed on a small scale. Besides, we find wind-mills before the crusades, or at least at the time when they were first undertaken. It is probable that these buildings may have been made known to a great part of Europe, and

[1] See Pomponius Sabinus, *ut supra*.

[2] Lib. ix. c. 9; x. c. 1, 13.

[3] Natur. Quæst. lib. v. c. 18.

[4] Chrysost. in Psalm. cxxxiv. p. 362.

[5] "At the same period (718) one named Halek the son of Uladi the weak, built close to the city an ingenious mill which was driven by water. It was visited by many Bohemians, in whom it excited much wonder, and who taking it as a model, built others of the like kind here and there on the rivers; for before that time all the Bohemian mills were wind-mills, erected on mountains."—Wenceslai Hagecii Chronic. Bohem. translated into German by John Sandel. Nuremberg, 1697, fol. p. 13.

particularly in France and England[1], by those who returned from these expeditions; but it does not thence follow that they were invented in the East[2]. The crusaders perhaps saw such mills in the course of their travels through Europe; very probably in Germany, which is the original country of most large machines. In the like manner, the knowledge of several useful things has been introduced into Germany by soldiers who have returned from different wars; as the English and French, after their return from the last war, made known in their respective countries many of our useful implements of husbandry, such as our straw-chopper, scythe, &c.

Mabillon mentions a diploma of the year 1105, in which a convent in France is allowed to erect water- and wind-mills, *molendina ad ventum*[3]. In the year 1143, there was in Northamptonshire an abbey (Pipewell) situated in a wood, which in the course of 180 years was entirely destroyed. One cause of its destruction was said to be, that in the whole neighbourhood there was no house, wind- or water-mill built, for which timber was not taken from this wood[4]. In the

[1] See De la Mare, Traité de la Police, &c. *ut supra*.—Déscription du Duché de Bourgogne. Dijon, 1775, 8vo, i. p. 163.—Dictionnaire des Origines, par d'Origny, v. p. 184. The last work has an attracting title, but it is the worst of its kind, written without correctness or judgement, and without giving authorities.

[2] There are no wind-mills at Ispahan nor in any part of Persia. The mills are all driven by water, by the hand, or by cattle. Voyages de Chardin. Rouen, 1723, 8vo, viii. p. 221.—The Arabs have no wind-mills; these are used in the East only in places where no streams are to be found; and in most parts the people make use of hand-mills. Those which I saw on Mount Lebanon and Mount Carmel had a great resemblance to those which are found in many parts of Italy. They are exceedingly simple and cost very little. The mill-stone and the wheel are fastened to the same axis. The wheel, if it can be so called, consists of eight hollow boards shaped like a shovel, placed across the axis. When the water falls with violence upon these boards it turns them round and puts in motion the mill-stone over which the corn is poured.—Darvieux, Reisen, Part iii. Copenh. 1754, 8vo. I did not see either water- or wind-mills in all Arabia. I however found an oil-press at Tehama, which was driven by oxen; and thence suppose that the Arabs have corn-mills of the like kind.—Niebuhr, p. 217.

[3] Mabillon, Annales Ord. Benedicti. Paris, 1713, fol. p. 474.

[4] Dugdale, Mon. i. p. 816.—The letter of donation, which appears also to be of the twelfth century, may be found in the same collection, ii. p. 459. In it occurs the expression *molendinum ventriticum*. In a charter also in vol. iii. p. 107, we read of *molendinum ventorium*. See Dugdale's Monasticon, ed. nov. vol. v. p. 431–442.

twelfth century, when these mills began to be more common, a dispute arose whether the tithes of them belonged to the clergy; and Pope Celestine III. determined the question in favour of the church[1]. In the year 1332, one Bartolomeo Verde proposed to the Venetians to build a wind-mill. When his plan had been examined, a piece of ground was assigned to him, which he was to retain in case his undertaking should succeed within a time specified[2]. In the year 1393, the city of Spires caused a wind-mill to be erected, and sent to the Netherlands for a person acquainted with the method of grinding by it[3]. A wind-mill was also constructed at Frankfort in 1442, but I do not know whether there had not been such there before.

To turn the mill to the wind, two methods have been invented. The whole building is constructed in such a manner as to turn on a post below, or the roof alone, together with the axle-tree, and the wings are moveable. Mills of the former kind are called German-mills, those of the latter Dutch. They are both moved round either by a wheel and pinion within, or by a long lever without[4]. I am inclined to believe that the German-mills are older than the Dutch; for the earliest descriptions which I can remember, speak only of the former. Cardan[5], in whose time wind-mills were very common both in France and Italy, makes however no mention of the latter; and the Dutch themselves affirm, that the mode of building with a moveable roof was first found out by a Fleming in the middle of the sixteenth century[6]. Those mills, by which in Holland the water is drawn up and thrown off from the land, one of which was built at Alkmaar in 1408, another

[1] Decretal Greg. lib. iii. tit. 30. c. 23. [2] Zanetti, *ut supra*.

[3] Lehmann's Chronica der Stadt Speyer. Frankf. 1662, 4to, p. 847. "Sent to the Netherlands for a miller who could grind with the wind-mill."

[4] Descriptions and figures of both kinds may be found in Leupold's Theatrum Machinarum Generale. Leipzig, 1724, fol. p. 101, tab. 41, 42, 43.

[5] De Rerum Varietate, lib. i. cap. 10.

[6] This account I found in De Koophandel van Amsterdam, door Le Long. Amst. 1727, 2 vol. 8vo, ii. p. 584. "The moveable top for turning the mill round to every wind was first found out in the middle of the sixteenth century by a Fleming." We read there that this is remarked by John Adrian Leegwater; of whom I know nothing more than what is related of him in the above work, that he was celebrated on account of various inventions, and died in 1650, in the 75th year of his age.

at Schoonhoven in 1450, and a third at Enkhuisen in 1452, were at first driven by horses, and afterwards by wind. But as these mills were immoveable, and could work only when the wind was in one quarter, they were afterwards placed not on the ground, but on a float which could be moved round in such a manner that the mill should catch every wind[1]. This method gave rise perhaps to the invention of moveable mills.

It is highly probable, that in the early ages men were satisfied with only grinding their corn, and that in the course of time they fell upon the invention of separating the meal from the pollard or bran. This was at first done by a sieve moved with the hands; and even yet in France, when what is called *mouture en grosse* is employed, there is a particular place for bolting, where the sieve is moved with the hand by means of a handle. It is customary also in many parts of Lower Saxony and Alsace, to bolt the flour separately; for which purpose various sieves are necessary. The Romans had two principal kinds, *cribra excussoria* and *pollinaria*, the latter of which gave the finest flour, called *pollen*. Sieves of horse-hair were first made by the Gauls, and those of linen by the Spaniards[2]. The method of applying a sieve in the form of an extended bag to the works of the mill, that the meal might fall into it as it came from the stones, and of causing it to be turned and shaken by the machinery, was first made known in the beginning of the sixteenth century, as we are expressly told in several ancient chronicles[3].

[1] See Beschryving der Stadt Delft, Delft, 1729, folio 625.

[2] Plin. lib. xviii. cap. 11.

[3] At Midsummer 1502, machinery for bolting in mills was first introduced and employed at Zwikau; Nicholas Boller, who gave rise to this improvement, being then sworn master of the bakers' company. It may be thence easily seen, that coarse and not bolted flour, such as is still used in many places, and as was used through necessity at Zwikau in 1641, was before that period used for baking. Chronica Cygnea, auct. Tob. Schmidten. Zwikau, 1656, v. vol. 4to, ii. p. 219. See also Theatri Freibergensis Chronicon. Freyberg, 1653, 4to, ii. p 335. Anno 1580, a great drought and scarcity of water. Of all the mills near town there were only fifteen going; and in order that the people might be better suppl ed with meal, the bolting machinery was removed, and this was attended with such good consequences that each mill could grind as much as before. In Walser's Appenzeller Chronik. 8vo, p. 471, we are told that about that time (1533), a freeman of Memmingen taught the people of Appenzel to make the beautiful white bolted flour so much and so far celebrated.

This invention gave rise to an employment which at present maintains a great many people; I mean that of preparing bolting-cloths, or those kinds of cloth through which meal is sifted in mills. As this cloth is universally used, a considerable quantity of it is consumed. For one bolting-cloth, five yards are required; we may allow, therefore, twenty-five to each mill in the course of a year. When this is considered, it will not appear improbable, that the electorate of Saxony, according to a calculation made towards the end of the seventeenth century, when manufactories of this cloth were established, paid for it yearly to foreigners from twelve to fifteen thousand rix-dollars. That kind of bolting-cloth also which is used for a variety of needle-work, for young ladies' samplers, and for filling up the frames of window-screens, &c., is wove after the manner of gauze, of fine-spun woollen yarn. One might imagine that this manufacture could not be attended with any difficulty; yet it requires many ingenious operations which the Germans cannot easily perform, and with which they are, perhaps, not yet perfectly acquainted. However this may be, large quantities of bolting-cloth are imported from England. It indeed costs half as much again per yard as the German cloth, but it lasts much longer. A bolting-cloth of English manufacture will continue good three months, but one of German will last scarcely three weeks. The wool necessary for making this cloth must be long, well-washed, and spun to a fine equal thread, which, before it is scoured, must be scalded in hot water to prevent it from shrinking. The web must be stiffened; and in this the English have an advantage we have not yet been able to attain. Their bolting-cloth is stiffer as well as smoother, and lets the flour much better through it than ours, which is either very little or not at all stiffened. The places where this cloth is made are also not numerous. A manufactory of it was established at Ostra, near Dresden, by Daniel Kraft, about the end of the seventeenth century; and to raise him a capital for carrying it on, every mill was obliged to pay him a dollar. Hartau, near Zittau, is indebted for its manufactory to Daniel Plessky, a linen-weaver of the latter, who learned the art of making bolting-cloth in Hungary, when on a visit to his relations, and was enabled to carry it on by the assistance of a schoolmaster named Strietzel. Since that period this business

has been continued there, and become common[1]. The cloth which is sent for sale, not only everywhere around the country, but also to Bohemia, Moravia, and Silesia, is wove in pieces. Each piece contains from sixty-four to sixty-five Leipsic ells: the narrowest is ten, and the widest fourteen inches in breadth. A piece of the former costs at present from four to about four dollars and a half, and one of the latter six dollars. This cloth, it must be allowed, is not very white; but it is not liable to spoil by lying in warehouses. Large quantities of bolting-cloth are made also by a company in the duchy of Wurtemberg. At what time this art was introduced there I cannot say; for every thing I know of it I am indebted to a friend, who collected for me the following information in his return through that country. The cloth is not wove in a manufactory, but by eighteen or twenty master weavers, under the inspection of a company who pay them, and who supply all the materials. The company alone has the privilege of dealing in this cloth; and the millers must purchase from their agents whatever quantity they have occasion for[2]. The millers however choose rather, if they can, to supply themselves privately with foreign and other home-made bolting-cloth, as they complain that the weavers engaged by the company do not bestow sufficient care to render their cloth durable: besides, the persons employed to carry about this cloth for sale, often purchase secretly cloth of an inferior quality in other places, and sell it as that of the company. Bolting-cloth is made also at Gera, as well as at Potsdam and Berlin; at the latter of which there is a manufactory of it carried on by the Jews.

For some years past the French have so much extolled a manner of grinding called *mouture économique*, that one might almost consider it as a new invention, which ought to form an epoch in the history of the miller's art. This art, which however is not new, consists in not grinding the flour so fine at once as one may wish, and in putting the meal afterwards several times through the mill, and sifting it through various

[1] Transactions of the Economical Society at Leipsic, 1772. Dresden, 8vo, p. 79.

[2] According to the general rescript of 1750, which has been often renewed. The company obtained this exclusive right as early as the year 1668.

sieves. This method, which in reality has nothing in it either very ingenious or uncommon, was known to the ancient Romans, as we may conclude from the account of Pliny, who names the different kinds of meal, such as *similago*, *simila*, *flos*, *pollen*, *cibarium*, &c.; for these words are not synonymous, but express clearly all the various kinds of meal or flour which were procured from the same corn by repeated grinding and sifting. In general, the Romans had advanced very far in this art[1]; and they knew how to prepare from corn more kinds of meal, and from meal more kinds of bread, than

[1] One may easily perceive by what Pliny says, that the Romans had made a variety of observations and experiments on grinding and baking. By comparing his information with what we know at present, I have remarked two things, which, as they will perhaps be serviceable to those who hereafter may endeavour to illustrate Pliny, I shall lay before the reader. That author says, book xviii. ch. 9, "Quæ sicca moluntur plus farinæ reddunt; quæ salsa aqua sparsa, candidiorem medullam, verum plus retinent in furfure." A question here arises, whether the corn was moistened before it was ground, and whether this was done with fresh or with salt water. If Pliny, as is probable, here means a thorough soaking, he is not mistaken; for it is certain that corn which has been exposed to much wet yields less meal, and that the meal, which is rather gray or reddish than white, will not keep long. The millers also are obliged, when corn has been much wetted, to put it through the mill oftener, because it is more difficult to be ground. It is true also, that when salt water is used for moistening corn, the meal becomes clammier and more difficult to be separated from the bran. It is well known that it is not proper to steep in salt water, malt which is to be ground for beer. On the other hand, a moderate soaking, which requires experience and attention, is useful, and is employed in preparing the finest kinds of flour, such as the Frankfort, Augsburg and Ulm speltmeal, which is exported to distant countries.

There is another passage in the tenth chapter of the same book of Pliny, where he seems to recommend a thorough soaking of corn that is to be ground. "De ipsa ratione pisendi Magonis proponetur sententia: triticum ante perfundi aqua multa jubet, postea evalli, deinde sole siccatum pilo repeti." I am of opinion that we have here the oldest account of the manner of making meal; that is, by pounding. This appears to me probable from the words immediately preceding, which I have above endeavoured to explain, and from the word *evalli*. I do not think that it ought to be translated *to winnow*, as almasius says, in Exercitat. Plinianæ, p. 907; but agree with Gesner in Thesaur. Steph., that it signifies to free the corn from the husk. The corn was first separated from the husks by pounding, which was more easily done after the grain had been soaked; the shelled corn was then soaked again, and by these means rendered so brittle, that it was easily pounded to meal. The like method is employed when people make grits without a mill, only by pounding; a process mentioned by Krünitz in his Encyclopédie, vol. ix. p. 805.

the French have hitherto been able to obtain. Pliny reckons that bread should be one-third heavier than the meal used for baking it; and that this was the proportion in Germany above a hundred years ago, is known from experiments on bread made at different times, which, however uncertain they may always have been, give undoubtedly more bread than meal[1] In latter times the arts of grinding and of baking have declined very much in Italy; and sensible Italians readily acknowledge that their bread is much inferior to that of most parts of Europe, and that in this respect the Germans are their masters[2]. Rome indeed forms an exception; for one can procure there as good bread as in Germany; but it is necessary to acquaint the reader, that it is not baked by Italians but by Germans; and all the bread and biscuit baked at Venice in the public ovens, either for home consumption, the use of shipping, or for exportation, is the work of German masters and journeymen. They are called to Venice expressly for that purpose; and at Rome they form at present a company, and have a very elegant church. The ovens of these German bakers are seldom suffered to cool, and the greater part of the owners of them become rich; but as through avarice they often continue their labour, without interruption, in the greatest heat for several days and nights, scarcely one in ten of them lives to return with his wealth to Germany. The Germans have, it is certain, long supplied the inhabitants of proud Rome, the metropolis of Catholic Christendom, with bread; for in the fifteenth century it was customary in all the great families to use no other than German bread, as is very circumstantially related by Felix Fabri, a Dominican monk, who wrote about the end of the above century, and died in 1502[3].

[1] Further information on this subject may be found collected in Krünitz, Encyclopédie, vol. iii. p. 334. According to experiments mentioned by Köhler, a hundred pounds of meal in Germany produce a hundred and fifty pounds of dough, and these a hundred and fifty-three pounds eleven and a half ounces of good bread.

[2] See the treatise of Rosa, professor of medicine at Pavia, on the baking of bread in Lombardy, in Atti dell' Academia delle Scienze di Siena, tom. iv. p. 321.

[3] "Italy, the most celebrated country in the world, and abundant in grain, has no delicate, wholesome and pleasant bread, but what is baked by a German baker, who, by art and industrious labour, subdues the fire,

The *mouture économique* has been long known in Germany. Sebastian Muller, in the beginning of the seventeenth century, gave so clear a description of it, that the French even acknowledge it[1]. This author says that one Butré, who came to Germany to teach the Germans to grind and to bake, was not a little disconcerted when he found his scholars more expert than their officious master, and that he met with nothing to console him but that, according to his opinion, the mill-stones at Carlsruhe were too small, and that the bolting-sieves were not made in the same manner as those at Paris[2].

Millers and bakers, even in France, practised sometimes this method of grinding so early as the sixteenth century; but it was some time forbidden by the police as hurtful. In the year 1546, those were threatened with punishment who should grind their corn twice[3]; and in 1658 this threat was renewed, and the cause added, that such a practice was prejudicial to the health[4]. Such prohibitions however, made by the police without sufficient grounds, could not prevent intelligent per-

tempers the heat, and equalises the flour in such a manner, that the bread becomes light, fine and delicate; whereas, if baked by an Italian, it is heavy, hard, unwholesome and insipid. His holiness, therefore, prelates, kings, princes and great lords, seldom eat any bread except what is baked in the German manner. The Germans not only bake well our usual bread, but they prepare also biscuit for the use of ships or armies in the time of war, with so much skill, that the Venetians have German bakers only in their public bakehouses; and their biscuit is sent far and wide over Illyria, Macedonia, the Hellespont, Greece, Syria, Egypt, Libya, Mauritania, Spain, France, and even to the Orkney Islands and Britain, to be used by their own seamen, or sold to other nations."—Historia Suevorum, lib. i. c. 8. This history of Felix Fabri may be found in Suevicarum Rerum Scriptores, Goldasti. Franc. 1605, 4to, and Ulm, 1727, fol.

[1] Bericht von Brodtbacken, etc., durch Sab. Mullern, Leipsig, 1616, 4to. Muller's work is republished in Arcana et Curiositates Œconomicæ. By David Maiern, 1706, 8vo.

[2] Schreber, in his Observations on Malouin, shows that the mill-stones in France are too large.

[3] Traité de la Police, par De la Marc, ii. p. 259.

[4] "Défenses sont aussi faites à tous boulangers, tant maîtres que forains, de faire remoudre aucun son, pour par après en faire et fabriquer du pain, attendu qu'il seroit indigne d'entrer au corps humain, sur peine de quarante-huit livres Parisis d'amende."—De la Mare, p. 228. The following was the true cause of this prohibition. As a heavy tax in kind was demanded for all the meal brought to Paris, many sent thither not meal, but

sons from remarking that the bran still contained meal, which, when separated from it, would be as proper for food as the first. Those who had observed this were induced, by the probability of advantage, to try to separate the remaining meal from the bran; and the attempt was attended with success, but it was necessary to keep it concealed. Malouin relates, that above a hundred years before, a miller at Senlis employed this method, and that the same practice was generally, though privately, introduced at all the mills in the neighbourhood. There were people who made a trade of purchasing bran in order to separate it from the meal, which they sold; and it is probable that many of them carried the art too far, and even ground bran along with the meal. This was done chiefly during times of scarcity, as in the year 1709. As men at that time were attentive to every advantage, this art was more known and more used, so that at length it became common, The clergy of the royal chapel and parish church at Versailles sent their wheat to be ground at an adjacent mill; it was, according to custom, put through the mill only once, and the bran, which still contained a considerable quantity of meal, was sold for fattening cattle. In time, the miller, having learned the *mouture économique*, purchased the bran from these ecclesiastics, and found that it yielded him as good flour as they procured from the whole wheat. The miller at length discovered to them the secret, and gave them afterwards fourteen bushels of flour from their wheat, instead of eight which he had given them before. This voluntary discovery of the miller was made in 1760, and it is probable that the art was disclosed by more at the same time. A baker named Malisset proposed to the lieutenant-général de police to teach a method, by which people could grind their corn with more advantage; and experiments were set on foot and published, which proved the possibility of it. A mealman of Senlis, named Buquet, who had the inspection of the mill belonging to the large hospital at Paris, made the same proposal; the result of his experiments, conducted under the direction of magistrates, was printed; the investigation of this art was

bran abundant in meal, which they caused to be ground and sifted there, and by these means acquired no small gain. When the tax was abolished, an end was put to this deception, which would otherwise have brought the *mouture économique* much sooner to perfection.

now taken up by men of learning, who gave it a suitable name; and they explained it, made calculations on it, and recommended it so much, that the *mouture économique* engaged the attention of all the magistrates throughout France[1]. Government sent Buquet to Lyons in 1764, to Bordeaux in 1766, to Dijon in 1767, and to Montdidier in 1768; and the benefit which France at present derives from this improvement is well worth that trouble. Before that period, a Paris *sétier* yielded from eighty to ninety pounds of meal, and from one hundred and fifty to one hundred and sixty pounds of bran; but the same quantity yields now one hundred and eighty-five, and according to the latest improvements one hundred and ninety-five pounds of meal. In the time of St. Louis, from four to five *sétiers* were reckoned necessary for the yearly maintenance of a man, and these even were scarcely sufficient; as many were allowed to the patients in the hospital aux Quinze-Vingts; and such was the calculation made by Budée in the sixteenth century[2]. When the miller's art was everywhere improved, these four *sétiers* were reduced to three and a half, and after the latest improvements to two.

Mills by which grain is only freed from the husk and rounded, are called barley-mills, and belong to the new inventions. At first barley was prepared only by pounding, but afterwards by grinding; and as it was more perfectly rounded by the latter method, it was distinguished from that made by pounding by the name of pearl-barley. Barley-mills differ very little in their construction from meal-mills; and machinery for striking barley is generally added to the latter. The principal difference is that the mill-stone is roughhewn around its circumference; and, instead of an understone, has below it a wooden case, within which it revolves, and which, in the inside, is lined with a plate of iron pierced like a grater, with holes, the sharp edges of which turn upwards. The barley is thrown upon the stone, which, as it runs round, draws it in, frees it from the husk, and rounds it; after which it is put into sieves and sifted. At Ulm, however, the well-known Ulm barley is struck by a common mill, after the stones have been separated a sufficient distance from each

[1] Histoire de la Vie Privée des François, par M. Le Grand d'Aussy. Paris, 1782, 3 vols. 8vo, i. p. 50.

[2] Budæus De Asse. Basiliæ, 1556, fol. p. 214.

other. The first kind of barley-mills is a German invention. In Holland the first was erected at Saardam not earlier than the year 1660. This mill, which at first was called the Pellikaan, scarcely produced in several years profit sufficient to maintain a family; but in the beginning of the last century there were at Saardam fifty barley-mills, which brought considerable gain to their proprietors[1].

As long as the natural freedom of man continued unrestrained by a multiplicity of laws, every person was at liberty to build on his own lands and possessions whatever he thought proper, and not only water- but also wind-mills. This freedom was not abridged even by the Roman law[2]. But as it is the duty of rulers to consult what is best for the whole society under their protection, princes took care that no one should make such use of common streams as might impede or destroy their public utility[3]. On this account no individual was permitted to construct a bridge over any stream; and it is highly probable that the proprietors of land, when water-mills began to be numerous, restrained, from the same principle, the liberty of erecting them, and allowed them only, when after a proper investigation they were declared to be not detrimental. Water-mills, therefore, were included among what were called *regalia*; and among these they are expressly reckoned by the emperor Frederic I.[4] On small streams however which were not navigable, the proprietors of the banks might build mills everywhere along them[5].

The avarice of landholders, favoured by the meanness and injustice of governments, and by the weakness of the people, extended this regality not only over all streams, but also over the air and wind-mills. The oldest example of this with which I am at present acquainted, is related by Jargow[6]. In the end of the fourteenth century, the monks of the celebrated but long since destroyed monastery of Augustines, at Winds-

[1] De Koophandel van Amsterdam, door Le Long. ii. p. 538.

[2] Digestorum lib. xxxix. tit. 2. 24.

[3] *Ibid.* lib. xliii. tit. 12. 1.

[4] See a diploma of Frederic I., dated 1159, in Tolneri Codex Diplomaticus Palatinus, Franc. 1700, fol. p. 54. In Reliquiæ Manuscriptorum, P. Ludewig. Franc. 1720, 8vo, ii. p. 200, we read an instance of the emperor Frederic I. having forbidden the building of a mill.

[5] Digestor. lib. xliii. tit. 11, 12.

[6] Einleitung in die Lehre von den Regalien. Rostock, 1757, 4to, p. 494.

heim, in the province of Overyssel, were desirous of erecting a wind-mill not far from Zwoll; but a neighbouring lord endeavoured to prevent them, declaring that the wind in that district belonged to him. The monks, unwilling to give up their point, had recourse to the bishop of Utrecht, under whose jurisdiction the province had continued since the tenth century. The bishop, highly incensed against the pretender who wished to usurp his authority, affirmed that no one had power over the wind within his diocese but himself and the church at Utrecht, and he immediately granted full power, by letters patent, dated 1391, to the convent at Windsheim, to build for themselves and their successors a good wind-mill, in any place which they might find convenient[1]. In the like manner the city of Haerlem obtained leave from Albert count palatine of the Rhine to build a wind-mill in the year 1394[2].

Another restraint to which men in power subjected the weak, in regard to mills, was, that vassals were obliged to grind their corn at their lord's mill, for which they paid a certain value in kind. The oldest account of such ban-mills, *molendina bannaria*, occurs in the eleventh century. Fulbert, bishop of Chartres, and chancellor of France, in a letter to Richard duke of Normandy, complains that attempts began to be made to compel the inhabitants of a part of that province to grind their corn at a mill situated at the distance of five leagues[3]. In the chronicle of the Benedictine monk Hugo de Flavigny, who lived in the eleventh and twelfth century, we find mention of *molendina quatuor cum banno ipsius villæ*[4]. More examples of this servitude, *secta ad molendinum*, in the twelfth and thirteenth centuries, may be seen in Du Fresne, under the words *molendinum bannale*.

It is not difficult to account for the origin of these ban-mills. When the people were once subjected to the yoke of slavery, they were obliged to submit to more and severer servitudes, which, as monuments of feudal tyranny, have continued even to more enlightened times. De la Mare[5] gives an instance

[1] Chronicon Canon. reg. ord. August. capituli Windesemensis; auctore Joh. Buschio. Antv. 1621, 8vo, p. 73.

[2] Schrevelii Harlemum. Lugd. Bat. 1647, 4to, p. 181.

[3] This letter of Fulbert may be found in Maxima Bibliotheca Veterum Patrum. Lugduni 1677, fol. tom. xviii. p. 9.

[4] In Labbei Biblioth. Manuscr. i. p. 132.

[5] Traités de la Police, ii. p. 151.

where a lord, in affranchising his subjects, required of them, in remembrance of their former subjection, and that he might draw as much from them in future as possible, that they should agree to pay a certain duty, and to send their corn to be ground at his mill, their bread to be baked in his oven, and their grapes to be pressed at his wine-press. But the origin of these servitudes might perhaps be accounted for on juster grounds. The building of mills was at all times expensive, and undertaken only by the rich, who, to indemnify themselves for the money expended in order to benefit the public, stipulated that the people in the neighbourhood should grind their corn at no other mills than those erected by them.

VERDIGRIS, OR SPANISH GREEN.

RESPECTING the preparation of verdigris, various and in part contradictory opinions have been entertained; and at present, when it is with certainty known, it appears that the process is almost the same as that employed in the time of Theophrastus, Dioscorides, and Vitruvius[1]. At that period, however, every natural green copper salt was comprehended under the name of *ærugo*. Dioscorides and Pliny say expressly, that a substance of the nature of those stones which yielded copper when melted, was scraped off in the mines of Cyprus; as is still practised in Hungary, where the outer coat of the copper ore is collected in the like manner, and afterwards purified by being washed in water. Another species, according to the account of Dioscorides, was procured from the water of a grotto in the same island; and the most saleable natural verdigris is still collected by a similar method in Hungary. The clear water which runs from old copper-works is put into large vessels, and after some time the green earth falls to the bottom as a sediment.

[1] Dioscorid. lib. v. cap. 91, 92. Theophrastus De Lapidibus, edit. Heinsii. p. 399. Plin. lib. xxxiv. cap. 11, 12. Oribasius, lib. xiii. Stephani Medicæ Artis Principes, p. 453. Vitruv. lib. vii. cap. 12.

The artificial *ærugo* of the ancients, however, was our verdigris, or copper converted into a green salt by acetic acid. To discover the method of procuring this substance could not be difficult, as that metal contracts a green rust oftener than is wished, when in the least exposed to acids. The ancients, for this purpose, used either vessels and plates of copper, or only shavings and filings; and the acid they employed was either the sourest vinegar, or the sour remains left when they made wine; such as grapes become sour, or the stalks and skins after the juice had been pressed from them[1]. Sometimes the copper was only exposed to the vapour of vinegar in close vessels, so that it did not come into immediate contact with the acid; in the same manner as was practised with plates of lead in the time of Theophrastus, when white-lead was made, and as is still practised at present. Sometimes the metal was entirely covered with vinegar, or frequently besprinkled with it, and the green rust was from time to time scraped off; and sometimes copper filings were pounded with vinegar in a copper mortar, till they were changed into the wished-for green salt. This article was frequently adulterated, sometimes with stones, particularly pumice-stone reduced to powder, and sometimes with copperas. The first deception was easily discovered; and to detect the second, nothing was necessary but to roast the verdigris, which betrayed the iron by becoming red; or to add to the verdigris some gall-nut, the astringent ingredients of which united with the oxide of iron of the copperas, and formed a black ink.

In early periods verdigris was used principally for making plasters, and for other medicinal purposes; but it was employed also as a colour, and on that account it is by Vitruvius reckoned among the pigments. When applied to the former purpose, it appears that the copper salt was mixed with various other salts and ingredients. One mixture of this kind was called vermicular verdigris[2], the accounts of which in ancient

[1] Plinius: *vinacea*. Dioscorides: *στέμφυλα*. Theophrastus: *τρύξ*. The last word has various meanings: sometimes it signifies squeezed grapes; sometimes wine lees, &c., of which Niclas gives examples in his Observations on Geop. lib. vi. c. 13, p. 457; but it can never be translated by *amurca*, though that word is used by Furlanus, the translator of Theophrastus. The old glossary says, *Ἀμυργή, ἐστὶν δὲ τρὺξ ἐλαίου*. Oil, however, has nothing to do with verdigris.

[2] *Ἰὸς σκωληξ*, ærugo scolacea, or vermicularis.

authors seem to some commentators to be obscure; but in my opinion we are to understand by them, that the ingredients were pounded together till the paste they formed assumed the appearance of pieces or threads like worms; and that from this resemblance they obtained their name. For the same reason the Italians give the name of *vermicelli* to wire-drawn paste of flour used in cookery[1]. When the process for making this kind of verdigris did not succeed, the workmen frequently added gum to it, by which the paste was rendered more viscous; but this mixture is censured both by Pliny and Dioscorides. It appears that the greater part of the verdigris in ancient times was made in Cyprus, which was celebrated for its copper-works, and in the island of Rhodes.

At present considerable quantities of verdigris are manufactured at Montpelier in France, and by processes more advantageous than those known to the ancients[2]. The dried stalks of grapes are steeped in strong wine, and with it brought to a sour fermentation. When the fermentation has ceased, they are put into an earthen pot, in alternate layers with plates of copper, the surface of which in a few days is corroded by the acetic acid, and the salt is then scraped off. It is certain, that, even in the fifteenth century, the making of verdigris was an old and profitable branch of commerce in France. The city of Montpelier having been obliged to expend large sums in erecting more extensive buildings to carry it on, and having had very small profits for some years before, received by letters patent from Charles VI., in 1411, permission to demand sixteen sous for every hundred weight of verdigris made there. In later times this trade has decayed very much. Between the years 1748 and 1755, from nine to ten thousand quintals were manufactured annually, by which the proprietors had a clear profit of 50,000 crowns; but a sudden change

[1] Should this explanation be just, we ought for *æruca*, the name given by Vitruvius to verdigris, to read *eruca*: though the conjecture of Marcellus Vergilius (Dioscorides, interprete Mar. Vergilio. Coloniæ, 1529, fol. p. 656), that the reading should be *ænea* or *ærea*, is no less probable; for by this epithet its difference from *æruyo ferri* was frequently distinguished.

[2] [Dr. Ure states, in his Dictionary of Arts and Manufactures, that the manufacture of verdigris at Montpelier is altogether domestic. In most wine farm-houses there is a verdigris cellar; and its principal operations are conducted by the females of the family. They consider the forming the strata, and scraping off the verdigris the most troublesome part.]

seems to have taken place, for in 1759 the quantity manufactured was estimated at only three thousand quintals. This quantity required 630 quintals of copper, valued at 78,750 livres: the expenses of labour amounted to 1323 livres; the necessary quantity of wine, 1033 measures, to 46,485 livres, and extraordinaries to 10,330 livres; so that the three thousand quintals cost the manufacturers about 136,888 livres. In the year 1759, the pound of verdigris sold for nine sous six deniers: so that the three thousand quintals produced 142,500 livres, which gave a net profit of only 5612 livres. Other nations, who till that period had purchased at least three-fourths of the French verdigris, made a variety of experiments in order to discover a method of corroding copper which might be cheaper; and some have so far succeeded that they can supply themselves without the French paint in cases of necessity [1].

In commerce there is a kind of this substance known under the name of distilled verdigris, which is nothing else than verdigris purified, and crystallized by being again dissolved in vinegar [2]. For a considerable period this article was manufactured solely by the Dutch, and affords an additional example of the industry of that people. Formerly there was only one person at Grenoble acquainted with this art, which he kept secret and practised alone; but for some years past manufactories of the same kind have been established in various parts of Europe.

The German name of verdigris (*Spangrün*) has by most authors been translated Spanish green; and it has thence been concluded that we received that paint first from the Spaniards. This word and the explanation of it are both old; for we find *ærugo*, and *viride Hispanicum*, translated *Spangrün*, *Spon-*

[1] [In England large quantities of verdigris are now prepared by arranging plates of copper alternately with pieces of coarse woollen cloth steeped in crude pyroligneous acid, which is obtained by the destructive distillation of wood.]

[2] [Verdigris is a mixture of three compounds of acetic acid with oxide of copper, which contain a preponderance of the base, hence basic acetates; distilled verdigris is made by digesting verdigris, or the mixture of basic acetates of copper, with excess of acetic acid and crystallizing by evaporation: the acid then exists in such proportions as to form a neutral acetate of copper.]

grün, or *Spansgrün*, in many of the earliest dictionaries[1], such as that printed in 1480[2]. For this meaning, however, I know no other proof than the above etymology, which carries with it very little probability; and I do not remember that I ever read in any other works that verdigris first came from the Spaniards.

SAFFRON.

THAT the Latin word *crocus* signified the same plant which we at present call saffron, and which, in botany, still retains the ancient name, has, as far as I know, never been doubted; and indeed I know no reason why it should, however mistrustful I may be when natural objects are given out for those which formerly had the like names. The moderns often apply ancient names to things very different from those which were known under them by the Greeks and the Romans: but what we read in ancient authors concerning *crocus* agrees in every respect with our saffron, and can scarcely be applied to any other vegetable production. *Crocus* was a bulbous plant, which grew wild in the mountains. There were two species of it, one of which flowered in spring, and the other in autumn. The flowers of the latter, which appeared earlier than the green leaves that remained through the winter, contained those small threads or filaments[3] which were used as a medicine and a paint, and employed also for seasoning various kinds of food[4].

[1] Frisch's Worterbuch, p. 291. In the works of George Agricola, printed together at Basle, 1546, fol., we find in p. 473, where the terms of art are explained, "Ærugo, Grünspan, or Spansch-grün, quod primo ab Hispanis ad Germanos sit allata; barbari nominant viride æris."

[2] By Conrad Zeninger, Nuremberg. In that scarce work, Josua Maaler, Teutsche Spraach oder Dictionarium Germano-Latinum, Zurich, 1561, 4to, ærugo is called Spangrüne.

[3] [The stigmata of Botanists.]

[4] Plin. lib. xxi. cap. 6. Geopon. lib. xi. cap. 26, and Theophrast. Histor. Plant. lib. vi. cap. 6, where Joh. Bod. von Stapel, p. 661, has collected, though not in good order, every thing to be found in the ancients respecting saffron. The small aromatic threads, abundant in colour, the only parts of the whole plant sought after, were by the Greeks called γλωχῖνες,

It appears that the medicinal use, as well as the name of this plant, has always continued among the Orientals; and the Europeans, who adopted the medicine of the Greeks, sent to the Levant for saffron[1], until they learned the art of rearing it themselves; and employed it very much until they were made acquainted with the use of more beneficial articles, which they substituted in its stead. Those who are desirous of knowing the older opinions on the pharmaceutical preparation of saffron, and the diseases in the curing of which it was employed, may read Hertodt's Crocologia, where the author has collected all the receipts, and even the simplest, for preparing it[2].

What in the ancient use of saffron is most discordant with our taste at present, is the employing it as a perfume. Not only were halls, theatres, and courts, through which one wished to diffuse an agreeable smell, strewed with this plant[3], but it entered into the composition of many spirituous extracts, which retained the same scent; and these costly smelling waters were often made to flow in small streams, which spread abroad their much-admired odour[4]. Luxurious people even moistened or filled with them all those things with which they were desirous of surprising their guests in an agreeable manner[5], or with which they ornamented their apartments. From saffron, with the addition of wax and other ingredients, the Greeks as well as the Romans prepared also scented salves, which they used in the same manner as our ancestors their balsams[6].

κροκίδες, or τρίχες; and by the Romans *spicæ*. They are properly the end of the pistil, which is cleft into three divisions. A very distinct representation of this part of the flower may be seen in plate 184 of Tournefort's Institut. Rei Herbariæ, [or in Stephens and Churchill's Medical Botany.]

[1] On this account we often find in prescriptions, Recipe croci Orien talis . . . . .

[2] Jena, 1670, 8vo.

[3] See Beroald's Observations on the 54th chapter of the Life of Nero by Suetonius; and Spartian, in the Life of Adrian, chap. 19.

[4] Lucan, in the ninth book of his Pharsalia, verse 809, describing how the blood flows from every vein of a person bit by a kind of serpent found in Africa, says that it spouts out in the same manner as the sweet-smelling essence of saffron issues from the limbs of a statue.

[5] Petron. Satyr. cap. 60.

[6] Of the method of preparing this salve or balsam, mentioned by Athenæus, Cicero, and others, an account is to be found in Dioscorides, lib. i. c. 26.

Notwithstanding the fondness which the ancients showed for the smell of saffron, it does not appear that in modern times it was ever much esteemed. As a perfume, it would undoubtedly be as little relished at present as the greater part of the dishes of Apicius, fricassees of sucking puppies[1], sausages, and other parts of swine, which one could not even mention with decency in genteel company[2]; though it certainly has the same scent which it had in the time of Ovid, and although our organs of smelling are in nothing different from those of the Greeks and the Romans. From parts of the world to them unknown, we have, however, obtained perfumes which far excel any with which they were acquainted. We have new flowers, or, at least, more perfect kinds of flowers long known, which, improved either by art or by accident, are superior in smell to all those in the gardens of the Hesperides, of Adonis and Alcinous, so much celebrated. We have learned the art of mixing perfumes with oils and salts, in such a manner as to render them more volatile, stronger, and more pleasant; and we know how to obtain essences such as the ancient voluptuaries never smelt, and for which they would undoubtedly have given up their saffron. The smelling-bottles and perfumes which are often presented to our beauties, certainly far excel that promised by Catullus to a friend, with the assurance that his mistress had received it from Venus and her Cupids, and that when he smelt it he would wish to become all nose:

> Nam unguentum dabo quod mcæ puellæ
> Donarunt Veneres Cupidinesque,
> Quod tu quom olfacies, deos rogabis,
> Totum ut te faciant, Fabulle, nasum.

It cannot, however, be denied that both taste and smell depend very much on imagination. We know that many ar-

[1] Plin. lib. xxix. cap. iv.

[2] Martial, b. xiii. ep. 43, praises a cook who dressed the dugs of a sow with so much art and skill, that it appeared as if they still formed a part of the animal, and were full of milk. A dish of this sort is mentioned by Apicius, lib. vii. cap. 2. The same author gives directions, book vii. chap. i. for cooking that delicious dish of which Horace says, ep. i. 15, 41, "Nil vulva pulchrius ampla." Further information on this subject may be found in the notes to Pliny's Epistles, lib. i. 15; Plin. lib. xi. c. 37; Martial. Epig. xiii. 56; and, above all, in Lottichii Commentar. in Petronium, lib. i. cap. 18.

ticles of food, as well as spices, are more valued on account of their scarcity and costliness than they would otherwise be. Hence things of less value, which approach near to them in quality, are sought after by those who cannot afford to purchase them; and thus a particular taste or smell becomes fashionable. Brandy and tobacco were at first recommended as medicines; they were therefore much used, and by continual habit people at length found a pleasure in these potent and almost nauseating articles of luxury. Substances which gratify the smell become, nevertheless, like the colour of clothes, oft unfashionable when they grow too common. Certain spiceries, in which our ancestors delighted, are insupportable to their descendants, whose nerves are weak and more delicate; and yet many of the present generation have accustomed themselves to strong smells of various kinds, by gradually using them more and more, till they have at length become indispensable wants. Some have taken snuff rendered so sharp by powdered glass, salts, antimony, sugar of lead, and other poisonous drugs, that the olfactory nerves have been rendered callous, and entirely destroyed by it.

That saffron was as much employed in seasoning dishes as for a perfume, appears from the oldest work on cookery which has been handed down to us, and which is ascribed to Apicius. Its use in this respect has been long continued, and in many countries is still more prevalent than physicians wish it to be. Henry Stephen says, "Saffron must be put into all Lent soups, sauces, and dishes: without saffron we cannot have well-cooked peas[1]."

It may readily be supposed that the great use made of this plant in cookery must have induced people to attempt to cultivate it in Europe; and, in my opinion, it was first introduced into Spain by the Arabs, as may be conjectured from its name, which is Arabic, or rather Persian[2]. From Spain it

[1] Apologie pour Herodote, par H. Estienc. A la Haye, 1735, 2 vols. 8vo.

[2] Meninski, in his Turkish Lexicon, has *Zae' feran*, crocus. Golius gives it as a Persian word. That much saffron is still cultivated in Persia, and that it is of the best kind, appears from Chardin. See his Travels, printed at Rouen, 1723, 10 vols. 12mo. iv. p. 37. That the Spaniards borrowed the word *safran* from the Vandals is much more improbable. It is to be found in Joh. Marianæ Histor. de Rebus Hispaniæ. Hagæ, 1733, fol. i. p. 147. The author, speaking of foreign words introduced into the Spanish language, says, "Vandalis aliæ voces acceptæ feruntur, *camara, azafran*," &c.

was, according to every appearance, carried afterwards to France, perhaps to Albigeois, and thence dispersed into various other parts[1]. Some travellers also may, perhaps, have brought bulbs of this plant from the Levant. We are at least assured that a pilgrim brought from the Levant to England, under the reign of Edward III., the first root of saffron, which he had found means to conceal in his staff, made hollow for that purpose[2]. At what period this plant began to be cultivated in Germany I do not know; but that this was first done in Austria, in 1579, is certainly false. Some say that Stephen von Hausen, a native of Nuremberg, who about that time accompanied the imperial ambassador to Constantinople, brought the first bulbs to Vienna, from the neighbourhood of Belgrade. This opinion is founded on the account of Clusius, who, however, does not speak of the autumnal saffron used as a spice, but of an early sort, esteemed on account of the beauty of its flowers[3]. Clusius has collected more species of this plant than any of his predecessors; and has given an account by whom each of them was first made known.

In the fifteenth and following century, the cultivation of saffron was so important an article in the European husbandry, that it was omitted by no writer on that subject; and an account of it is to be found in Crescentio, Serres, Heresbach, Von Hohberg, Florinus, and others. In those periods, when it was an important object of trade, it was adulterated with various and in part noxious substances; and attempts were made in several countries to prevent this imposition by severe penalties. In the year 1550, Henry II., king of France, issued an order for the express purpose of preventing such frauds, the following extract from which will show some of the methods employed to impose on the public in the sale of this article[4]: "For some time past," says the order, "a certain quantity of the said saffron has been found altered, disguised

[1] Rozier, Cours complet d'Agriculture, i. p. 266.

[2] It is reported at Saffron-Walden, that a pilgrim, proposing to do good to his country, stole a head of saffron, and hid the same in his palmer's staff, which he had made hollow before on purpose, and so he brought this root into this realm, with venture of his life; for if he had been taken, by the law of the country from whence it came, he had died for the fact.—Hakluyt, vol. ii. p. 164.

[3] Clusii Rar. Plant. Hist. 1601, fol. p. 207

[4] Traité de Police, par De la Mare, iii. p. 428.

and sophisticated, by being mixed with oil, honey, and other mixtures, in order that the said saffron, which is sold by weight, may be rendered heavier; and some add to it other herbs, similar in colour and substance to beef over-boiled, and reduced to threads, which saffron, thus mixed and adulterated, cannot be long kept, and is highly prejudicial to the human body; which, besides the said injury, may prevent the above-said foreign merchants from purchasing it, to the great diminution of our revenues, and to the great detriment of foreign nations, against which we ought to provide," &c.

[The high price demanded for saffron offers considerable temptation to adulteration, and this is not uncommonly taken advantage of. The stigmata of other plants, besides the true saffron crocus (*Crocus sativus*), are frequently mixed with those which are genuine; moreover, many other foreign substances are added, such as the florets of the safflower (*Carthamus tinctorius*), those of the marigold (*Calendula officinalis*), slices of the flower of the pomegranate, saffron from which the colouring has been previously extracted, and even fibres of smoked beef. Most of these adulterations may be detected by the action of boiling water, which softens and expands the fibres, thus exposing their true shape and nature. The cake saffron of commerce appears entirely composed of foreign substances. Great medicinal virtues were formerly attributed to saffron. Its principal use is now as a colouring matter.]

ALUM.

This substance affords a striking instance how readily one may be deceived in giving names without proper examination. Our alum was certainly not known to the Greeks or the Romans; and what the latter called *alumen*[1] was vitriol, (the green sulphate of iron)[2]; not however pure, but such as forms in mines

[1] Called by the Greeks στυπτηρία.

[2] [It is scarcely necessary to observe, that many of the compounds of sulphuric acid with metallic oxides were formerly commonly termed *vitriols*

To those who know how deficient the ancients were in the knowledge of salts, and of mineralogy in general, this assertion will without further proof appear highly probable[1]. Alum and green vitriol are saline substances which have some resemblance; both contain the same acid called the vitriolic or sulphuric; both have a strong astringent property, and on this account are often comprehended under the common name of styptic salts; and both are also not only found in the same places, but are frequently obtained from the same minerals. The difference, that the vitriols are combinations of sulphuric acid with a metallic oxide, either that of iron, copper or zinc, and alum on the other hand with a peculiar white earth, called on this account alumina, has been established only in modern times[2].

A stronger proof however in favour of my assertion, is what follows:—The Greeks and the Romans speak of no other than natural alum; but our alum is seldom produced spontaneously in the earth, and several of our most accurate mineralogists, such as Scopoli and Sage, deny the existence of native alum[3]. Crystals of real alum are formed very rarely on minerals which abound in a great degree with aluminous particles, when they have been exposed a sufficient time to the open air and the rain; and even then they are so small and so much scattered, that it requires an experienced and attentive observer to know and discover them. The smallest trace of alum-works is not to be found in the ancients, nor even of works for making

from their glassy appearance; thus, the green vitriol, or briefly vitriol, is the sulphate of the protoxide of iron, white vitriol is sulphate of zinc, and blue vitriol is the sulphate of copper. Sulphuric acid is still more generally known by the name of oil of vitriol and vitriolic acid, from its having been originally obtained by distilling green vitriol.]

[1] [There can be little doubt however that even Pliny was acquainted with our alum, but did not distinguish it from sulphate of iron, for he informs us that one kind of alum was white and was used for dyeing wool of bright colours.—Pereira's Materia Medica, vol. i.]

[2] [The alums, for at present several kinds are distinguished, are not merely combinations of sulphuric acid and the earth alumina, but double sulphates, the one constituent being sulphate of alumina, the other either sulphate of potash, sulphate of ammonia, sulphate of soda, &c. The alum of this country generally contains potash, that of France ammonia, or both potash and ammonia, hence the name potash-alum, ammonia-alum, &c.]

[3] [Although native alum is not abundant, there is no question of its occasional occurrence.]

vitriol (sulphate of iron), except what is mentioned by Pliny, who tells us that blue vitriol was made in Spain by the process of boiling; and this circumstance he considers as the only one of its kind, and so singular, that he is of opinion no other salt could be obtained in the same manner[1]. Besides, everything related by the ancients of their alum agrees perfectly with native vitriols: but to describe them all might be difficult; for they do not speak of pure salts, but of saline mixtures, which nature of itself exhibits in various ways, and under a variety of forms; and every small difference in the colour, the exterior or interior conformation, however accidental, provided it could be clearly distinguished, was to them sufficient to make a distinct species, and to induce them to give it a new name[2].

The celebrity which the ancient alum had, as a substance extremely useful in dying and medicine, was entirely forgotten when the alum of the moderns became known; but this celebrity was again revived when it was discovered that real alum could be often made from minerals containing sulphur compounds; or that where the latter are found there are generally minerals which abound with it. In many of these places alum-works have in the course of time been erected; and this circumstance has served in some measure to strengthen the opinion that the alum of the ancients and that of the moderns are the same salt; because where the former was found in ancient times, the latter has since been procured by a chemical process. Some historians of the fifteenth century even speak of the alum-works erected at that period, as if the art of making this salt had only been revived in Europe.

The ancients procured their alum from various parts of the world. Herodotus mentions Egyptian alum; for he tells us that when the people of Delphos, after losing their temple by a fire, were collecting a contribution in order to rebuild it, Amasis king of Egypt sent them a thousand talents of alum[3]. In Pliny's time the Egyptian alum was accounted the best. It is well known that real alum is reckoned among the exports

[1] Plin. lib. xxxiv. c. 12. The same account is given by Isidor. Origin. lib. xvi. c. 2, and by Dioscorides, lib. v. c. 114. The latter, however, differs from Pliny in many circumstances.

[2] Those who are desirous of seeing everything that the ancients have left us respecting their alum may consult Aldrovandi Museum Metallicum, Lugd. 1636, fol. p. 334.

[3] Herodot. lib. ii. c. 180.

of Egypt at present, but I am acquainted with no author who mentions the place where it is found or made, or who has described the method of preparing it.

The island of Melos, now called Milo, was particularly celebrated on account of its alum, as we learn from Diodorus Siculus, Celsus, Pliny and others, though none was to be found there in the time of Diodorus[1]. This native vitriol has been observed in the grottos of that island by several modern travellers, especially Tournefort[2], who very properly considers it as the real alum of the ancients.

The islands of Lipara and Strongyle, or, as they are called at present, Lipari and Stromboli, contained so great a quantity of this substance, that the duty on it brought a considerable revenue to the Romans[3]. At one period, Lipari carried on an exclusive trade in alum, and raised the price of it at pleasure; but in that island at present there are neither vitriol nor alum-works. Sardinia, Macedonia, and Spain, where alum was found formerly, still produce a salt known under that name[4].

When our alum became known, it was considered as a species of the ancient; and as it was purer, and more proper to be used on most occasions, the name of alum[5] was soon appropriated to it alone. The kinds of alum however known to the ancients, which were green vitriol, maintained a preference in medicine and for dyeing black; and on this account, these impure substances have been still retained in druggists' shops

[1] Diodor. Sic. lib. v. ed. Wesselingii, i. p. 338.

[2] Tournefort, Voyage i. p. 63. Some information respecting the same subject may be seen in that expensive but useful work, Voyage Pittoresque de la Grèce, i. p. 12.

[3] Diodor. Sic. lib. c. Strabo, lib. vi. edit. Almel. p. 423.

[4] Copious information respecting the Spanish alum-works may be found in Introduccion à la Historia Natural de Espagna, par D. G. Bowles: and in Dillon's Travels through Spain, 1780, 4to, p. 220.

[5] The derivation of the Latin name *alumen*, which, if I mistake not, occurs first in Columella and Pliny, is unknown. Some deduce it from ἅλμη; others from ἄλειμμα; and Isidore gives a derivation still more improbable. May it not have come from Egypt with the best sort of alum? Had it originated from a Greek word, it would undoubtedly have been formed from στυπτηρία. This appellation is to be found in Herodotus; and nothing is clearer than that it has arisen from the astringent quality peculiar to both the salts, and also from στύφειν, as has been remarked by Dioscorides, Pliny, and Galen.

under the name of *misy*, *sory*, &c. But a method was at length found out of procuring thence crystallized martial salts (salts of iron), which obtained the new name of *vitriol*. This appellation had its rise first in the eleventh or twelfth century, at least I know no writer older than Albertus Magnus by whom it is mentioned or used. Agricola conjectures that it was occasioned by the likeness which the crystals of vitriol had to glass. This is also the opinion of Vossius[1]; and it is very singular that Pliny says nearly the same thing; for he observes, speaking of blue vitriol, the only kind then known, that one might almost take it for glass[2].

By inquiring into the uses to which the ancients applied their alum, I find that it was sometimes employed to secure wooden buildings against fire. This remark I have here introduced to show that this idea, which in modern times has given occasion to many expensive experiments, is not new. Aulus Gellius[3] relates, from the works of an historian now lost, that Archelaus, one of the generals of Mithridates, washed over a wooden tower with a solution of alum, and by these means rendered it so much proof against fire, that all Sylla's attempts to set it in flames proved abortive. Many have conjectured that the substance used for this purpose was neither vitriol nor our alum, but rather asbestos, which is often confounded with Atlas-vitriol[4]; and against this mistake cautions are to be found even in Theophrastus. But it may be asked, With what was the asbestos laid on? By what means were the threads, which are not soluble in water, made fast to the wood? How could a tower be covered with it? I am rather inclined to believe, that a strongly saturated solution of vitriol might have in some measure served to prevent the effects of the fire, at least as long as a thin coat of potters' earth or flour-paste, which in the present age have been thought deserving of experiments attended with considerable expense. It does not however appear that the invention of Archelaus, which is still

[1] Etymol. p. 779. [2] Plin. lib. xxxiv. c. 12. [3] Noct. Att. lib. xv. c. 1.

[4] The *halotrichum* of Scopoli. The first person who discovered this salt to be vitriolic was Henkel, who calls it *Atlas-vitriol*. [The mineral halotrichite is, in a chemical sense, a true alum in which the sulphate of potash is replaced by the sulphate of the protoxide of iron. It is composed of one atom of protosulphate of iron, one atom of sulphate of alumina, and contains, like all the true alums, twenty-four atoms of water.]

retained in some old books[1], has been often put in practice[2]; for writers on the art of war, such, for example, as Æneas, recommended vinegar to be washed over wood, in order to prevent its being destroyed by fire.

I shall now proceed to the history of our present alum, which was undoubtedly first made in the East. The period of the invention I cannot exactly determine, but I conclude with certainty that it is later than the twelfth century[3]; for John, the son of Serapion, who lived after Rhazes, was acquainted with no other alum than the impure vitriol of Dioscorides[4]. What made the new alum first and principally known was its beneficial use in the art of dyeing, in which it is employed for fixing as well as rendering brighter and more beautiful different colours. This art therefore the Europeans learned from the Orientals, who, even yet, though we have begun to apply chemistry to the improvement of dyeing, are in some respects superior to us, as is proved by the red of Adrianople, their silks and their Turkey leather. The Italians procured their first alum from the Levant, along with other materials for dyeing; but when these countries were taken possession of by the Turks, it grieved the Christians to be obliged to purchase these necessary articles from the common enemy, and bitter complaints on that subject may be seen in the works of various authors. In the course of time the Italians became acquainted with the art of boiling alum; for some of them had rented Turkish alum-works, and manufactured that salt on their own account. They at length found aluminous minerals in their own country, on which they made experiments. These having answered their expectations, they were soon brought into use; and this branch of trade declined afterwards so much in Turkey, that many of the alum-works there were abandoned.

We are told by many historians that the Europeans who first made alum in Italy learned their art, as Augustin Justi-

[1] Wecker De Secretis, lib. ix. 18, p. 445.

[2] One instance of its being used for this purpose is found in Ammianus Marcellinus, lib. xx. c. 12.

[3] [This cannot be correct; for Geber, who is supposed to have lived in the eighth century, was acquainted with three kinds of it, and describes the method of preparing burnt alum.]

[4] Joh. Serapionis Arabis de simplicibus medicinis opus, cap. 410.

nian says, at Rocca di Soria, or Rocca in Syria. Neither in books of geography nor in maps, however, can I find any place of this name in Syria. I at first conjectured that Rocca on the Euphrates might be here meant, but at present it appears to me more probable that it is Edessa, which is sometimes called Roha, Raha, Ruha, Orfa, and also Roccha, as has been expressly remarked by Niebuhr[1]. Edessa is indeed reckoned to be in Mesopotamia, but some centuries ago Syria perhaps was understood in a more extended sense. This much at least is certain, that minerals which indicate alum have been often observed by travellers in that neighbourhood.

It appears that the new alum was at first distinguished from the ancient vitriol by the denomination of *Rocca*, from which the French have made *alun de roche*, and some of the Germans *rotzalaun*[2]. Respecting the origin of this name very different conjectures have been formed. Some think it is derived from *rocca*, which in the Greek signifies a rock, because this salt is by boiling procured from a stone; and these translate the word *alumen rupeum*, from which the French name is formed[3]. Some are of opinion that alum obtained from alum-stone has been so called to distinguish it from that procured from schists, which is generally mixed with more iron than the former[4]; and others maintain that alum acquired the name of *Rocca* from the alum-rocks in the neighbourhood of Tolfa[5]. It is to be remarked, on the other hand, that Biringoccio, that expert Italian, confesses he does not know whence the name has arisen[6]. For my part I am inclined to adopt the opinion of Leibnitz, that *alumen roccæ* was that kind first procured from Rocca in Syria; and that this name was afterwards given to every good species of alum, as we at present call the purest Roman alum[7].

In the fifteenth century there were alum-works in the neighbourhood of Constantinople, from which John di Castro,

[1] Reisebeschreibung, ii. p. 408, 409.

[2] This singular appellation occurs in Valentini Historia Simplicium, and several other works.

[3] Jul. Cæs. Scaligeri Exot. exercitat. Franc. 1612, 8vo, p. 325.

[4] I shall here take occasion to remark, that schist seems to have been employed for making alum in the time of Agricola, as appears by his book De Ortu et Causis Subterraneorum, p. 47.

[5] Mercati, Metallotheca, p. 54.

[6] Pyrotechnia. Ven. 1559, 4to.

[7] Leibnitii Protogæa, p. 47.

of whom I shall have occasion to speak hereafter, learned his art. May not these alum-works be those visited by Bellon, and of which he has given an excellent description[1]? He names the place *Cypsella* or *Chypsilar*, and says that the alum in commerce is called *alumen Lesbium*, or *di Metelin*. The alum procured from Constantinople at present may perhaps be brought from the same spot; but I am not sufficiently acquainted with its situation to determine that point with certainty, for Büsching makes no mention of it. In some maps I find the names *Ypsala* and *Chipsilar* on the western side of the river Mariza, Maritz or Maricheh, which was the Hebrus of the ancients; in others stands the name *Scapsiler* on the west bank of the sea Bouron; and it is not improbable that these may be all derived from the old *Scaptesyle* or *Scapta Hyla*, where, according to the account of Theophrastus, Pliny and others, there were considerable mines.

Another alum-work, no less celebrated in the fifteenth century, was established near the city *Phocæa Nova*, at present called *Foya Nova*, not far from the mouth of the Hermus, in the neighbourhood of Smyrna. Of this work, Ducas, who had a house there, has given a particular description, from which we learn that in his time, that is under the reign of Michael Palæologus, it was farmed by Italians, who sold the produce of it to their countrymen, and to the Dutch, French, Spaniards, English, Arabs, Egyptians, and people of Syria. This author relates very minutely in what manner the alum was made, but that work has been long since abandoned[2]: alum however

[1] Bellonii Observationes, cap. lxi.

[2] "In Phocis, which lies close to Ionia, there is a mountain abundant in aluminous mineral. The stones found on the top of this mountain are first calcined in the fire, and then reduced to powder by being thrown into water. The water mixed with that powder is put into a kettle; and a little more water being added to it, and the whole having been made to boil, the powder is lixiviated, and the thick part which falls to the bottom in a cake is preserved; what is hard and earthy is thrown away as of no use. The cake is afterwards suffered to dissolve in vessels for four days; at the end of which the alum is found in crystals around their edges, and the bottoms of them also are covered with pieces and fragments of the like nature. The remaining liquor, which at the end of four days does not harden, is poured into a kettle, more water and more powder are added to it, and being boiled as before, it is put into proper vessels, and the alum obtained in this manner is preserved as an article very necessary for dyers. All masters of ships bound from the Levant to Europe, consider alum as a

made in the neighbourhood is still exported from Smyrna[1]. It is much to be wished that ingenious travellers would examine the alum-works in Thrace, around Smyrna, and in Turkey in general, and give an accurate description of them according to the state in which they are at present[2].

The oldest alum-works in Europe were established about the middle of the fifteenth century, but where they were first erected cannot with certainty be ascertained; for it appears that several were set on foot in different places at the same period. Some affirm that the first alum made in Europe was manufactured in the island Ænaria, or Pithacusa, at present called Ischia, by a Genoese merchant, whom some name Bartholomew Perdix, and others Pernix. This man, who is praised on account of his ingenuity and attachment to the study of natural history, having often travelled through Syria, learned the method of boiling alum at Rocca; and on his return found alum-stones among the substances thrown up by the eruption of a volcano which had destroyed part of the island, and gave occasion to their being first employed in making that salt. Such is the account of respectable historians, Pontanus[3],

very convenient and useful lading for vessels. . . . . In the reign of Michael Palæologus, the first emperor of his family, some Italians requested a lease of that mountain, for which they promised to pay a certain sum annually. . . . . The Romans and the Latins built Phocæa Nova on the sea-shore, at the bottom of that mountain which lies on the east side of it. On the west it has the island of Lesbos, on the north the neighbouring bay of Elæa, and on the south it looks towards the Ionian sea."—Ducæ Historia Byzantina. Venet. 1729, p. 71.

[1] The alum of Smyrna is mentioned by Baumé in his Experimental Chemistry, i. p. 458.

[2] Some account of other Eastern alum-works is contained in a treatise of F. B. Pegolotti, written in the middle of the fourteenth century, on the state of commerce at that time, and printed in a book entitled Della decima e di varie altre gravezze imposte dal commune di Firenze. Lisbona e Lucca, 1765, 4to, 4 vols. It appears from this work, that in the fourteenth century the Italians were acquainted with no other than Turkish alum.

[3] "I shall embrace this opportunity of giving a brief account of the situation of the island, and of the nature of its soil. That Ænaria has been at some time violently separated from the continent by an earthquake, seems proved by a variety of circumstances, such as calcined rocks; the ground full of caverns; and the earth, which, like that of the main land, being abundant in warm springs, and dry, feeds internal fire, and on that account contains a great deal of alum. A few years ago Bartholomew Perdix, a Genoese merchant passing this island in his way to Naples, observed some aluminous rocks scattered here and there along the sea-coast.

Bizaro[1], Augustine Justinian[2], and Bottone[3], who wrote much later. Bizaro says that this happened in the year 1459, which agrees perfectly with the account of Pontanus; for he tells us that it was under the reign of Ferdinand I., natural son of Alphonsus, who ascended the throne in 1458. Besides, the earthquake, which had laid waste the island one hundred and sixty-three years before, took place in 1301, which makes the time of this invention to fall about the year 1464. So seems Bottone also to have reckoned, for he mentions expressly the year 1465.

The alum-work which is situated about an Italian mile north-

About a hundred and sixty-three years before that period, the earth having suddenly burst by the effects of fire confined in its bowels, a considerable part of Ænaria was involved in flames. By this eruption a small town was burned and afterwards swallowed up; and large masses of rock mixed with flames, sand and smoke, thrown up where the shore looks towards Cumæ, fell upon the neighbouring fields, and destroyed the most fruitful and the most pleasant part of the island. Some of these huge pieces of rock being at that time still lying on the shore, Bartholomew, by calcining them in a furnace, extracted alum from them, and revived that art which he had brought from Rocca in Syria, where he had traded for several years, and which had been neglected in Italy for many centuries."—Pontani Hist. Neapol. in Grævii Thesaurus Antiq. Italiæ, ix. part 3. p. 88.

[1] "I must not omit to mention that about this time Bartholomew Pernix, a citizen and merchant of Genoa, who had resided long in Syria for the purpose of commerce, returned to his native country. Soon after, he made a voyage to the island of Ænaria, situated in the Tuscan sea, called formerly Pythacusa, and now in the vulgar Greek Iscla or Ischia; and being a man of an acute genius, and a diligent investigator of natural objects, he observed near the sea-coast several rocks fit for making alum. He took some fragments of them therefore, and having calcined them in a furnace, he procured from them most excellent alum. He was the first person who, to the incredible benefit of many, brought as it were again into use that art long abandoned and almost lost in Italy and the greater part of other countries. On that account his name deserves to be rescued from oblivion." —Genuensis Rerum Annal. auct. P. Bizaro Sentinati. Antv. 1579, fol. p. 302.

[2] "About that period (1459) Bartholomew Pernix, a Genoese merchant, sailing past the island of Ænaria or Ischia, learned that there were near the shore many aluminous rocks, that is to say, fit for making alum. He took some of them, therefore, and having caused them to be calcined in a furnace, he procured from them most excellent alum. This Bartholomew brought back to Italy from the city of Rocca, in Syria, where he had traded many years, the art of making alum, which had been neglected and lost for a long space of time."—Annali della Republica di Genoa, per Agostino Giustiniano. Genoa, 1537, fol. lib. v. p. 214.

[3] Dom. Bottone, Pyrologia Topographica. Neapoli, 1692, 4to. This author calls the inventor Perdix, and not Pernix.

west from Tolfa, and six from Civita Vecchia, in the territories of the Church, is by some Italian historians reckoned to have been the first. However this may be, it is certain that it is the oldest carried on at present. The founder of it was John di Castro, a son of the celebrated lawyer, Paul di Castro[1], who had an opportunity at Constantinople, where he traded in Italian cloths and sold dye-stuffs, of making himself acquainted with the method of boiling alum. He was there at the time when the city fell into the hands of the Turks; and after this unfortunate event, by which he lost all his property, he returned to his own country. Pursuing there his researches in natural history, he found in the neighbourhood of Tolfa a plant which he had observed growing in great abundance in the aluminous districts of Asia: from this he conjectured that the earth of his native soil might also contain the same salt; and he was confirmed in that opinion by its astringent taste. At this time he held an important office in the Apostolic Chamber; and this discovery, which seemed to promise the greatest advantages, was considered as a real victory gained over the Turks, from whom the Italians had hitherto been obliged to purchase all their alum. Pope Pius II., who was too good a financier to neglect such a beneficial discovery, caused experiments to be first made at Viterbo, by some Genoese who had formerly been employed in the alum-works in the Levant, and the success of them was equal to his expectations. The alum, which was afterwards manufactured in large quantities, was sold to the Venetians, the Florentines, and the Genoese. The Pope himself has left us a very minute history of this discovery, and of the circumstances which gave rise to it[2]. Some pretend that Castro was several years a slave

[1] Fabricii Biblioth. Lat. mediæ et infimæ Ætatis, vol. v. p. 617.

[2] "A little before that period came to Rome John di Castro, with whom the Pontiff had been acquainted when he carried on trade at Basle, and was banker to Pope Eugenius. His father, Paul, was a celebrated lawyer of his time, who sat many years in the chair at Padua, and filled all Italy with his decisions; for law-suits were frequently referred to him, and judges paid great respect to his authority, as he was a man of integrity and sound learning. At his death he left considerable riches, and two sons arrived to the age of manhood, the elder of whom, following the profession of the father, acquired a very extensive knowledge of law. The other, who was a man of genius, and who applied more to study, made himself acquainted with grammar and history: but, being fond of travelling, he resided some time at Constantinople, and acquired much wealth by dyeing cloth made

to a Turk who traded in alum[1]; others affirm that he had even been obliged to labour as a slave in alum-works[2]; and

in Italy, which was transported thither and committed to his care. on account of the abundance of alum in that neighbourhood. Having by these means an opportunity of seeing daily the manner in which alum was made, and from what stones or earth it was extracted, he soon learned the art. When, by the will of God, that city was taken and plundered about the year 1453, by Mahomet II., emperor of the Turks, he lost his whole property; but, happy to have escaped the fire and sword of these cruel people, he returned to Italy, after the assumption of Pius II., to whom he was related, and from whom he obtained, as an indemnification for his losses, the office of commissary-general over all the revenues of the Apostolic Chamber, both within and without the city. While, in this situation, he was traversing all the hills and mountains, searching the bowels of the earth, leaving no stone or clod unexplored, he at length found some alum-stone in the neighbourhood of Tolfa. Old Tolfa is a town belonging to two brothers, subjects of the Church of Rome, and situated at a small distance from Civita Vecchia. Here there are high mountains, retiring inland from the sea, which abound with wood and water. While Castro was examining these, he observed that the grass had a new appearance. Being struck with wonder, and inquiring into the cause, he found that the mountains of Asia, which enrich the Turkish treasury by their alum, were covered with grass of the like kind. Perceiving several white stones, which seemed to be minerals, he bit some of them, and found that they had a saltish taste. This induced him to make some experiments by calcining them, and he at length obtained alum. He repaired therefore to the Pontiff, and addressing him said, 'I announce to you a victory over the Turk. He draws yearly from the Christians above three hundred thousand pieces of gold, paid to him for the alum with which we dye wool different colours, because none is found here but a little at the

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[1] "The Frangipani a third time acquired lands in the kingdom of Naples. When they possessed in Maremma di Roma, Tolfa, Castello, and a jurisdiction which brings at present eighty thousand crowns annually to the Church, it happened that a son of Paul di Castro, a celebrated doctor, and a vassal of these lords, who had been many years a slave in Turkey to an alum-merchant, returned free to his own country; and observing that in the territories of Tolfa there was abundance of alum mineral, he gave notice of it to Lodovico Frangipani, his lord, and was the cause of greatly increasing his revenues. Pope Paul II., however, pretending that the mineral belonged to the Apostolic See, as supreme lord of the fief, and not being able to persuade Lodovico to give it up to the Church, he declared war against him, but was vigorously opposed by Lodovico and his brother Peter, lords of Tolfa, assisted by the Orsini their relations; so that the Pope was obliged to bring about an accommodation with them by means of king Ferrante I., and to pay them as the price of Tolfa sixteen thousand crowns of gold, of which Lodovico gave twelve thousand to the king, and was invested by him in the lordship of Serino in the year 1469."

[2] Ferbers Briefe über Welschland, p. 246.

others, that he learned the art of boiling alum from a citizen of Corneto, a town in the dominions of the Pope, and from a Genoese, both of whom had acquired their knowledge in the Levant[1]. But as I do not wish to ascribe a falsehood to the

island of Hiscla, formerly called Ænaria, near Puteoli, and in the cave of Vulcan at Lipari, which, being formerly exhausted by the Romans, is now almost destitute of that substance. I have however found seven hills, so abundant in it, that they would be almost sufficient to supply seven worlds. If you will send for workmen, and cause furnaces to be constructed, and the stones to be calcined, you may furnish alum to all Europe; and that gain which the Turk used to acquire by this article, being thrown into your hands, will be to him a double loss. Wood and water are both plenty, and you have in the neighbourhood the port of Civita Vecchia, where vessels bound to the West may be loaded. You can now make war against the Turk: this mineral will supply you with the sinews of war, that is money, and at the same time deprive the Turk of them.' These words of Castro appeared to the Pontiff the ravings of a madman: he considered them as mere dreams, like the predictions of astrologers; and all the cardinals were of the same opinion. Castro, however, though his proposals were often rejected, did not abandon his project, but applied to his Holiness by various persons, in order that experiments might be made in his presence, on the stones which he had discovered. The Pontiff employed skilful people, who proved that they really contained alum; but lest some deception might have been practised, others were sent to the place where they had been found, who met with abundance of the like kind. Artists who had been employed in the Turkish mines in Asia were brought from Genoa; and these, having closely examined the nature of the place, declared it to be similar to that of the Asiatic mountains which produce alum; and, shedding tears for joy, they kneeled down three times, worshiping God, and praising his kindness in conferring so valuable a gift on our age. The stones were calcined, and produced alum more beautiful than that of Asia, and superior in quality. Some of it was sent to Venice and to Florence, and, being tried, was found to answer beyond expectation. The Genoese first purchased a quantity of it, to the amount of twenty thousand pieces of gold; and Cosmo of Medici for this article laid out afterwards seventy-five thousand. On account of this service, Pius thought Castro worthy of the highest honours and of a statue, which was erected to him in his own country, with this inscription: 'To John di Castro, the inventor of alum;' and he received besides a certain share of the profit. Immunities and a share also of the gain were granted to the two brothers, lords of Tolfa, in whose land the aluminous mineral had been found. This accession of wealth to the Church of Rome was made, by the divine blessing, under the pontificate of Pius II.; and if it escape, as it ought, the hands of tyrants, and be prudently managed, it may increase and afford no small assistance to the Roman Pontiffs in supporting the burdens of the Christian religion." —Pii Secundii Comment. Rer. Memorab. quæ temp. suis contigerunt. Francof. 1614, fol. p. 185.

[1] "This year (1460) is distinguished by the discovery of alum at Tolfa

Pontiff, I am of opinion that the history of this discovery must have been best known to him. He has not, indeed, established the year with sufficient correctness; but we may conclude from his relation that it must have been 1460 or 1465. The former is the year given by Felician Bussi; and the latter that given in the history of the city of Civita Vecchia.

The plant which first induced John di Castro to search for alum was that evergreen, prickly shrub, the *Ilex aquifolium*, or holly, which in Italy is still considered as an indication that the regions where it grows abound with that salt. But though it is undoubtedly certain that the quality of the soil may be often discovered by the wild plants which it produces, it is also true that this shrub is frequently found where there is not the smallest trace of alum; and that it is not to be seen where the soil abounds with it, as has been already remarked by Boccone[1] and Tozzetti[2].

Among the earliest alum-works may be reckoned that which was erected at Volterra, in the district of Pisa, in 1458, by a Genoese named Antonius[3]. Others say that it was constructed by an architect of Sienna; but this opinion has perhaps arisen only from the work having been farmed by a citizen of Sienna, or built at his expense. On account of this alum-work

vecchia, no one there having been acquainted with it till that period: and this happened by means of one John di Castro, who had acquired some knowledge of it from a young man of Corneto, and a Genoese, who had learned in Turkey the whole process of making it. The said John having observed that in the mountains of Tolfa there were undoubtedly veins of alum, he caused some of the earth and stones to be dug up, and the first experiments were made on them at Viterbo in the following manner. The stones were first calcined in a furnace; a large quantity of water was then thrown over them; and when they were entirely dissolved, the water was boiled in great leaden caldrons; after which it was poured into wooden vessels, where, evaporating by degrees, the result was alum of the most perfect kind. Pope Pius II., sensible of the great benefit which might arise from this mineral to the Apostolic Chamber, employed more than eight hundred persons at Tolfa in preparing it."—Historia della Città de Viterbo, di Feliciano Bussi. In Roma 1742, fol. p. 262.

[1] Museo di Fisica, &c. Ven. 1697, p. 152. [2] Viaggi, vii. p. 234.

[3] Anno 1458. "Rock alum, which the Greeks call *pharno*, was at this time first discovered by a Genoese in the territories of Volterra, where being boiled and found to be good, it began to be dug up afterwards in many of the mountains of Italy. Till that period the Italians had made no use of mines of this kind; for our alum was all brought from Turkey. The above discovery was therefore a great advantage to us."

an insurrection of the inhabitants of Volterra broke out in 1472; but it was at length quelled by the Florentines, who took and plundered the city[1]. Brutus, who wrote his History of Florence in the year 1572, says that this alum-work was carried on in his time: but this is certainly false; for Raphael di Volterra[2], who died in 1521 in his native city, expressly tells us that in his time alum was no longer boiled there; and this is confirmed by Baccius[3], who also lived in the sixteenth century. At present no remains of it are left; so that Tozzetti was not able to discover the place where the alum-stones were broken[4].

It appears from what has been said, that the art of boiling alum in Europe was first known in Italy, but not before the year 1548. That document therefore of the year 1284, quoted by Tozzetti, and in which alum-works, *alumifodinæ*, are mentioned, must, as he himself thinks, be undoubtedly false[5].

The great revenue which the Apostolical Chamber derived from alum, induced many to search for aluminous minerals, and works were erected wherever they were found. Several manufactories of this substance were established therefore in various parts, which are mentioned by Baccius[6], Biringoccio, and other writers of the sixteenth century. The pope however understood his own interest so well, that he never rested until he had caused all the works erected in the territories of others to be given up, and until he alone remained master of the prize. He then endeavoured by every method possible to prevent foreigners from acquiring an accurate knowledge of the art of boiling alum; and at the same time found means, by entering into commercial treaties with other nations, and by employing the medium of religion, which has always the greatest effect on weak minds, to extend his commerce in this article more and more. The price was raised from time to time, and it at length became so high that foreigners could purchase this salt at a cheaper rate from the Spaniards, and even when they sent for it to Turkey. His Holiness, that he might convert this freedom of trade into a sin, and prevent it

[1] An account of this dispute between the Florentines and the people of Volterra may be seen in Machiavelli's History of Florence, book vii.
[2] Rap. Volaterrani Comment. Urbani.
[3] De Thermis.
[4] Viaggi, iii. p. 117.
[5] Ibid. vii. p. 51
[6] De Thermis, p. 293. Tozzetti, iv. p. 186.

by the terror of excommunication, artfully gave out that he meant to set apart the income arising from his alum-works to the defence of Christianity; that is, towards carrying on war against the Turks. Prohibitions and threats now followed in case any one should be so unchristian as to purchase alum from the Infidels; but every person was at liberty to make what bargain he could with his Holiness for this commodity.

In the year 1468 Pope Paul II. entered into a commercial treaty respecting alum with Charles the Bold, duke of Burgundy; but in 1504 Roman alum had risen to such an exorbitant price, that Philip the Fair, archduke of Austria, caused a council of inquiry to be held at Bruges, by which it appeared that this article could be purchased at a much cheaper rate in Turkey. Commissions therefore were sent thither for that purpose; but scarcely was this known at Rome, when a prohibition, under pain of excommunication, was issued by Pope Julius II. This pontiff however was not the only one from whom such prohibitions proceeded: bulls of the like kind were issued also by Julius III., Paul III., Paul IV., Gregory XIII. and others[1].

But these means, like all those founded on the simplicity of others, could not be of long duration; and as soon as men became a little more enlightened, they learned to know their own interest, and to discover the selfishness of the Pope's bulls. Unless Biringoccio, who visited a part of the German mines, be under a mistake, the first European alum-work out of Italy was erected in Spain; and is that still carried on with considerable profit at Almacaron, not far from Carthagena[2]. In the beginning of the sixteenth century very large quantities of alum were brought to Antwerp, as we learn from Guicciardini's Description of the Netherlands.

At what time the first alum-work was erected in Germany, I am not able to determine; but it appears that alum began to be made at Oberkaufungen in Hesse in the year 1554. For the alum-work at Commotau in Bohemia, the first letters-patent were granted in 1558. An alum-work was established at Lower Langenau in the county of Glatz in 1563; but it

[1] Nicol. Rodrig. Fermosini Tractatus Criminalium. Lugd. 1670, 2 vol. fol. tom. ii. p. 63.

[2] Pyrotechn. p. 31. He says expressly that this was the only alum-work in Europe in his time without the boundaries of Italy.

was soon after abandoned. Several other manufactories of alum are mentioned by Agricola, such as that of Dieben or Duben, in the circle of Leipsic, and those of Dippoldiswalda, Lobenstein, &c.

In England the first alum-work was erected at Gisborough in Yorkshire, in the reign of queen Elizabeth; though Anderson[1] says in 1608. Sir Thomas Chaloner, who had an estate there, conjecturing from the nature of the plants which grew wild that there must be minerals in the neighbourhood, after making some search, at length discovered alum. As there was however no one in England at that time who understood the method of preparing it, he privately engaged workmen belonging to the Pope's alum-works; and it is said, that as soon as the Pontiff heard this, he endeavoured to recall them by threats and anathemas. These however did no injury to the heretics; and in a little time the alum-work succeeded so well, that several more of the same kind were soon after established[2]. But what more dishonoured the Pontiff's de-

[1] History of Commerce, iv. p. 406. "The manufacture of alum," says he, "was first found out in England, and carried on with success in 1608. It was supported and patronized in the county of York by lord Sheffield, sir John Bourcher, and other landholders of the said county, to the great benefit of England in general, and of the proprietors in particular, to the present day. King James was a great promoter of this alum-work, after he had by the advice of his minister appropriated to himself a monopoly of it, and forbidden the importation of foreign alum."

[2] Such is the account of Pennant in his Tour in Scotland, 1768. "The alum-works in this country are of some antiquity; they were first discovered by sir Thomas Chaloner in the reign of queen Elizabeth, who observing the trees tinged with an unusual colour, made him suspicious of its being owing to some mineral in the neighbourhood. He found out that the strata abounded with an aluminous salt. At that time the English being strangers to the method of managing it, there is a tradition that sir Thomas was obliged to seduce some workmen from the Pope's alum-works near Rome, then the greatest in Europe. If one may judge from the curse which his Holiness thundered out against sir Thomas and his fugitives, he certainly was not a little enraged; for he cursed by the very form that Ernulphus has left us, and not varied a tittle from that most comprehensive of imprecations. The first pits were near Gisborough, the seat of the Chaloners, who still flourish there notwithstanding his Holiness's anathema." The following passage, extracted from Camden's Britannia, is much to the same purpose: "This (alum) was first discovered a few years since (anno 1607) by the admirable sagacity of that learned naturalist sir Thomas Chaloner, knt. (to whose tuition his majesty (king James the First) com-

nunciations was, that in later times the proprietors of the English alum-works farmed those of the Apostolic Chamber, and increased in various ways the benefit derived from them[1].

At what period alum-works were established in other countries I have not been able to learn. I however know that one was erected at Andrarum[2] in Sweden in 1630.

[The process for obtaining alum from the alum-stone of Tolfa, which is also found in Hungary, Auvergne, and other parts of the world, and which contains *all* the ingredients requisite for the production of alum, has been fully described. The greater portion however of the alum manufactured in this country is obtained from alum-slate,—a bituminous schist containing iron-pyrites (sulphuret of iron) diffused in extremely fine particles throughout its mass. Many of these schists crumble to pieces when they are exposed to the air; the sulphur of the pyrites becomes gradually converted by the absorption of oxygen from the atmosphere into sulphuric acid, while, at the same time, the iron is peroxidized, and having in this state no very great affinity for the sulphuric acid, parts with the greater portion of it to the clay, which is thus converted into sulphate of alumina. Many of these schists are of such a loose texture, and contain the pyrites in so fine a state of division, that the requisite heat is generated by the rapidity with which the several chemical changes proceed; others, from their compactness and deficiency in combustible matter, require calcining by a slow smothered fire. When the calcination is complete, the mass is lixiviated, the solutions are run into cisterns for evaporation, and when they have attained a certain strength, are precipitated with sulphate or muriate of potash or ammonia. The precipitated alum is washed, drained,

mitted the delight and glory of Britain, his son prince Henry), by observing that the leaves of trees were of a more weak sort of green here than in other places, &c."

[1] "For some time past the marquis of Lepri has farmed the alum-works at Civita Vecchia for 37,000 scudi. The Apostolical Chamber supplies the necessary wood, which the marquis must be at the expense of cutting down and transporting. About two hundred men are employed in the works; and alum to the amount of from forty-five thousand to fifty thousand scudi is sold annually, particularly to the English and the French." See Voyage en Italie, par le Baron de R. (Riesch.) Dresden, 1781, 2 vols. 8vo.

[2] Voyages Metallurgiques, par M. Jars, vol. iii. p. 297.

and separated from various impurities by re-solution and crystallization, and is then fit for the market.

A very interesting process has recently been patented by Dr. Turner of Gateshead[1]. It consists in fusing felspar, which is a silicate of potash and alumina, with more potash. On treating the fused mass with water, it is separated into two parts; the first, a solution containing silicate of potash, from which the potash may be obtained by passing through it a stream of carbonic acid gas, or by filtering it through a bed of caustic lime; the second, an insoluble residue, consisting of a silicate of alumina and potash. On digesting this with sulphuric acid, the silica is separated and a solution of alum obtained.]

FALCONRY.

THE question whether Falconry was known to the ancient Greeks, has been determined in the negative by Flavius Blondus[2], Laurentius Valla[3], both writers of the fifteenth century;

[1] See Chemical Gazette for July 15, 1843.

[2] This author, Blondus or Biondo, describing an Italian village, says, "I shall embrace this opportunity of mentioning a new circumstance, which is, that fowling with that rapacious bird the falcon, a diversion much followed at Arno, by the celebrated Alphonsus king of Arragon, was entirely unknown about two hundred years ago; for though Servius, the grammarian, says that Capua received that name from the augury of a falcon, because the Hetruscans, when founding it, saw one of these birds, which in their language was called *capis*; yet he does not tell us of what use they were to mankind. Besides, Pliny, who gives the names of many rapacious birds of the hawk kind ('accipitres scilicet majores et minores achilvones, quos aliqui falcones fuisse volunt'), says nothing of their being employed to catch game; and, without doubt, had fowling in this manner been practised in the time of Virgil, he would have made Æneas and Dido carry such birds along with them when they went out a hunting, whereas he says only,

'Massylique ruunt equites et odora canum vis.'

I will venture therefore to affirm, that two hundred years ago, as I have already said, no nation or people were accustomed to catch either land- or water-fowls with any rapacious bird tamed for that purpose." I shall here observe, that Biondo must have had a faulty copy of Pliny; for the word *achilvones* is not to be found in that author, who, nevertheless, mentions the practice of fowling with birds of prey.

[3] Valla, the most learned man of the century in which he lived, contra-

and likewise by Rigallius[1], Pancirollus, Salmuth, and many others. It may, nevertheless, be here asked, what is generally understood under that term? However much the thousand barks which carried the Grecians to the siege of Troy might have been inferior to those floating castles lately seen by my countrymen before Gibraltar, they were nevertheless ships; and we cannot, on that account, deny that the Greeks were acquainted with the art of ship-building, though it was evidently then in its infancy. In the like manner I agree with Giraldus[2], in allowing that they had some knowledge of falconry. I do not believe that they knew the art of hawking, that is, of chasing game with birds of prey previously trained, as practised in modern times, and which serves more for the amusement of trifling princes than for any useful purpose; but that they had begun to employ the rapacity of some of the winged tribe in hunting and fowling, cannot, in my opinion, be denied[3].

So early as the time of Ctesias, hares and foxes were hunted in India by means of rapacious birds[4]. The account of Aristotle however is still more to the purpose, and more worthy of notice[5]. "In Thrace," says he, "the men go out to catch birds with hawks[6]. The men beat the reeds and bushes which

dicts Antonius Renaudensis, who says, *Nola* is a hawk's bell. "If *Nola*," says Valla, "be an old word, it cannot signify that bell now worn by hawks, because the ancients never tamed these birds for catching game, as we do, nor ornamented them with bells. If it be a new word, let him produce the author from whom it is taken."—Laurentii Vallæ Opera. Basiliæ, 1543, fol. p. 433.

[1] In the preface to Scriptores Rei Accipitrariæ.

[2] Gyraldi Dialogismi, in Op. Lugd. 1696, fol. ii. p. 870.

[3] Those who are desirous of being acquainted with the art of falconry, may consult Pluche, Spectacle de la Nature, vol. i., or the article Fauconnerie, in the French Encyclopédic.

[4] See Herodotus.

[5] "In that part of Thrace, called formerly Cedropolis, the men go out into the marshes in quest of birds, accompanied by falcons. The men beat the trees and bushes with poles, and put the birds to flight; the hawks fly after them, by which means they are so frightened that they fall to the ground, where the men strike them with their poles and kill them."—Histor. Animal. lib. ix. c. 6.

[6] The Grecian authors above quoted call the rapacious birds used for pursuing game ἱέρακες; and Pliny calls them *accipitres*. It would be

grow in marshy places, in order to raise the small birds, which the hawks pursue and drive to the ground, where the fowler kills them with poles." A similar account is to be found in another book ascribed also to Aristotle, which appears, at any rate, to be the work of an author not much younger, but with two additions, which render the circumstance still more remarkable[1]. The first is, that the falcons appeared when called by their names; and the second, that of their own accord they brought to the fowlers whatever they caught themselves. Nothing is here wanting but the spaniel employed to find out game, the hood which is put upon the head of the hawk while it is perched on the hand, and the thong used for holding it, to form a short description of falconry as still practised. Our falconers, when they have taken the bird from the hawk, give him, in return, a small share of it; and in the like manner the Thracian hawks received some part of their booty. Other writers after Aristotle, such as Antigonus[2],

difficult, perhaps impossible, to distinguish with sufficient accuracy all the species of these birds to which the ancients gave different names. This genus is numerous, and the species often differ so little from each other, that it is not easy to establish their characterizing marks. Besides, they for the most part change their colour, and often their whole appearance, according to their age or the season of the year; so that these characters become very uncertain. It appears that on this account the ancients often divided one species into two or more, and imagined that many species passed one into the other, or that new species were produced by the mixture of different breeds. It seems however certain that the ancients divided those birds of prey which fly abroad in the day-time, into three species: ἀετὸς aquila; γὺψ vultur; and ἱέραξ accipiter. The first and last belong to that genus which Linnæus calls *falco*, and are the large species of it. The vultures are the Ger-falcons, which are sufficiently distinguished by their bald head and neck.

[1] "Respecting Thrace which is situated above Amphipolis, a wonderful thing is related, which might appear incredible to those who had never heard it before. It is said that boys go out into the fields, and pursue birds by the assistance of hawks. When they have found a place convenient for their purpose, they call the hawks by their names, which immediately appear as soon as they hear their voices, and chase the birds into the bushes, where the boys knock them down with sticks and seize them. What is still more wonderful, when these hawks lay hold of any birds, they throw them to the fowlers; but the boys, in return, give them some share of the prey."—De Mirabilibus Auscultat. cap. 128.

[2] Antigoni Carystii Historiæ Mirabiles, cap. 34.

Ælian[1], Pliny[2], and Phile[3], have also given an account of this method of fowling. Ælian, who seldom relates anything without some alteration or addition, says that in Thrace nets were used, into which the birds were driven by the hawks; and in this he is followed by the poet Phile. Ælian, also, in another place describes a manner of hunting with hawks in India, which, as we are told by several travellers, is still practised in Persia, where it is well understood, and by other eastern nations[4].

It seems, therefore, that the Greeks received from India and Thrace the first information respecting the method of fowling with birds of prey; but it does not appear that this practice was introduced among them at a very early period. In Italy, however, it must have been very common, for Martial and Apuleius speak of it as a thing everywhere known.

[1] "Hawks, which are no less fit for fowling than eagles, and which are not inferior to them in size, are of all birds reckoned to be the tamest and the fondest of man. I have heard that in Thrace they accompany people when they go out in quest of birds in the fens. The fowlers, having spread their nets, remain quiet, while the hawks flying about terrify the birds, and drive them into them. When the Thracians catch any birds, they divide them with the hawks, by which means they render them faithful partners in fowling; if they did not give them a share of the booty, they would be deprived of their assistance."—Histor. Anim. lib. ii. cap. 42.

[2] Lib. x. c. 8. In a part of Thrace above Amphipolis, men and hawks go out a-fowling, as it were in company. The former drive the birds from among the bushes and reeds, and the latter flying after them strike them down. The fowlers divide with them their prey.

[3] Phile De Animal. Proprietate, p. 36. Gesner, in his Hist. Anim. lib. iii., has collected all the information to be found respecting that species of hawk or falcon called κίρκος, circus.

[4] "The Indians hunt hares and foxes in the following manner. They do not employ dogs, but eagles, crows, and, above all, kites, which they catch when young, and train for that purpose. They let loose a tame hare or fox, with a piece of flesh fastened to it, and suffer these birds to fly after it, in order to seize the flesh, which they are fond of, and which, on their return, they receive as the reward of their labour. When thus instructed to pursue their prey, they are sent after wild foxes and hares in the mountains; these they follow in hopes of obtaining their usual food, and soon catch them and bring them back to their masters, as we are informed by Ctesias. Instead of the flesh, however, which was fastened to the tame animals, they receive as food the entrails of the wild ones which they have caught."—Æliani Hist. Animal. lib. iv. c. 26. Compare with this what Pluche says in Nature Displayed, and the accounts given by Chardin and Gemelli Carreri.

The former calls a hawk a fowler's servant, and the latter makes use of a kind of pun on the word *accipiter*, which signified also a species of fish[1]. It cannot indeed be said that this art was ever forgotten; but, like other inventions, though at first much admired, it was afterwards neglected, so that it remained a long time without improvement. It is however certain that it was at length brought to the utmost degree of perfection. It is mentioned in the Roman laws[2], and in writers of the fourth and fifth centuries.

Julius Firmicus Maternus, who in the time of Constantine the Great, about the year 336, wrote his Astronomicon, in which he teaches the art of casting nativities, assures us that those who are born under certain signs will become great sportsmen, and keep hounds and falcons[3]. Caius Sollius Apollinaris Sidonius, who lived about the year 480, celebrates Herdicius, his wife's brother, and son of the emperor Avitus, because he first practised in his territories hunting and fowling with dogs and hawks. The same author mentions hawking also in other parts of his work. That this diversion, however, has not been oftener spoken of and praised, needs excite little wonder. Hunting, and all the concomitant arts, were at first employed for use; in the course of time they were practised by servants, and easy means only of catching game were sought for. But when luxury was introduced into states, and the number of those who lived by other people's labour increased, these idlers began to employ that time which they had not learned to make a proper use of, or which they were not compelled to apply to more valuable purposes, in catching wild animals by every method that ingenuity could suggest, or in tormenting them by lingering deaths. Hunting and fowling, therefore, received many improvements by the

[1] Martial. Epigr. lib. xiv. 216.

[2] Digest. lib. xliii. tit. 24, 22.

[3] "Those born when the planet Venus is in Aquarius will be much given to hunting and fowling; in other things they will be slow, indolent, inactive, and melancholy, and will apply to no laudable pursuit. They will, however, be fond of breeding hawks, falcons, eagles, and other birds of the like kind, and horses for hunting. They will be also very ingenious in such exercises, and acquire by them a comfortable subsistence."—Lib. v. c. 7. This nativity displays a knowledge of mankind; for one may without much difficulty find princes and great men with whose lives it exactly corresponds, and who, to the great misfortune of their subjects and tenants, have undoubtedly been born under the sign Aquarius.

assistance of art; and the indolent clergy even indulged in these cruel sports, though often forbidden by the church. Such prohibitions were issued by the council of Agda in the year 506; by that of Epaon in 517; by that of Macon in 585, and perhaps oftener, but never with much effect.

Before I proceed further, I shall make two remarks. First, that Pietro Crescentio gives one Daucus as the inventor of the art of taming hawks, but without proof, or even probability. Secondly, that the ancients bred up to hunting and fishing several rapacious animals which at present are not used for that purpose, such as the seal[1] and sea-wolf[2]. Astruc[3] has endeavoured to confute this idea; but his reasoning appears to me to have little weight; and I agree in opinion with Rondeletius and Isaac Vossius[4], that seals might be instructed to catch fish; I myself have seen some, that, when commanded by their master, exhibited a variety of movements and tricks which undoubtedly prove their aptness to learn.

The art of falconry seems to have been carried to the greatest perfection, and to have been much in vogue at the principal courts of Europe in the twelfth century. Some on that account have ascribed the invention of it to the emperor Frederic I., and others to Frederic II. Frederic I., called Barbarossa, was the first who brought falcons to Italy; at least Pandolfo Collenuccio[5] says that this was the common report, and Radevicus[6] seems to confirm it; but I do not know from what authority Pancirollus tells us that that emperor invented falconry at the time when he was besieging Rome. Rainaldo, marquis of Este, was the first among the Italian princes who used this method of fowling[7]; and that the emperor Henry followed the example of his father, seems proved by the words of Collenuccio. The service rendered by Frederic II. to this art, if it can be said to deserve service, is shown by the book which he wrote in Latin on it, entitled De Arte Venandi cum Avibus, and which was printed for the first time at Augsburg

[1] Plin. lib. ix. Ælian. Hist. Anim. l. ii. Oppiani Halieut. l. v.
[2] Plin. lib. x. cap. 8. Aristot. Hist. an. l. ix. c. 36. Ælian. Hist. An. l. vi. c. 65. Antigonus Caryst. cap. 33.
[3] Histoire Nat. de Languedoc, p. 568. [4] In Obs. on Pomp. Mela, ii. 5.
[5] Istoria di Napoli, Ven. 1613, 4to, i. p. 88.
[6] Radevicus de Gestis Frid. I. lib. ii. cap. ultimo.
[7] See Grævii Thesaurus Antiq. et Hist. vol. vii. p. 12.

in the year 1596, from a manuscript belonging to Joachim Camerarius, a physician of Nuremberg. It has here and there deficiencies, because the manuscript was torn, and some additions by the author's son Manfred, king of Sicily. In the second book, there is an account of the use and manner of making hoods, called *capellæ*, which we are there told were invented by the Arabs. The emperor received as a present some hooded falcons from Arabian princes, and procured people from Arabia who understood the management of them[1]. Albertus Magnus has inserted a great deal from the work of this emperor in his book upon animals.

In none of the sports of the field have the fair sex partaken so much as in falconry. The ladies formerly kept hawks, in which they greatly delighted, and which were as much fondled by those who wished to gain their favour as lap-dogs are at present[2]. What tended principally, however, to bring it into disuse, was the invention of gunpowder. After that, hawks were discarded, and the whole enjoyment of fowling was confined to shooting. Less skill and labour were indeed required in this new exercise; but the ladies abandoned the pleasures of the chase, because they disapproved of the use of fire-arms, which were attended both with alarm and danger.

Among the oldest writers on falconry, we may reckon Demetrius, who about the year 1270 was physician to the emperor Michael Palæologus. His book, written in Greek, was first printed at Paris in 1612, by Nicholas Rigaltius, from a manu-

[1] As this work is extremely scarce, I shall here quote the following passage from it:—"The hood had its origin among the Oriental nations; for the eastern Arabs used it more than any other people with whom we are acquainted, in taming falcons and birds of the same species. When I crossed the sea, I had an opportunity of observing that the Arabs used hoods in this art. Some of the kings of Arabia sent to me the most expert falconers, with various kinds of falcons; and I did not fail, after I had resolved to collect into a book every thing respecting falconry, to invite from Arabia and every other country such as were most skilful in it; and I received from them the best information they were able to give. Because the use of the hood was one of the most effectual methods they knew for taming hawks, and as I saw the great benefit of it, I employed a hood in training these birds; and it has been so much approved in Europe, that it is proper it should be handed down to posterity."

[2] Sainte-Palaye, Mémoires sur l'Ancienne Chevalerie, tom. iii. p. 183. In this work may be found many anecdotes respecting the taste of the French ladies for the sports of the field in the ages of chivalry.

script in the king's library, and with the Latin translation of Peter Gyllius[1]. Some other works on the same subject, the antiquity of which is unknown, were printed at the same time. One in the Catalonian dialect has the forged title of Epistola Aquilæ, Symmachi et Theodotionis ad Ptolemæum regem Ægypti de re accipitraria. All these writings treat chiefly on the rearing and diseases of hawks; and contain cures, which, though some of them perhaps may be good enough, would not undoubtedly be all approved by any person of skill at present[2]. Aloes, to the size of about a bean, are ordered as a purge; and quicksilver is prescribed for the itch and outbreaking. We are told also, that a wild and untractable falcon was confined some time with a hood on in a smith's shop, where it was soon tamed by the continual thumping of the hammers. One precept in Demetrius respecting the art of falconry seems very ill-suited to the practice of modern times. He desires sportsmen to say their prayers before they go out to the field. Had this custom been continued to the present day, many great men would be like the people mentioned by a certain traveller, who solicit the assistance of God when they are preparing for a piratical expedition[3]; but with this difference, that these rovers plunder only strange ships, whereas the latter destroy the property and possessions of their own subjects.

TURF.

The discovery, that many kinds of earth, when dried, might be employed as fuel, may have easily been occasioned by an accident in some place destitute of wood. A spark falling fortuitously on a turf-moor during a dry summer often sets it on fire, and the conflagration it occasions generally lasts so

[1] Rei Accipitrariæ Scriptores. Lutet. 1612, 4to.

[2] Among the works of Sir Thomas Brown, there is one on Hawks and Falconry, Ancient and Modern, which, however, consists chiefly of old medical prescriptions.

[3] Remarques d'un Voyageur Moderne au Lévant. Amst. 1773, 8vo.

long that it cannot escape notice[1]. Of the earth taking fire in this manner there are many instances to be found in the ancients. One of the most remarkable is that mentioned by Tacitus, who relates, that not long after the building of the city of Cologne, the neighbouring land took fire, and burned with such violence that the corn, villages, and every production of the fields were destroyed by the flames, which advanced even to the walls of the city[2]. This remarkable passage is not to be understood as alluding to a volcanic eruption, but to a morass which had been set on fire. In the duchy of Berg and around Cologne there are very extensive morasses, from which turf is dug up for fuel, and which undoubtedly serve to confirm this idea.

That the use of turf was well known in the earliest periods in the greater part of Lower Saxony, and throughout the Netherlands, is fully proved by Pliny's account of the Chauci, who inhabited that part of Germany which at present comprehends the duchies of Bremen and Verden, the counties of Oldenburg, Delmenhorst, Diepholz, Huy and East Friesland. Pliny says expressly, that the Chauci pressed together with their hands a kind of peat earth, which they dried by the wind rather than by the sun, and which they used not only for cooking their victuals, but also for warming their bodies[3]. I explain also by turf a short passage of Antigonus Carystius, quoted from Phanias, in which it is said that a morass in Thessaly having become dry, took fire and burned.

The account therefore given in some Dutch chronicles, that turf and the manner of preparing it were first found out about the year 1215, and that about 1222 it had become common, is certainly false[4]. This information may be applicable to

[1] In Siberia, a village which stood on a turf-moor was, on account of its marshy situation, removed to another place; and that the remains might be more easily destroyed, they were set on fire. The flames having communicated to the soil, which was inflammable, occasioned great devastation; and when Gmelin was there, it had been continually burning for half a year. See Gmelin's Reisen durch Russland, vol. i. p. 22.

[2] The rustics, in despair, when they found the fire was unquenchable either by rain or by the river-water which they poured over it, threw in heaps of stones, beat down the flames issuing from the interstices with clubs, and as the fire became subdued flung on their clothes, which being made of skins and wetted, eventually extinguished the conflagration. See Tacitus, An. xiii. 57.

[3] Hist. Nat. lib. xvi. c. 1.

[4] "The foresters, who had then got a new employment, that of turf-

certain lands and districts, and correct as to the introduction of this kind of fuel in those parts; for the use of it was not extended far till a late period; and even yet turf is neither employed nor known in many places which possess it, even though they are destitute of wood [1]. Some improvement in the manner of preparing turf may have also been considered as the invention of this fuel, which is undoubtedly of greater antiquity. What induced Monconys to ascribe the invention of turf to Erasmus, or who first propagated that error, I can as little conjecture as Misson [2].

Scaliger has erred [3] no less than Monconys, whose account was doubted by Uffenbach [4]. According to the first-mentioned author, turf had been used in the Netherlands only about three hundred years before his time, and he adds that he did not know that this kind of fuel had ever been mentioned by the ancients.

Those however are mistaken also who believe that it is to be found in the Salic laws and those of the Alemanni. It is true that the word *turpha* occurs in the former, and that Wendelin and others have declared it to mean turf; but the asser-

digging, which had been before unknown, or at least very uncommon, gave as a present to the monastery of Mariengard, in 1215, several turf-bogs in and near Backefeen."—Chronique van Vriesland door P. Winsemium, 1622, p. 158. That monastery was situated at the distance of two miles from Leeuwaarden.

In Kronijck der Kronijcken, door S. de Vries, printed at Amsterdam in 1688, the following passage occurs, vol. v. p. 553:—"About this time (1221) the digging of turf was first practised, which in some measure made amends for the damage occasioned by the sea-water, and by which several acquired great riches."

Some Dutch writers make turf-digging to be of much higher antiquity, and in support of this opinion quote an old chronicle in rhyme, in which mention is made of a donation by Gerolf count of Friesland; but I am not acquainted with the antiquity of that chronicle, and of the letter of donation there is only a Flemish translation. See Berkhey, Nat. Hist. v. Hol. vol. ii. p. 552.

[1] The use of turf was first made known in France in the year 1621, by Charles de Lamberville, advocate of the parliament of Paris, who resided some time in Holland, to which he had been sent by the king on public business. See Anciens Mineralogistes, par Gobet, i. p. 302.

[2] Voyages de Monconys. Lyons, 1666, 2 vol. 4to, ii. p. 129. C'est lui (Erasme) qui a donné l'invention de la tourbe, qu'on brusle au lieu du charbon. See also Misson's Travels.

[3] Scaligerana, ii. p. 243; Je ne sçache aucun ancien, qui fasse mention de tourbes.

[4] Voyages, vol. iii.

tion of Eccard, that it signifies a village, called in German *Dorf*[1], is more probable. Still less can the doubtful word *curfodi*, in the laws of the Alemanni, be supposed to allude to this substance, though we are assured by Lindenbrog that he found in a manuscript, in its stead, the term *zurb*[2]. It is also not credible that turf should be employed at that period, as wood was everywhere superabundant.

The oldest certain account of turf in the middle ages with which I am at present acquainted, is that pointed out by Trotz[3], who says that it occurs in a letter of donation of the year 1113. He has given the words in the Dutch language, as if they had stood so in the original. But he has quoted his authority in so careless a manner, that I have not been able to conjecture what kind of book he meant. I have however found a Latin copy of the letter of donation in a work pointed out to me by Professor Reuss[4]. An abbot Ludolph, in the year 1113, permitted a nunnery near Utrecht to dig *cespites* for its own use in a part of his *venæ*, but at the same time he retained the property of these *venæ*. Now there can be no doubt that *vena* signifies a turf bog, and *cespites* turf. The former is the same word as *Fenne* or *Venne*, which occurs in the old Frisic and the present *Veen*[5] of the Dutch. The nuns also could make no other use of the turf but employ it as fuel. This passage however proves nothing; though Trotz says that a great trade was carried on with turf in the twelfth century, and that the abbot wished to interdict the nuns from using it.

It is worthy of remark that the words *turba*, *turbo*, *turbæ ad focum*, *turfa*, occur for turf, in the years 1190, 1191, 1201 and 1210, as is proved by the instances quoted by Du Cange. *Turbaria* for a turf-moor is found in Matthew Paris, who died in 1259; *Turbagium*, in a diploma of Philip the Fair in the year 1308, signifies the right of digging turf, as *turbare* does to dig up turf. The word *mor* also is found in a document of

[1] Leges Salicæ, ed. Eccardi, p. 42.

[2] Lindenbrogii Codex Legum Antiquarum. Franc. 1613.

[3] Trotz Jus Agrarium Fœd. Belgii, ii. p. 643.

[4] Historia Episcopatuum Fœderati Belgii. Lugd. Bat. 1719, 2 vols. fol. i. p. 130.

[5] Wiarda Altfrisisches Wörterbuch; where it is conjectured, not without probability, that the name Finland is thence derived.—Du Cange, Glossarium, under the word Venna.

the year 1246, quoted by Du Cange; who however has not introduced it into his dictionary [1]. It seems to be the same as *mariscus* and *marescus*. Brito, who lived about 1223, describing the productions of Flanders, says, "Arida gleba foco siccis incisa marescis[2]." That the last of these words signifies a turf-bog is proved by a passage of Lambert, who lived at Ardres about the year 1200: "Quendam similiter mariscum, ut aiunt, proprium perfodi fecit, et in turbas dissecari."

The assertion of Winsem and others, that the practice of digging turf first became common after the year 1215, is undoubtedly founded on information obtained from Sibrand Leo's Vitæ Abbatum Horti Divæ Virginis seu Mariengard[3]; but this writer died in 1588, and can by no means be adduced as an evidence: he even says himself that turf-digging in 1212 was a new occupation.

The conjecture that the Netherlanders, who in the twelfth century established themselves as colonists in some districts of Germany, and particularly Lower Saxony, first made known there the preparation and use of this kind of fuel is improbable, or at any rate not proved [4]. It is improbable, because the Chauci, the oldest inhabitants of that country, burnt turf before that period.

It is related by the Icelanders that Einar, Count or Earl of Orkney or of the Orkney islands, discovered turf there, and on that account was named Torffeinar. He was the son of Raugnwauld, or Rognwald, earl of Mören, Sued and Nordmör in Norway, in the time of the celebrated Norwegian King Harold, commonly called Haarfager or Pulcricomus, on account of his beautiful hair [5]. He must have lived therefore in the middle of

[1] The words are, "Morum dedit dictus comes dictæ ecclesiæ ad turfas fodiendas."

[2] Britonis Philippidos lib. ii. v. 144.

[3] These lives are in Matthæi Veteris Ævi Analecta, Hag. 1738, v. p. 247.

[4] I find quoted for this conjecture the Dissertation, Eelking de Belgis sæculo xii. in Germaniam advenis, Gottingæ, 1770, pp. 162, 164. But nothing further is found there than that the right of digging turf was in all probability confirmed to the colonists. This important Dissertation was written by Professor Wundt of Heidelberg.

[5] This information may be found in Crymogæa, sive rerum Islandicarum libri iii. per Arngrimum Jonam Islandum. Hamburgi (1609), 4to, p. 50. "Torf cujus inventor perhibetur in Orcadibus dux quidam Orcadensis, Einarus Raugnvaldi ducis Norvegici de Maere filius, tempore pulcricomi Norveg. regis, qui idcirco Torffeinarus dictus est."

the ninth century; but on so trifling a subject I shall enter no further into the labyrinth of the Icelandic Saga.

In Sweden turf was first made known at a very modern period by some navigators in the district of Halland; and in the time of Charles XI. much trouble was taken to introduce it as fuel. In 1672 the town of Laholm obtained an exemption from duty for the turf dug up in the lands belonging to it.

In later times turf began to be burned to charcoal, sometimes in kilns, and sometimes in furnaces built for that purpose, by which this advantage is obtained, that it kindles sooner, burns with less air, and forms a more moderate and uniform fire without much smoke. This method of reducing turf to charcoal, which is still practised in some parts of Bohemia, Silesia, and Upper Saxony, was, it appears, proposed about the year 1669, by the well-known John Joachim Becher, who recommended at that time a method of depriving coals of their sulphur by burning them, and the use of naphtha or rock-oil procured from them by that process[1]. The burning of turf to coal seems to have been first made known in Germany by

[1] "In Holland there is turf, and in England there are coals, neither of which are good for burning either in apartments or in melting-houses. I have, however, discovered a method of burning both these to good coals, so that they shall not only produce no smoke or bad smell, but yield a heat as strong for melting metals as that of wood, and throw out such flames that a foot of coal shall make a flame ten feet long. This I have demonstrated at the Hague with turf, and proved here in England with coals, in the presence of Mr. Boyle, by experiments made at Windsor on a large scale. It deserves to be remarked on this occasion, that as the Swedes procure their tar from fir-wood, I have procured tar from coals, which is in everything equal to the Swedish, and even superior to it for some purposes. I have tried it both on timber and ropes, and it has been found excellent. The king himself ordered a proof of it to be made in his presence. This is a thing of very great importance to the English, and the coals after the tar has been extracted from them are better for use than before."—Narrische Weisheit und weise Narrheit. Frankfurt, 1683, 12mo, p. 91. Boyle seems to speak of this invention in The Usefulness of Natural Philosophy, London, 1774, fol. i. p. 515. The burning of coals in order to procure from them rock-oil, which was used particularly by the leather manufacturers, and which on that account could not be exported, was much practised in England. It appears, however, that something of the like kind was attempted before Becher's time; for in the year 1627, John Hacket and Octav. Strada obtained a patent for their invention of rendering coals as useful as wood for fuel in houses without hurting anything by their smoke. See Anderson's History of Commerce.

Hans Charles von Carlowitz, chamber-counsellor, and principal surveyor of the mines of the electorate of Saxony[1]. To save wood and promote the benefit of the mines he sought for turf; and having discovered it, he then endeavoured to find out some method of rendering it fit to be employed in the melting-houses, and this was the reducing to coal, which, as he himself says[2], he first attempted in kilns at Scheibenberg, in the year 1708. At the Brocken the first experiments were made in 1744, with turf which had been dug up several years. This was announced by F. C. Brückman in 1745[3], as a new invention; but an anonymous writer stated[4] soon after, that this charring had been long used in the district of Hadeln, and that the smiths there employed no other kind of coals for their work.

[In 1842 a patent was taken out by Mr. Williams for compressing peat into a dense mass, resembling coals. It is said to be superior to coal in its properties of producing heat by combustion, forming an excellent charcoal or coke. It is asserted that this charcoal is much more combustible than that of wood, and very useful in the manufacture of fire-works. The process is as follows:—Immediately after being dug it is triturated under revolving edge-wheels faced with iron plates perforated all over the surface, and is forced by the pressure through these apertures, till it becomes a kind of pap, which is freed from the greater part of its moisture by a hydraulic press. It is then dried, and converted into coke in the same manner as pit-coal. The factitious coal of Mr. Williams is made by incorporating pitch or rosin, melted in a caldron with as much peat-charcoal ground to powder as will form a tough doughy mass, which is then moulded into bricks.]

[1] The practice of charring turf appears however to be much older, if it be true that charred turf was employed about the year 1560 at the Freiberg smelting-houses, though that undertaking was not attended with success.—See Hoy's Anleitung zu einer bessern Benutzung des Torfs. Altenburg, 1781.

[2] Von Carlowitz, Sylvicultura Œconomica. Leipzig, 1713, fol. p. 430, where an account is given of the first experiment.

[3] In Hamburgischen Berichten, p. 93. [4] Ib. p. 170.

ARTICHOKE.

THAT I might be able to investigate whether our artichoke was known to the ancients, I have not only collected a variety of scattered passages, compared them with one another and with nature, and laboured through a tedious multitude of contradictions and a confusion of names, but I have also been obliged to examine a load of groundless conjectures, heaped together by commentators[1], in order that I might understand them and ascertain their value. By these means I have learned more than seems hitherto to have been known; and I have found that more is believed than can be proved; but that the fruits of my toil will give complete satisfaction to my readers, I do not pretend to hope. Before the botany, however, and the natural history in general of the ancients can be properly elucidated, before truth can be separated from falsehood, what is certain from what is uncertain, and things defined from those which are undefined, researches of this kind must be undertaken, and the same method as that which I have followed must be adopted.

The names of plants in ancient authors which have been applied to our artichoke, are the following: *Cinara, Carduus, Scolymus*, and *Cactus*.

The *Cinara*, which is originally a Greek word, belonged certainly to the thistle species; and the description of its top, as given by Columella[2], seems, as has already been remarked by Nonnius[3] and others, to agree perfectly with that of our artichoke. The *cinara* was commonly furnished with prickles, but that was preferred which had lost them by cultivation, and for which means were prescribed that did not produce the desired effect[4]. It was raised from seed sown in spring, but was propagated also from slips or shoots which in Italy were

[1] See Stapel, über die Pflanzen des Theophrast. p. 618. Salmasius ad Solinum, p. 159. Casauboni Animadv. in Athen. Lugd. 1621, fol. p. 146. Bauhini Hist. Plant. iii. p. 48.

[2] Colum. lib. x. ver. 235.

[3] Lud. Nonnii Diætcticon. Antv. 1646, 4to, p. 56.

[4] It was said, that if the corners of the seeds were bruised, no prickles would be produced. See Geopon. lib. xii. cap. 39. [It is a well-known physiological fact in botany, that many plants which are naturally spinous, when cultivated in gardens or rich soil, become unarmed. The production

planted in autumn, that they might bear earlier the next summer[1]. The direction given to water these plants frequently, is still followed by our gardeners in respect to their artichokes, and they expect from this attention that the fruit will be more abundant and tender. By this method many give to their artichokes a superiority which others that have not been watered so carefully cannot attain. A complaint, which occurs in ancient authors, is also prevalent, that the roots are often destroyed by mice. I do not, however, find it remarked what part of the *cinara* was properly used, but it may be conjectured it was the top, because the tender fruit is praised[2].

Carduus, among the Romans, was the common name of all plants of the thistle kind. It occurs among those of weeds[3], and may be then properly translated by the word *thistle*. It, however, often signified an eatable thistle; and this has given Pliny occasion to make use of an insipid piece of raillery, when he says that luxury prepared as food for man what would not be eaten by cattle.

It is an old and common fault, that when the Greek and Roman authors have not given us such descriptions of natural objects as are sufficient to enable us to ascertain exactly what they are, we suppose that they have been known under different names, and a variety of characteristics are drawn together to enable us to determine them. What, for example, we find respecting the *cinara* is too little to give a just idea of the plant; we read somewhat more of the *carduus*; and because between these there seems to be an affinity, it is concluded that the *cinara* and the *carduus* were the same plant; and everything told us respecting both of them is thrown into one. Some even go further, and add what they find under a third or a fourth name. It is indeed true, that many natural objects have had several names, and the species may sometimes be rightly guessed; but conjecture ought never to be admitted

of spines seems to arise from an imperfect development of the growing point of a plant; when this development is increased by the greater supply of nutriment, the spines disappear, their places being supplied by a branch having leaves. We have instances of this in the apple, pear, &c., which are naturally spinous.]

[1] Geopon. *l. c.* Columella, xi. cap. 3.

[2] Geopon. 925, where repeated watering is directed; it is said you will then have tenderer fruit, and in more abundance.

[3] Virgil. Geor. i. 150. Plin. xviii. cap. 17.

unless the identity can be fully established; else one may form such a monstrous production as Horace has delineated, when he says,

> Humano capiti cervicem pictor equinam
> Jungere si velit, et varias inducere plumas,
> Undique collatis membris—

I wish commentators would follow the example of our naturalists, who consider a plant as a distinct species until it has been proved on sure grounds that it is nothing else than a variety of a plant already characterized. I should not therefore affirm that the *cinara* and the *carduus* are the same, were I not able to produce the following incontestable proofs in support of my assertion.

In the first place, the Latins, Palladius and Pliny, give us the same account of the *carduus* that Columella and the Greeks do of the *cinara*. The former lost its prickles through cultivation [1]; its flowers were also of a purple colour [2]; it was propagated by seed and by shoots; it required frequent watering; and it was remarked that it throve better when the earth was mixed with ashes. Had not the *carduus* and the *cinara* been the same, Palladius and Pliny would have mentioned the latter; for we cannot suppose that they otherwise would have omitted a plant that formed a dish so much esteemed and so well-known among their countrymen. The latter claims to himself the merit of having passed over no one that was held in estimation. In the second place, Virgil has translated the word *cynaros* in a part of Sophocles now lost, by *carduus* [3]; thirdly, Athenæus says expressly, that the *cinara* was by the Latins named *cardus* and *carduus* [4]; and, lastly, the old glossaries explain *cinara* by *carduus*, as we are told by Salmasius. On these grounds, therefore, I am of opinion that the *cinara* and the *carduus* were the same.

[1] Palladius, iv. 9, p. 934, and lib. xi. Octob. p. 987. In the first-mentioned place he gives the same direction for preventing prickles, as that quoted respecting the *cinara*.

[2] Pliny, lib. xx. says, "The wind easily carries away the withered flowers on account of their woolly nature."

[3] Κύναρος ἄκανθα πάντα πληθύει γύην.—Sophocles, in Phœnicæ.

. . . . . Segnisque horreret in arvis
Carduus . . . . . .—Virgil. Georg. i. 50.

[4] Athen. Deipnos. at the end of the second book, p. 70. Salmasius, in his Remarks on Solinus, p. 159, is of opinion that Athenæus wrote κάρδον, not κάρδυον; and the Latins not *carduus*, but *cardus*.

We are informed by Apicius[1] and Pliny[2] in what manner the *carduus* was dressed by the ancient cooks. The latter gives directions for pickling it in vinegar; but neither of them tells us what part of it was eaten. Lister thinks that Apicius speaks of the tops of the young shoots, which, as far as I know, are parts of the artichoke never eaten at present. It is, however, worthy of remark, that the tops (*turiones*) of certain kinds of the thistle family of plants, and among these the common burr[3], are in some countries dressed and eaten like asparagus. It is not improbable also that Pliny and Apicius may have meant the ribs of the leaves; though none of the ancients has taught us the art of binding up, covering with earth, and blanching the *cinara* or *carduus*. This, perhaps, was a new invention of the gardeners; and the cooks may have had other methods of rendering the ribs of the leaves tender and eatable. Had they meant the bottom of the calyx, they would not have omitted to give a circumstantial account of the preparation previous to its being pickled.

The *Scolymus* is by Pliny and Theophrastus reckoned to belong to the genus of the thistles. The former says, that, like most others of the same kind, the seeds were covered by a sort of wool (*pappus*). It had a high stem, surrounded with leaves, which were prickly, but which ceased to sting when the plant withered[4]. It flowered the whole summer through, and had often flowers and ripe seed at the same time; which is the case also with our artichoke plants. The calyx of the *scolymus* was not prickly[5]; the root was thick, black and sweet, and contained a milky juice. It was eaten both raw and cooked; and Theophrastus observes, as something very remarkable, that when the plant was in flower, or, as others explain the words, when it had finished blowing, it was most

[1] Lib. iii. cap. 19. [2] Lib. xix. cap. 8.

[3] *Arctium Lappa*, an indigenous weed, difficult to be rooted out. Elsholz, in his Gartenbau, speaking of the Spanish cardoons, says, "The strong stem of the large burr, *Arctium Lappa*, may be dressed in the same manner, and is not much different in taste." See also Thomas Moufet's Health's Improvement. Lond. 1746, 8vo, p. 217.

[4] Plin. lib. xxi. cap. 16.

[5] Theophrastus: "Conceptus non spinosus, sed oblongus." But Dioscorides says, "Capitulum spinosum." This contradiction, and other small variations, have induced some to consider the *scolymus* of Theophrastus and that of Dioscorides as two different plants.

palatable. What renders this circumstance singular is, that most milky roots used for food lose their milk and become unfit to be eaten as soon as they have blown. This is the case with the goat's beard, which is eatable only the first year.

The *scolymus* however is not the only plant which forms an exception; for the garden Scorzonera retains its milk, and continues eatable after it has bloomed, and as long as it has milk it may be used. According to Theophrastus and Pliny, the roots of the *scolymus* are eatable. On the other hand, Dioscorides says that the roots were not eaten, but the young leaves only: as he informs us, however, that they were dressed like asparagus, it would appear that he meant the young shoots[1]. Theophrastus expressly tells us, that, besides the roots, the flowers also were used as food; and he calls that which was eatable the pulpy part. We have, therefore, full proof that the ancients ate the tops of some plants in the same manner as we eat our artichokes.

It may however be asked, what kind of a plant was the *scolymus*? That it was different from the *cinara* is undoubtedly certain; for Dioscorides[2] expressly distinguishes them; nor was it the eatable *carduus*, for Pliny compares it with the *carduus*, and says that it was characterized from the latter by having roots fit to be eaten. Stapel is of opinion that the *scolymus* is our artichoke; but this seems to me improbable, for the leaves and roots of the latter are not sweet, but harsh and bitter, and the calyx is prickly, which was not the case in the *scolymus* of Theophrastus. Besides, I find nothing in the whole description of the *scolymus* or in the accounts given us by the ancients of the *cinara* and *carduus*, that can be applied to our artichoke alone, and not to any other plant. It may be here replied, that it would be very difficult to ascertain plants from the names of the ancients, were such strong proofs required, because they had not the art of separating the different genera correctly, and of assigning to each certain characterizing marks. This I allow; and for that reason it is impossible to elucidate properly the Greek and Latin names of plants; but, in my opinion, it is better to confess this impossibility, than to deceive oneself with distant probabilities. Let the genus be

[1] Dioscor. iii. 16.

[2] Dioscor. lib. iii. cap. 10, where he says of a plant that its leaves were like those of the *Scolymus*, and its stem like that of the *Cinara*.

ascertained when one cannot ascertain the species; let the order to which the plant belongs be determined when one cannot determine the genus; or, at least, let the class be assigned when there is sufficient authority to do so. The *cinara*, *carduus* and *scolymus* were therefore species of the thistle, of which the roots and young shoots, and also the bottom of the calyx of the last, were eaten. Were I appointed or condemned to form a new Latin dictionary, I should explain the article *Scolymus* in the following manner:—Planta composita, capitata. Caulis longus, obsitus foliis spinosis. Radix carnosa, lactescens, nigra, dulcis, edulis. Calyx squamis inermibus, disco carnoso, ante efflorescentiam eduli. Semina papposa. Turiones edules. This description, short as it is, contains every thing that the ancients have said in order to characterize that plant. It can, indeed, be understood only by those who are acquainted with the terms of botany; but what follows will require no explanation or defining of botanical names.

Should it be said that the *scolymus* must be our artichoke because no other plant of the thistle kind is known the bottom of the calyx of which is eatable, I would in answer observe:—First, other species may have been known in ancient times, which perhaps have been disused and forgotten since the more pleasant and delicious artichoke became known. It is certain that many old plants have in this manner been banished from our gardens by the introduction of new ones. Thus have common alexanders (*Smyrnium olusatrum*) fallen into neglect since celery was made known by the Italians, about the end of the seventeenth century; and so at present has the cultivation of winter-cresses (*Erysimum barbarea*), bulbous-rooted chærophyllum (*Chærophyllum bulbosum*), rocket (*Brassica eruca*), and others, been abandoned since better vegetables have been obtained to supply their place. Secondly, it is certain that, even at present, the bottom of the calyx of some others of the thistle-kind, besides the genus of the artichoke, is eaten; such as the cotton-thistle (*Onopordum acanthium*), and the carline thistle (*Carlina acaulis*), without mentioning the sun-flowers which has been brought to us in modern times from South America.

Without engaging to examine all the hypotheses of commentators and ancient botanists on this subject, I shall take notice of one conjecture, which, upon mature consideration,

appears to have some probability. Clusius[1] is of opinion that the plant called by the botanists of the seventeenth century *Carduus chrysanthemus*, and by those of the present age *Scolymus hispanicus*, the golden thistle, is the *scolymus* of Theophrastus; because its leaves, beset with white prickles, and its pulpy, sweet, milky roots are eaten, and excel in taste all roots whatever, even those of skirret; and because it was collected and sold in Spain, Italy, and Greece. But what has principally attracted my attention to this conjecture, is the account of Bellon[2], that this plant in Crete or Candia is called still by the Greeks there *ascolymbros*. This name seems to have arisen from *scolymos*; and besides Stapel[3] found in an old glossary the word *ascolymbros*. I am likewise convinced that, as Tournefort[4] has said, the botany of the ancients would be much illustrated and rendered more certain, were the names used by the modern Greeks known. It is certain that many old names have been preserved till the present time with little

[1] Rariorum Plantarum Historiæ, lib. iv. p. 153.

[2] "In Crete there is a kind of prickly plant, which in the common Greek idiom is generally called *ascolimbros*. The ancient Latins called it also by a Greek name, *glycyrrhizon*, though different from *glycyrrhiza* (liquoriee). It grows everywhere spontaneously, has a yellow flower, and abounds with a milky juiee. The roots and leaves are usually eaten before it shoots up into a stem. We saw it exposed for sale with other herbs in the market-plaee of Ravenna, and at Aneona, where the women who were digging it up, gave it the name of *riuci*. We saw it gathered also in the Campagna di Roma, where the inhabitants called it *spinaborda*. This is the plant which by the modern Greeks is named *ascolimbros*."—Bellonii Observationes, lib. i. eap. 18. "In Crete it is ealled *ascolymbros*, and in Lemnos *scombrouolo*, that is *scombri carduus*. This thistle abounds with a milky juice, like suceory, has a yellow flower, and is exeellent eating; so that I know no root eultivated in gardens whieh ean be eompared to it in taste, the parsnip not even excepted."

[3] Theophrast. Hist. Plant. p. 620. The figure which Stapel gives, p. 621, is not of the *Scolymus hispanicus*, but of *Scolymus maculatus*. It is taken from Clusius, who has also a figure of the former.

[4] "I considered the heads of these poor Greeks as so many living inscriptions, whieh preserve to us the names mentioned by Dioseorides and Theophrastus. Though liable to different variations, they will, doubtless, be more lasting than the hardest marble, beeause they are every day renewed, whereas marble is effaced or destroyed. Inseriptions of this kind will preserve, therefore, to future ages the names of several plants known to those skilful Greeks who lived in happier and more learned times."—Voyage du Levant, i. p. 34. Compare with the above what Haller says in his Biblioth. Botan. i. p. 28.

variation; but nevertheless I can as little admit the assertion of Clusius as that of Stapel; for *Scolymus hispanicus* has neither the bottom of the calyx pulpy, nor wool adhering to the seeds, like the *scolymus* of Theophrastus; and the young roots only can be eaten, because, like those of most plants of the genus of the thistle, they lose their milk when the flower is in bloom; lastly, the leaves retain their power of pricking, even after they have become withered.

The fourth name which, with any kind of probability, has been translated by the word artichoke is *cactus*. This plant, which, in the time of Theophrastus and Pliny, grew only in Sicily and not in Greece, had broad prickly leaves [1]; the flower was filled with a kind of wool, which, when eaten inadvertently, was pernicious [2]; the calyx was prickly: and, besides a long stem, it shot forth branches which crept along the ground [3], and which, when the outer rind had been peeled off, were eaten either fresh, or pickled in salt water [4]. The bottom of the calyx of this plant was likewise used, after it had been freed from its seeds and woolly substance [5]. It had a great resemblance to the pith of the palm-tree [6].

That the *cactus* was different from the *scolymus* we are expressly told by Theophrastus; and Pliny also distinguishes them both from each other and from the *carduus*. Athenæus [7] is the only author who says that the *cactus* and the *cinara* were the same; but he gives no other proof than a very simple

[1] Plin. lib. xxi. cap. 16. See Theophrast. lib. vi. cap. 4. Theoocritus, Idyll. x. 4, mentions a lamb wounded in the foot by a *cactus*. Tertullian names this plant among prickly weeds, together with the *rubus*, in the end of the second chapter of that unintelligible book De Pallio. De la Cerda, in his excellent edition of Opera Tertulliani, Lutetiæ Paris. 1624, 2 vols. fol. i. p. 13, reads *carecto* instead of *cacto*; but Salmasius, in his edition of that work, p. 172, has sufficiently vindicated the latter.

[2] Dioscorid. Alexipharm. cap. 33. [3] Theoph. p. 613.

[4] The creeping branches were in particular called *cacti*, the upright stem *pternix*.

[5] Theophrastus calls the bottom of the calyx *περικάρπιον*, a word which is still retained in botany. But he also says that the same part of the *cactus* was called also *σκαλία*; from which is derived the *ascalia* of Pliny. Galen calls it *σπόνδυλον*.

[6] Theoph. This term is explained by Pliny, lib. xiii. c. 4:—"Dulcis medulla palmarum in cacumine, quod cerebrum appellant."

[7] Athen. Deipnos. at the end of the second book, p. 70. He gives everything to be found in Theophrastus; but either the author or some of his transcribers have so confused what he says, that it is almost unintelligible.

etymology. It must therefore be admitted that the *cactus* was a species of the thistle kind entirely different from any of the former.

I think I have proved, therefore, that the Greeks and the Romans used the pulpy bottom of the calyx, and the most tender stalks and young shoots of some plants reckoned to belong to the thistle kind, in the same manner as we use artichokes and cardoons; and that the latter were unknown to them. It appears to me probable that the use of these plants, at least in Italy and Europe in general, was in the course of time laid aside and forgotten, and that the artichoke, when it was first brought to Italy from the Levant, was considered as a new species of food. It is undoubtedly certain that our artichoke was first known in that country in the fifteenth century. Hermolaus Barbarus, who died in 1494, relates that this plant was first seen at Venice in a garden in 1473, at which time it was very scarce[1]. About the year 1466, one of the family of Strozzi brought the first artichokes to Florence from Naples[2]. Politian, in a letter in which he describes the dishes he found at a grand entertainment in Italy in 1488, among these mentions artichokes[3]. They were introduced into France in the beginning of the sixteenth century[4]; and into England in the reign of Henry the Eighth[5].

Respecting the origin of the name various conjectures have been formed, none of which, in my opinion, are founded even on probability. Hermolaus Barbarus, Henry Stephen, Ruellius, Heresbach, and others think that *artichoke* or *artichaut*, as it is called by the French, and *arciocco* by the Italians, is derived from the Greek word *coccalus*, which signifies a fir-cone, with the Arabic article *al* prefixed, from which was formed *alcocalon*, and afterwards the name now used[6]. This etymology is contradicted by Salmasius[7], who denies that *coccalus* had ever that signification. He remarks also that artichokes were by the Arabs called *harsaf*, *harxaf*, or *harchiaf*; and he seems not disinclined to derive the name from these

[1] Herm. Barbar. ad Dioscor. iii. 15.
[2] Manni de Florentinis inventis commentarium, p. 34.
[3] Politiani Opera. Lugd. 1533, 8vo, p. 444.
[4] Ruellius De Natura Stirpium. Bas. 1543, fol. p. 485.
[5] Hakluyt, vol. ii. p. 164. Biographia Britannica, vol. iv. p. 2462; and Anderson's History of Commerce.
[6] Herm. Barbarus, in his Observations on Dioscorides.
[7] Salmas. ad Solin. p. 160.

appellations[1]. Grotius, Bodæus, and some others, derive it from a Greek word[2], which occurs in Alexander Trallianus, and which is supposed to signify our plant; but that word is to be found in this author alone, and in him only once; so that the idea of these critics appears to me very improbable. Frisch affirms, in his dictionary, that our modern name is formed from *carduus* and *scolymus* united. Ihre[3] considers the first part of the name as the German word *erde* (the earth), because it is often pronounced *erdschoke*; but I rather think that the Germans changed the foreign word *arti* into the word *erde*, which was known to them, in the same manner as of *tartuffolo* we have made *erdtoffeln*[4]; besides, Ihre leaves the latter part unexplained[5]. In the seventeenth century the plant was often called *Welsch distel* (Italian thistle), because the seeds were procured from Italy, and also *Strobeldorn*, a word undoubtedly derived from *strobilus*.

Were the original country of the artichoke really known, the etymology of the name, perhaps, might be easily explained. Linnæus says that it grew wild in Narbonne, Italy, and Sicily, and the cardoons in Crete; but, in my opinion, the information respecting the latter has been taken only from the above-quoted passage of Bellon, which is improperly supposed to allude to the artichoke. As far as I know, it was not found upon that island either by Tournefort or any other traveller. Garidel, however, mentions the artichoke under the name given it by Bauhin, *cinara sylvestris latifolia*, among the plants growing wild in Provence; but later authors assure us that they sought for it there in vain[6]. I shall here remark that the artichoke is certainly known in Persia; but Tavernier says expressly that it was carried thither, like asparagus, and other European vegetables of the kitchen-garden, by the Carmelite and other monks; and that it was only in later times that it became common[7].

[1] It is remarked in Golius's Dictionary, p. 597, that this word signifies also the scales of a fish, and the strong scales of the calyx of the plant may have given rise to the name. [2] The Greek word is *αρτυτική*.

[3] Glossarium Suiogothicum, i. p. 411. [4] Potatoes.

[5] A variety of derivations may be found in Menage's Dictionnaire Etymologique.

[6] See Rozier, Cours Complet d'Agriculture, vol. ii. p. 14.

[7] See his Travels. Geneva, 1681, fol. p. 164.

SAW-MILLS.

In early periods, the trunks of trees were split with wedges into as many and as thin pieces as possible [1]; and if it was necessary to have them still thinner, they were hewn on both sides to the proper size. This simple and wasteful manner of making boards has been still continued to the present time. Peter the Great of Russia endeavoured to put a stop to it by forbidding hewn deals to be transported on the river Neva. The saw, however, though so convenient and beneficial, has not been able to banish entirely the practice of splitting timber used in building, or in making furniture and utensils, for I do not speak here of fire-wood; and, indeed, it must be allowed that this method is attended with peculiar advantages, which that of sawing can never possess. The wood-splitters perform their work more expeditiously than sawyers, and split timber is much stronger than that which has been sawn; for the fissure follows the grain of the wood, and leaves it whole; whereas the saw, which proceeds in the line chalked out for it, divides the fibres, and by these means lessens its cohesion and solidity. Split timber, indeed, turns out often crooked and warped; but in many purposes to which it is applied this is not prejudicial; and such faults may sometimes be amended. As the fibres, however, retain their natural length and direction, thin boards, particularly, can be bent much better. This is a great advantage in making pipe-staves, or sieve-frames, which require still more art, and in forming various implements of the like kind.

Our common saw, which needs only to be guided by the hand of the workman, however simple it may be, was not known to the inhabitants of America when they were subdued by the Europeans [2]. The inventor of this instrument has by the Greeks

[1] Virgil. Georg. lib. i. v. 144. Pontoppidan says, "Before the middle of the sixteenth century all trunks were hewn and split with the axe into two planks; whereas at present they would give seven or eight boards. This is still done in some places where there are no saw-mills in the neighbourhood; especially at Sudenoer and Amte Nordland, where a great many boats and sloops are built of such hewn boards, which are twice as strong as those sawn; but they consume too many trunks." See Natürliche Historie von Norwegen. Copenhagen, 1753, 2 vols. 8vo, i. p. 244.

[2] De Gareilasso de la Vega, Histoire des Incas.

been inserted in their mythology, with a place in which, among their gods, they honoured the greatest benefactors of the earliest ages. By some he is called Talus, and by others Perdix. Pliny[1] alone ascribes the invention to Dædalus; but Hardouin, in the passage where he does so, chooses to read Talus rather than Dædalus. In my opinion, Pliny may have committed an error as well as any of the moderns; and as one writer at present misleads another, Seneca[2], who gives the same inventor, may have fallen into a mistake by copying Pliny. Diodorus Siculus[3], Apollodorus[4], and others name the inventor Talus. He was the son of Dædalus's sister; and was by his mother placed under the tuition of her brother, to be instructed in his art. Having once found the jaw-bone of a snake, he employed it to cut through a small piece of wood; and by these means was induced to form a like instrument of iron, that is, to make a saw. This invention, which greatly facilitates labour, excited the envy of his master, and instigated him to put Talus to death privately. We are told, that being asked by some one, when he was burying the body, what he was depositing in the earth, he replied, a serpent. This suspicious answer discovered the murder; and thus, adds the historian, a snake was the cause of the invention, of the murder, and of its being found out[5]

Hyginus[6], Servius[7], Fulgentius[8], Lactantius Placidus[9], Isidorus[10], and others call the inventor Perdix. That he was the son of a sister of Dædalus they all agree; but they differ respecting the name of his parents. The mother, by Fulgentius, is called Polycastes, but without any proof; and Lactantius gives to the father the name of Calaus. In Apollodorus, however, the mother of Talus is called Perdix; and the same name is given by Tzetzes to the mother of the inventor, whose name Talus he changes into Attalus[11]. Perdix, we are told, did not employ for a saw the jaw-bone of a snake, like Talus, but the

[1] Lib. vii. 1. cap. 56. [2] Epist. 90. [3] Diodor. Sicul. iv. cap. 78.
[4] Apollodori Bibl. lib. iii. cap. 16.
[5] Those who are desirous of seeing the whole account may consult Diodorus, or Banier's Mythology, [or Keightley's Mythology of Ancient Greece and Italy, p, 398, Lond. 1838.]
[6] Hygin. Fab. 39, 244, 274. [7] Ad Georg. i. 143.
[8] Mythographi, ed. Van Staveren, lib. iii. 2, p. 708.
[9] In Mythogr. et in Ovid. Burm. lib. viii. fab. 3.
[10] Orig. lib. xix. cap. 19. [11] Chiliad. i. 493.

back-bone of a fish; and this is confirmed by Ovid[1], who nevertheless is silent respecting the name of the inventor.

What may be meant by *spina piscis* it is perhaps difficult to conjecture; but I can by no means make *spina dorsi* of it, as Dion. Salvagnius has done, in his observations on the passage quoted from Ovid's Ibis. The small bony processes which project from the spine of a fish have some similitude to a saw; but it would be hardly possible to saw through with them small pieces of wood. These bones are too long, as well as too far distant from each other; and the joints of the back-bone are liable to be dislocated by the smallest force. I am not acquainted with the spine of any fish which would be sufficiently strong for that purpose. The jaw-bone of a fish furnished with teeth would be more proper; but the words *spina in medio pisce* prevent us from adopting that alteration. I should be inclined rather to explain this difficulty by the bone which projects from the snout of the saw-fish, called by the Romans *serra*, and by the Greeks *pristis*. That bone, indeed, might not be altogether unfit for such a use: the teeth are strongly united to the broad bone in the middle, and are capable of resisting a great force; but they are placed at rather too great a distance. The old inhabitants of Madeira, however, we are told, really used this bone instead of a saw[2]. That Talus found the jaw-bone of a snake with teeth like a saw is extremely probable, for there are many snakes which have teeth of that kind.

The saws of the Grecian carpenters had the same form, and were made in the like ingenious manner as ours are at present. This is fully shown by a painting still preserved among the antiquities of Herculaneum[3]. Two genii are represented

[1] Metamorph. lib. viii. 244. The folowing line from the Ibis, ver. 500, alludes to the same circumstance:

"Ut cui causa necis serra reperta fuit."

[2] See Cadomosto's Voyage to Africa, in Novi Orbis Navigat. cap. 6. This account is not so ridiculous as that of Olaus Magnus, who says that the saw-fish can with his snout bore through a ship. [There are however many well-authenticated instances of the planks of ships being perforated by the upper jaw of this powerful animal, which it has been supposed occasionally attacks the hulls of vessels in mistake for the whale.]

[3] Le Pitture antiche d'Ercolano, vol. i. tav. 34.

at the end of a bench, which consists of a long table that rests upon two four-footed stools. The piece of wood which is to be sawn through is secured by cramps. The saw with which the genii are at work has a perfect resemblance to our frame-saw. It consists of a square frame, having in the middle a blade, the teeth of which stand perpendicular to the plane of the frame. The piece of wood which is to be sawn extends beyond the end of the bench, and one of the workmen appears standing and the other sitting on the ground. The arms, in which the blade is fastened, have the same form as that given to them at present. In the bench are seen holes, in which the cramps that hold the timber are stuck. They are shaped like the figure seven; and the ends of them reach below the boards that form the top of it. The French call a cramp of this kind *un valet*[1].

Montfaucon[2] also has given the representation of two ancient saws taken from Gruter. One of them seems to be only the blade of a saw without any frame; but the other figure I consider as a cross-cut saw; and I think I can distinguish all the parts, though it is imperfectly delineated. One may however perceive both the handles between which the blade is fastened; the wooden bar that binds them together, though the blade is delineated too near it; and about the middle of this bar, the piece of wood that tightens the cord which keeps the handles as well as the whole instrument firm. Saws which were not placed in a frame, but fastened to a handle, are thus described by Palladius[3]:—"Serrulæ manubriatæ minores majoresque ad mensuram cubiti, quibus facile est, quod per serram fieri non potest, resecando trunco arboris, aut vitis interseri."

The most beneficial and ingenious improvement of this instrument was, without doubt, the invention of saw-mills, which are driven either by water, wind, [or by steam]. Mills of the first kind were erected so early as the fourth century,

[1] That cramps or hold-fasts are still formed in the same manner as those seen in the ancient painting found at Herculaneum, particularly when fine inlaid works are made, is proved by the figure in Roubo, l'Art du Menuisier, tab. xi. fig. 4, and xii. fig. 15.

[2] L'Antiquité Expliquée, vol. iii. pl. 189.

[3] Pallad. De Re Rust. lib. i. tit. 43.—Cicero, in his oration for Cluentius, chap. lxiv., speaks of an ingenious saw, with which a thief sawed out the bottom of a chest.

in Germany, on the small river Roer or Ruer[1]; for though Ausonius speaks properly of water-mills for cutting stone, and not timber, it cannot be doubted that these were invented later than mills for manufacturing deals, or that both kinds were erected at the same time. The art however of cutting marble with a saw is very old. Pliny[2] conjectures that it was invented in Caria; at least he knew no building incrusted with marble of greater antiquity than the palace of king Mausolus, at Halicarnassus. This edifice is celebrated by Vitruvius[3], for the beauty of its marble; and Pliny gives an account of the different kinds of sand used for cutting it; for it is the sand properly, says he, and not the saw, which produces that effect. The latter presses down the former, and rubs it against the marble; and the coarser the sand is, the longer will be the time required to polish the marble which has been cut by it. Stones of the soap-rock kind, which are indeed softer than marble, and which would require less force than wood, were sawn at that period[4]: but it appears that the far harder glassy kinds of stone were sawn then also; for we are told of the discovery of a building which was encrusted with cut agate, cornelian, lapis-lazuli, and amethysts[5]. I have, however, found no account in any of the Greek or Roman writers of a mill for sawing wood; and as the writers of modern times speak of saw-mills as new and uncommon, it would seem that the oldest construction of them has been forgotten, or that some important improvement has made them appear entirely new.

Becher says, with his usual confidence, that saw-mills were invented in the seventeenth century[6]. Though this is certainly false, I did not expect to find that there were saw-mills in the neighbourhood of Augsburg so early as the year 1337, as Stetten[7] has discovered by the town-books of that place. I shall here insert his own words, in answer to a request I

[1] Ausonii Mosella, v. 361.
[2] Plin. lib. xxxvi. cap. 6.
[3] Vitruv. lib. ii. cap. 8.
[4] Plin. lib. xxxvi. cap. 22.
[5] See Jannon de S. Laurent's treatise on the cut stones of the ancients, in Saggi di Dissertazioni nella Acad. Etrusca di Cortona, tom. vi. p. 56.
[6] "Saw-mills are useful machines, first introduced in this century; and I do not know any one who can properly be called the real inventor."—Närrische Weisheit. Frankf. 1683, 12mo, p. 78.
[7] In that excellent work, Kunst-und-handwerks Geschichte der Stadt Augsburg, 1779, 8vo, p. 141.

made that he would be so kind as to communicate to me all the information he knew on that subject:—"You are desirous of reading that passage in our town-books, where saw-mills are first mentioned; but it is of very little importance. There is to be found only under the year 1338 the name of a burgher called Giss Saegemuller; and though it may be objected that one cannot from the name infer the existence of the employment, I am of a different opinion; especially as I have lately been able to obtain a proof much more to be depended on. In the surveyors' book, which I have often before quoted, and which, perhaps, for many centuries has not been seen or consulted by any one, I find under the year 1322, and several times afterwards, sums disbursed under the following title: Molitori dicto Hanrey pro asseribus et swaertlingis. Schwartlings, among us, are the outside deals of the trunk, which in other places are called *Schwarten*. This word, therefore, makes the existence of a saw-mill pretty certain. As a confirmation of this idea, we have still a mill of that kind which is at present called the Hanrey-mill; and the stream which supplies it with water is called the Hanrey-brook. Since the earliest ages, the ground on which this mill, and the colour, stamping, and oil-mills in the neighbourhood are built, was the property of the hospital of the Holy Ghost. By that hospital it was given as a life-rent to a rich burgher named Erlinger, but returned again in 1417 by his daughter Anna Bittingerin, who had, above and under the Hanrey-mill, two other saw-mills, which still exist, and for which, in virtue of an order of council of that year, she entered into a contract with the hospital in regard to the water and mill-dams." There were saw-mills, therefore, at Augsburg so early as 1322. This appears to be highly probable also from the circumstance, that such mills occur very often in the following century in many other countries.

When the Infant Henry sent settlers to the island of Madeira, which was discovered in 1420, and caused European fruits of every kind to be carried thither, he ordered saw-mills to be erected also, for the purpose of sawing into deals the various species of excellent timber with which the island abounded, and which were afterwards transported to Portugal[1]. About

[1] This we are told by Abraham Peritsol, the Jew, in Itinera Mundi,

the year 1427 the city of Breslau had a saw-mill which produced a yearly rent of three marks; and in 1490 the magistrates of Erfurt purchased a forest, in which they caused a saw-mill to be erected, and they rented another mill in the neighbourhood besides. Norway, which is covered with forests, had the first saw-mill about the year 1530. This mode of manufacturing timber was called the new art; and because the exportation of deals was by these means increased, that circumstance gave occasion to the deal-tythe, introduced by Christian III. in the year 1545[1]. Soon after the celebrated Henry Ranzau caused the first mill of this kind to be built in Holstein[2]. In 1552 there was a saw-mill at Joachimsthal, which, as we are told, belonged to Jacob Geusen, mathematician. In the year 1555 the bishop of Ely, ambassador from Mary queen of England to the court of Rome, having seen a saw-mill in the neighbourhood of Lyons, the writer of his travels thought it worthy of a particular description[3]. In the sixteenth century, however, there were mills with different saw-blades, by which a plank could be cut into several deals at the same time. Pighius saw one of these, in 1575, on the Danube, near Ratisbon, when he accompanied Charles, prince of Juliers and Cleves, on his travels[4]. It may here be asked whether the Dutch had such mills first, as is commonly believed[5]. The first saw-mill was erected in Holland at Saar-

printed with the learned annotations of Thomas Hyde, in Ugolini Thesaur. Antiq. Sacr. vol. vii. p. 103. Peritsol wrote before the year 1547.

[1] Nic. Cragii Historia regis Christiani III. Hafniæ 1737, fol. p. 293. See also Pontoppidan's History of Norway.

[2] Allgemeine Welthistorie, xxxiii. p. 227.

[3] The account of this journey may be found in Hardwicke's Miscellaneous State Papers, from 1501 to 1726, i. p. 71:—"The saw-mill is driven with an upright wheel; and the water that maketh it go, is gathered whole into a narrow trough, which delivereth the same water to the wheels. This wheel hath a piece of timber put to the axle-tree end, like the handle of a broch, and fastened to the end of the saw, which being turned with the force of the water, hoisteth up and down the saw, that it continually eateth in, and the handle of the same is kept in a rigall of wood from swerving. Also the timber lieth as it were upon a ladder, which is brought by little and little to the saw with another vice."

[4] Hercules Prodicus. Coloniæ 1609, 8vo, p. 95.

[5] Leupoldi Theatrum Machinarum Molarium. Leipzig, 1735, fol. p. 114. I shall here take occasion to remark, that in the sixteenth century there were boring-mills driven by water. Felix Fabri, in his Historia Suevorum, p. 81, says that there were such mills at Ulm.

dam, in the year 1596; and the invention of it is ascribed to Cornelis Cornelissen[1]; but he is as little the inventor as the mathematician of Joachimsthal. Perhaps he was the first person who built a saw-mill at that place, which is a village of great trade, and has still a great many saw-mills, though the number of them is becoming daily less; for within the last thirty years a hundred have been given up[2]. The first mill of this kind in Sweden was erected in the year 1653[3]. At present, that kingdom possesses the largest perhaps ever constructed in Europe, where a water-wheel, twelve feet broad, drives at the same time seventy-two saws.

In England saw-mills had at first the same fate that printing had in Turkey, the ribbon-loom in the dominions of the Church, and the crane at Strasburgh. When attempts were made to introduce them they were violently opposed, because it was apprehended that the sawyers would be deprived by them of their means of getting a subsistence. For this reason it was found necessary to abandon a saw-mill erected by a Dutchman near London[4], in 1663; and in the year 1700, when one Houghton laid before the nation the advantages of such a mill, he expressed his apprehension that it might excite the rage of the populace[5]. What he dreaded was actually the case in 1767 or 1768, when an opulent timber-merchant, by the desire and approbation of the Society of Arts, caused a saw-mill, driven by wind, to be erected at Limehouse under the direction of James Stansfield, who had learned, in Holland and Norway, the art of constructing and managing machines of that kind. A mob assembled and pulled the mill to pieces; but the damage was made good by the nation, and some of the rioters were punished. A new mill was afterwards erected, which was suffered to work without molestation, and which gave occasion to the erection of others[6]. It appears, however, that this was not the only mill of the kind then in Britain;

[1] De Koophandel van Amsterdam. Amst. 1727, ii. p. 583.
[2] La Richesse de la Hollande. Lond. 1778, 4to, i. p. 259.
[3] Clason, Sweriges Handel Omskiften 1751.
[4] Anderson's History of Commerce.
[5] Houghton's Husbandry and Trade Improved, Lond. 1727, iii. p. 47.
[6] Memoirs of Agriculture and other Œconomical Arts, by Robert Dossie. Lond. 1768, 8vo, i. p. 123. Of Stansfield's mill, on which he made some improvements, a description and figure may be seen in Bailey's Advancement of Arts, Manufactures and Commerce. Lond. 1772, i. p. 231.

for one driven also by wind had been built at Leith, in Scotland, some years before[1].

[The application of the steam-engine has in modern times almost entirely displaced the use of either water or wind as sources of power in machinery, and most of the saw-mills now in action, especially those on a large scale, are worked by steam. Some idea of the precision with which their operations are now accomplished may be obtained from the following fact. At the City of London saw-mills, the largest log of wood which had been placed on the carriage in one piece—a log of Honduras mahogany 18 feet long and three feet one inch square,—was cut into unbroken sheets at the rate of ten to an inch, and so beautifully smooth as to require scarcely any dressing.]

STAMPED PAPER.

Paper stamped with a certain mark by Government, and which in many countries must be used for all judicial acts, public deeds, and private contracts, in order to give them validity, is one of those numerous modes of taxation invented after the other means of raising money for the service of states, or rather of their rulers, became exhausted. It is not of great antiquity; for before the invention of our paper it would not have been a very productive source of finance. When parchment and other substances employed for writing on were dear, when greater simplicity of manners produced more honesty and more confidence among mankind, and when tallies supplied the place of notes, bonds, and receipts, writings of that kind were very little in use.

De Basville, however, in his Mémoires pour servir à l'histoire de Languedoc, affirms that stamped paper was introduced so early as the year 537, by the emperor Justinian. This book, written by the author, intendant of that province in 1697, for the use of the duke of Burgundy, was printed, in octavo, at Marseilles in 1734, and not at Amsterdam, as announced

[1] Anderson *ut supra.*

in the title; but it was carefully suppressed by the Government, and on that account is very scarce even in France[1]. I have never seen it; but I know the author's ideas respecting stamped paper, from an extract in Variétés Historiques, Physiques, et Littéraires, printed at Paris in the year 1752[2]. The author of this work supports the opinion of his countryman: but it is undoubtedly false; for the law quoted as a proof requires only that documents should be written on such paper as had marked at the top (which was called the protocoll) the name of the intendant of the finances, and the time when the paper was made; and this regulation was established merely with a view to prevent the forging and altering of acts or deeds[3]. A kind of stamped paper therefore was brought into use, though different from what we have at present, the principal intention of which is not to render writings more secure, but by imposing a certain duty on the stamps, proportioned to the importance of the purpose it is employed for, to make a considerable addition to the public revenue[4]. The stamps serve as a receipt to show that the tax has been paid; and, though many law papers must be stamped, that burthen has tended as little to prevent law-suits as the stamping of cards has to lessen gaming: though some think differently. In both too much is risked and too much expected for taxes to deter mankind from engaging in either.

If in this historical research we look only to the antiquity of stamping, we shall find that both the Greeks and the Romans had soldiers marked in that manner; and, if we may be allowed to bring together things so different, we might include under the like head those runaway slaves who were marked by being branded; but I allude here only to the stamped paper now in use, which was certainly invented in Holland, a country where every necessary of life is subjected to taxation. The States of the United Provinces having promised a reward to any one who should invent a new impost, that might at the

[1] An account of this book may be found in Anecdotes secr. sur divers sujets de littérat. 1734, p. 573, and in the preface to Etat de la France, de M. de Boulainvilliers, fol. p. 12.

[2] Inserted in the Encyclopédie, vol. xi. p. 862.

[3] Novell. coll. iv. tit. 23. cap. 2. nov. 44.

[4] Such is the idea of Stryk in Continuat. altera usus moderni pandectarum, lib. xxii. tit. 4. p. 856.

same time bear light on the people and be productive to the government, some person proposed that of *bezegelde brieven*, or stamped paper, which was approved; and which Boxhorn, to whom we are indebted for this information, considers as a very proper tax. He is of opinion also that it might with great advantage be adopted in other countries[1]; and this was really the case soon after his death, which happened in 1653.

[1] "The States of Holland having laid sufficiently heavy duties on merchandise of every kind, and these not being equal to the expenditure, which was daily increasing, began to think of imposing new ones. For that purpose they issued an edict, inviting the ingenious to turn their thoughts towards that subject, and offering a very ample reward to whoever should invent a new tax, that might be as little burdensome as possible, and yet productive to the republic. Some shrewd, deep-thinking person, at length devised one on stamped paper (called *de impost van bezegelde brieven*), to be paid for all paper impressed with the seal of the States. The inventor proposed, that it should be enacted by public authority, that no petitions from the states, or from the magistrates of any city or district, or any public bodies, should be received; that no documents should be admitted in courts of justice; that no receipts should be legal, and that no acts signed by notaries, secretaries, or other persons in office, and, in short, no contracts should be valid, except such as were written upon paper to which the seal of the States had been affixed, in the manner above mentioned. It was proposed, also, that this paper should be sold by the clerks of the different towns and courts at the following rate; paper impressed with the great seal of the States for sixpence, and that with the less seal for twopence per sheet: for according to the importance of the business it was necessary that the great or less seal should be used. The States approved this plan, and it was immediately put in execution."—Boxhornii Disquisitiones Politic. casus 59. In this collection there is also Boxhornii Reip. Bataviæ Brevis et Accurata Descriptio, in the eighth chapter of which the author gives the following account of the origin of stamped paper:—"A very ingenious method has lately been invented of raising large sums of money for the use of the republic. As there are many rich people who have entrusted a considerable share of their property to the public treasury, the interest of which they receive annually on giving receipts; as many law-suits are carried on which are generally entered into by the wealthy, and which cannot be brought to a conclusion until a variety of instruments, as they are called, have been executed on each side; and as, on account of the flourishing state of trade, many contracts are made, which, for the sake of security, must be mutually signed, the States thought proper to enact by a public edict, that no receipts, law-papers, contracts, or instruments of the like kind, should be legal or valid, unless written on paper impressed with the great or small seal of the States. A price was also fixed on the paper, to be paid by those who had occasion for it; so that a sheet which before could be purchased for a half-penny, was raised to several pence; and it is incredible how great a revenue these sheets bring to the public, by so many of them being used. The poor,

Stamped paper was introduced in Holland on the 13th of August, 1624, by an ordinance which represented the necessity and great benefit of this new tax. Among other things advanced in its favour, it was said that it would tend to lessen law-suits, and, on that account, would soon recommend itself to neighbouring nations. What we are told therefore by the author of an extract in Variétés Historiques, before quoted, that stamped paper began to be used in Holland and Spain so early as the year 1555, is certainly false. The Spaniards may, indeed, have been the first people who followed the example of the Dutch; for the author above mentioned asserts, that he saw an act, executed by a notary at Brussels, in 1668, which was written on stamped paper.

This tax was introduced in the electorate of Saxony by an ordinance of the 22nd of March 1682; and into that of Brandenburg on the 15th of July, in the same year. Bartholdus however says, but without producing any proof[1], that stamped paper was used before that period in Denmark, Florence, and Silesia. In Hanover it was first introduced, as I think, on the 20th of February, 1709.

[The stamp-tax was first introduced into this country in the reign of William and Mary, in 1693 (5 W. & M. c. 21). This act imposes stamps upon grants from the crown, diplomas, contracts, probates of wills and letters of administration, and upon all writs, proceedings, and records in courts of law and equity; it does not however seem to impose stamps upon deeds, unless these are enrolled at Westminster or other courts of record. Two years afterwards, conveyances, deeds and leases, were subjected to the stamp duty, and by a series of acts in the succeeding reigns, every instrument recording a transaction between two individuals was subjected to a stamp duty before it could be used in a court of justice. These laws have been variously altered in later times, but it is beyond our province to trace them further.]

however, and those of small fortune, feel little of this burden, as the rich principally are concerned in the transactions above mentioned."

[1] Fr. Jac. Bartholdi Diss. de Charta Signata; resp. P. Kolhart, Franc. 1690, cap. 2, § 16, p. 36.

INSURANCE.

Insurance, that excellent establishment by which losses that would entirely ruin a merchant, being divided among a company, are rendered supportable, and almost imperceptible; by which undertakings too great for one person are easily accomplished, and by which commodities brought from the most distant regions are made cheaper[1], appears not to have been known to the Romans, however near they may have come to the invention of it. If we examine closely the information from which some endeavour to prove the contrary, it will be found that it is far from sufficient to support their opinion.

Puffendorf[2], Barbeyrac[3], Loccenius[4], Kulpis[5], and others, ground their assertions on a passage of Livy[6], who says, that when the Roman army in Spain was distressed for provisions, clothing and other necessaries, a company engaged to convey to them everything they stood in need of, under the stipulation that the State should make good their loss, in case their vessels should be shipwrecked by storms, or be taken by the enemy; and we are told that these terms were agreed to. This was undoubtedly a promise of indemnification, but by no means an insurance, in which it is always necessary that a premium should be given. On occasions of this kind, however, acts of fraud were practised, like those committed at present, to the prejudice of insurers. Shipwrecks were pretended to have happened which never took place; and old shattered vessels, freighted with articles of little value, were purposely sunk, and the crew saved in boats; and large sums were then demanded as a reimbursement for the loss[7].

Little more is proved by a passage of Suetonius[8], which

[1] "As the Turks are unacquainted with insurance, they do not lend money but at the rate of fifteen or twenty per cent. But when they lend to merchants who trade by sea, they charge thirty per cent."—Remarques d'un Voyageur Moderne au Lévant. Amst. 1773, 8vo.

[2] De Jure Naturæ et Gentium.

[3] Droit de la Nature.

[4] De Jure Maritimo. Holmiæ, 1650.

[5] Collegium Grotianum, Francof. 1722, 4to.

[6] Lib. xxiii. cap. 44.

[7] Lib. xxv. cap. 3.

[8] Lib. v. cap. 18. Langenbec, in his Anmerkungen über das Hamburgische Schiff-und-Seerecht, p. 370, is of opinion that no traces of insurance are to be found either in Livy or Suetonius.

Kulpis and others consider as affording an instance of insurance. That author tells us, that the emperor Claudius promised to indemnify merchants for their losses, if their ships should perish by storms at sea. This passage Anderson must not have read; else he would not have said that Suetonius ascribed the invention of insurance to Claudius.

In Simon's edition of Grotius, a passage is quoted from Cicero's epistles[1] as an instance of insurance among the Romans, which seems to be more probable. Cicero says he hopes to find at Laodicea security, by means of which he can remit the money of the republic, without being exposed to any danger on its passage. The word *prædes* may here signify insurers; but, in my opinion, this quotation ought rather to be classed among those which have been collected by Ayrer, as the first traces of bills of exchange[2].

Those remains of the ancient laws which, according to Kulpis and others, allude to insurance, concern bottomry (*fœnus nauticum*) only; and that this is much older than insurance has been already fully proved by Stypman[3].

Malynes[4], Anderson, and others affirm, that insurance is mentioned in the marine laws of the Isle of Oleron. This island, which lies opposite to the mouth of the Charente, on the coast of France, was much celebrated in the eleventh, twelfth, and following centuries on account of its trade. It belonged then to the duke of Aquitaine, and came to the crown of England by the marriage of Eleonora, daughter of the last duke, with Henry II. Under Eleonora were framed in the island those laws so well-known by the names *Roole d' Oleron*, *Roole des Jugemens d' Oleron*, that, like the laws of the Rhodians, they were used also by foreigners. These laws were afterwards enlarged and improved by Richard I., Eleonora's son; at least we are assured so by the French historians: but the English ascribe them to Richard alone. In order to determine the period when they were framed, I shall only observe that Eleonora died in the year 1202, and Richard in 1199; and

[1] Epist. ad Famil. ii. ep. 17.

[2] Ayreri Diatribe de Cambialis Instituti Vestigiis apud Romanos, added to Uhle's edition of Heineccii Elementa Juris Cambialis.

[3] De Jure Maritimo et Nautico. Gryphis. 1652.

[4] Lex Mercatoria, or the Ancient Law-Merchant, by Gerard Malynes. London, 1656, fol. p. 105.

Anderson, therefore, not without probability, places the origin of them in the year 1194. A copy of these laws, printed at Rouen, is still preserved, in which it is said that they were first drawn up in 1266. This, however, the French and the English declare to be false[1]. They are written in French, that is, in the old Gascon dialect. I am acquainted with them from the following scarce book, the author of which, in the preface, calls himself Cleirac: Us et Coutumes de la Mer[2]; but I find no traces in them of insurance. Even Cleirac himself, who has given an excellent explanation of the laws of Oleron, seems not to have found any; for where he relates everything he knew respecting the history of it, he ascribes this invention, and also that of bills of exchange, to the Jews, who made use of it when they were expelled from France. According to Cleirac, insurance was long detested by the Christians, who at that time considered it as a sin to take interest; and the use of it, as well as of bills of exchange, was first made common by the Guelphs and Ghibelines. Of this pretended service of the Jews in regard to insurance, I know no proof.

The celebrated maritime laws of the city of Wisby, in the island of Gothland, whether of later date, as the French assert, or older, which is more probable, than those of Oleron, are equally silent with respect to insurance. These laws were not written originally in Swedish, as l'Estocq[3] says, but in the Low-German. The translation into High-German by Marquard[4] is incorrect, and the French one of Cleirac is too free and too much abridged. The Dutch translation published at Amsterdam is the completest[5].

Insurance was, undoubtedly, not known at the time when the later Hanseatic maritime laws were framed, else it would have been mentioned in them. Of these laws there are various editions. One of those most used is that by Kericke, which is inserted also in Heineccii Scriptorum de Jure Nautico et Maritimo Fasciculus. Cleirac has given a French translation of them.

As little respecting insurance is to be found in Il Consolato del Mare. These maritime laws, highly worthy of notice,

[1] Seldeni Mare Clausum. Lond. 1636, p. 428. [2] Bourdeaux, 1661, 4to.
[3] Auszug der Historie des Allgemeinen und Preussischen See-rechts. Konigsberg, 1747 4to, p. 32. [4] De Jure Mercatorum et Commerciorum.
[5] Entitled, 'T boeck der Zee-rechten. Amst. 1664, 4to.

were originally written in the Catalonian dialect; and it seems very probable that they were drawn up at Barcelona. A part of them appears to have been framed in the eleventh, but the greater part in the thirteenth century; for the book itself proves, in more than one place, that they are not all of the same antiquity. The most correct edition is that published at Leyden in 1704[1]. Those writers who have pretended that insurance is mentioned in these Catalonian maritime laws have, perhaps, been led into this error, because, in an appendix to some of the common editions, there is a short account of insurance as once practised at Barcelona. As I have never seen this small treatise, I do not know whether it contains anything respecting the history of it. The oldest laws and regulations concerning insurance, with which I am at present acquainted, are the following.

On the 28th of January 1523, five persons appointed for that purpose drew up at Florence some articles which are still employed on the exchange at Leghorn. These important regulations, together with the prescribed form of policies, which may be considered as the oldest[2], have been inserted, i-

[1] The title runs thus: Il consolato del mare, nei quale si comprendono tutti gli statuti et ordini, disposti da gli antichi per ogni cosa di mercantia et di navigare. Leyden, 1704, 4to.

[2] In that old treatise, Le Guidon, inserted in Cleirac, it is remarked, chap. i. art. i. that in old times insurances were made without any writings: they were then called *Assecurances en confiance*; Confidential insurances.

[M'Culloch, in his Dictionary of Commerce, art. *Insurance*, observes respecting this passage, that "Beckmann seems to have thought that the practice of insurance originated in Italy, in the latter part of the fifteenth or the early part of the sixteenth century. But the learned Spanish antiquary, Don Antonio de Capmany, has given, in his very valuable publication on the History and Commerce of Barcelona (Memorias Historicas sobre la Marina, &c., de Barcelona, t. ii. p. 383), an ordinance relative to insurance, issued by the magistrates of that city in 1435; whereas the earliest Italian law on the subject is nearly a century later, being dated in 1523. It is however exceedingly unlikely, had insurance been as early practised in Italy as in Catalonia, that the former should have been so much behind the latter in subjecting it to any fixed rules; and it is still more unlikely that the practice should have escaped, as is the case, all mention by any previous Italian writer. We therefore agree entirely in Capmany's opinion, that until some authentic evidence to the contrary be produced, Barcelona should be regarded as the birth-place of this most useful and beautiful application of the doctrine of chances." Had M'Culloch consulted the treatise on Bills of Exchange, given in a subsequent part of the

Italian and German, by Magens, in his Treatise on Insurance, Average and Bottomry[1], published at Hamburgh in 1753. I should have been glad to have found in Italian authors some information respecting the antiquity of these regulations[2], a copy of which Magens says he procured from Leghorn; but I have hitherto sought for it in vain. Straccha however mentions a Florentine order of June the 15th, 1526, which forbids common insurance, unless the goods and commodities are specified[3].

There is still preserved a short regulation of the 25th May 1537, by the emperor Charles V., respecting bills of exchange and insurance, in which the strictly fulfilling only of an agreement of insurance is commanded.

In 1549 the same emperor issued an express order, "Op 't faict van der zee-vaerdt," in which occur some articles respecting insurance[4], and additions were afterwards made to it in 1561.

In the year 1556, Philip II., king of Spain, gave to the Spanish merchants certain regulations respecting insurance, which are inserted by Magens, with a German translation, in his work before mentioned. They contain some forms of policies on ships going to the Indies.

On the last of October 1563, Philip II. published his maritime laws, in which some forms of policies are given[5]; but on the last of March 1568 that prince forbade the practice of insurance, on account of the bad use to which it had been often applied. This prohibition I have not been able to find.

work (vol. iii. p. 430), he would have found that Beckmann, in noticing the curious memoirs of Capmany, with which he had *then* become acquainted, distinctly mentions "An ordinance of the year 1458 respecting insurance, which required that underwriting should be done in the presence of a notary, and declared *polices o scriptores privades* to be null and void."]

[1] Versuche über Assecuranzen, etc. Hamb. 1753, 4to.

[2] I found nothing on the subject, either in Della decima—e della Mercatura de' Fiorentini, fino al secolo xvi. Lisbona e Lucca, 1765, 1766, 4 vols. 4to, which contains a variety of useful information respecting the history of the Florentine trade, or in Mecatti, Storia Chronologica della città di Firenze. In Napoli 1775, 2 vols. 4to.

[3] Stracchæ aliorumque Jurisconsultorum de Cambiis, Sponsionibus, &c., Decisiones. Amst. 1669, fol. p. 24.

[4] It may be found in Ordonantien ende Placcaeten ghepubliceert Vlaenderen. Antwerp, 1662, fol. i. p. 360.

[5] Ordonantien ende Placcaetcn, ii. p. 307. Groote Placaet-boeck der Ver. Nederlanden, i. p. 796. Magens, p. 397.

I am acquainted with it only by an order of the 20th of January 1570, in which the king expressly recals it, because the merchants at Antwerp, both subjects and foreigners, had presented strong remonstrances against it[1].

In the year 1598, the Kamer von Assurantie, Chamber of Insurance, was established at Amsterdam. An account of the first regulations of this insurance-office may be seen in Pontanus's History of the City of Amsterdam, and in other works[2].

In the year 1600, regulations respecting insurance were formed by the city of Middelburg in Zealand.

It appears that the first regulations respecting insurances in England, which may be seen in Anderson's History of Commerce, were made in the year 1601. We find by them that insurers had before that period conducted themselves in such a manner, that the utmost confidence was reposed in their honesty, and that on this account few or no disputes had arisen[3].

In the year 1604, regulations were formed respecting insurance at Rotterdam; and in 1610 were drawn up those of Genoa, which Magens has inserted in his work, taken from the Latin statutes of the Republic, together with a German translation.

In 1612 the Insurance Chamber at Amsterdam was established by public authority, and received several privileges.

Malynes asserts, but without either proofs or probability, that the people of Antwerp were first taught insurance by the English; and says that, as the merchants assembled for transacting business in Lombard-street, so called because certain

[1] Ordonantien ende Placcaeten, ut supra, p. 335. Groote Placaetboeck, i. p. 828, and in the additions, ii. p. 2116.

[2] The changes which this institution afterwards underwent, with an extract from its regulations, may be seen in La Richesse de la Hollande. Lond. 1778, 4to, i. p. 81.

[3] [The marine insurers are called in this country *under-writers*, because they write their names under the policy. Under the authority of statute 6 George I. cap. 18, two corporate bodies, called the *Royal Exchange Assurance Company* and the *London Assurance Company*, were chartered by the crown. There are at present seven marine insurance companies in London:—the two old chartered companies above-mentioned; two established immediately upon the passing of the act of the year 1824, the *Alliance* and the *Indemnity Mutual*; the *Marine*, established in 1836; and the *General Marine* and *Neptune*, established in 1839.]

Italians from Lombardy had *lombards* there, or houses for lending money on pledges, long before the building of the Exchange, it became customary, as it was in his time (1622), to be guided in policies by what was done in Lombard-street, in London.

[M'Culloch states[1] that it is probable insurance was introduced into England some time about the beginning of the sixteenth century, for it is mentioned in the statute 43 Eliz. c. 12, in which its utility is very clearly set forth, that it had been an *immemorial usage* among merchants, both English and foreign, when they made any great adventure, to procure insurance to be made on the ships or goods adventured. From this it may reasonably be supposed that insurance had been in use in England for at least a century previous. It appears from the same statute, that it had originally been usual to refer all disputes that arose with respect to insurances to the decision of "grave and discreet" merchants appointed by the lord mayor. But abuses having grown out of this practice, the statute authorized the lord chancellor to appoint a commission for the trial of insurance cases; and in the reign of Charles II. the powers of the commissioners were enlarged. But this court soon after fell into disuse; and, what is singular, no trace can now be discovered of any of its proceedings.]

Guicciardini, who wrote his Account of the Netherlands in 1567, remarks, in describing Antwerp, that the merchants there were accustomed to insure their ships. Anderson says that this is the first instance of maritime insurance, which is very astonishing, as he thinks the invention of insurance is to be found in Suetonius, and in the laws of the Isle of Oleron.

A most useful imitation of insurance in trade is the institution of insurance-offices, to indemnify losses sustained by fire. As far as I have been able to learn, companies for that purpose were first formed towards the middle of the last century, though houses were insured by individuals much earlier. The fire-office at Paris was established in 1745; that of the electorate of Hanover in 1750; that of Nassau-Weilburg in 1751; those of Brunswick-Wolfenbuttel and Wirtemberg in 1753; that of Anspach in 1754; that of Baden-Durlach in 1758; that of the county of Mark in 1764; those of Saxe-Weimar and Eisenach in 1768; and that of the Society of the Clergy

[1] Dictionary of Commerce.

in the Mark of Brandenburg[1], to insure goods and household furniture, was established in 1769.

It is perhaps known to few, that even in the beginning of the seventeenth century, a proposal was made by some ingenious person, that all the proprietors of land should insure the houses of their subjects against fire, on their paying so much per cent. annually, according to the value of them. The author of this scheme presented it to count Anthony Gunther von Oldenburg, in the year 1609, as a means of finance not to be found in any work printed on that subject. The author in his plan said[2], that "as many fires happened by which a great number of people lost their property, the count might lay before his subjects the danger of such accidents; and propose to them, that if they would, either singly or united, put a value on their houses, and for every hundred dollars valuation pay to him yearly one dollar; he, on the other hand, would engage, that in case by the will of God their houses should be reduced to ashes, the misfortunes of war excepted, he would take upon himself the loss, and pay to the sufferers as much money as might be sufficient to rebuild them; and that all persons, both natives and foreigners, who might be desirous of sharing in the benefits of this institution, should not be excluded. The author was confident that, though the damage might fall heavy at first, a considerable sum would be gradually raised, from year to year; and that every one might thus insure his houses against accidents. He had no doubt that it would be fully proved, if a calculation were made of the number of houses consumed by fire, within a certain space, in the course of thirty years, that the loss would not amount, by a good deal, to the sum that would be collected in that time. He did not however advise that all the houses in every town should be comprehended, as the money claimed might amount to too much; but only that some and certain houses should be admitted into this association."

I shall here insert, from the same author, the count's reflections on this plan, and the conclusion which he formed:—"It is to be considered," says he, "what sum every proprietor of

[1] Krunitz, Oekonomische Encyclopedie, xiii. p. 221; where an account may be found of other companies.

[2] Winkelmanns Oldenburgischen Friedens- und der benachbarten Oerter Kriegshandlungen. 1671 fol. p. 67.

land may with certainty raise and receive; whether the proposed plan can, to the undoubted benefit of the subjects, and the advantage of their lord, be honourably, justly, and irreproachfully instituted without tempting Providence; without incurring the censure of neighbours; and without disgracing one's name and dignity; in the next place, that this institution may not have the appearance of a scheme to bring money into the country; and still more that it may have no resemblance to a duty, tax, or impost, but rather to a free contribution, or unconstrained remuneration for being insured from danger, and by which losses being made good, houses can be sooner rebuilt, and put in their former condition." The count allowed that the object of the plan was good, considered in every point of view, and that a company composed of common individuals might be formed to insure each other's houses, and pay the losses sustained by fire: but he concluded, that, if he undertook the plan, Providence might be tempted; that his own subjects might be displeased; and that, improper ideas being formed of his conduct, he might be accused unjustly of avarice. "God," he said, "had without such means preserved and blessed, for many centuries, the ancient house of Oldenburg; and he would still be present with him, through his mercy, and protect his subjects from destructive fires." He dismissed, therefore, the ingenious author of this plan, but not without rewarding him according to his usual liberality.

[Insurance against fire has been known and carried on in England for nearly a century and a half; at present the number of British Fire Offices amounts to nearly twenty. The premium demanded for insurance varies from 1*s.* 6*d.* to 10*s.* 6*d.* per £100 according to the supposed risk; the duty is enormous, being no less than 3*s.* per cent on the amount insured. This tax yields a considerable addition to the revenue; in 1842 it amounted to £986,420, which corresponds to £563,668,571 value of property insured, leaving out of consideration the value of insured farming stock, the duty on which was repealed in the year 1833. On common risks the duty is no less than 200 per cent. upon the premium! "Such a duty" observes M'Culloch, "is in the last degree oppressive and impolitic. There cannot, in fact, be the slightest doubt that, were it reduced, as it ought to be, to one-third its present amount, the business of insurance would be very much ex-

tended; and as it could not be extended without an increase of security and without lessening the injurious consequences arising from the casualties to which property is exposed, the reduction of the duty would be productive of the best results in a public point of view; while the increase of business would prevent the revenue from being materially diminished." Several attempts have of late been made in Parliament to induce the government to lower the amount of duty, hitherto without success; it is however to be hoped that some other mode of raising the revenue may be devised than that of taxing so enormously the prudence of the industrious classes[1].

In addition to the marine and fire insurance, a somewhat similar speculation has been applied to human life, in the formation of life-insurance companies. These receive small annual payments in consideration of securing to the relations of the assured, or others to whom his property may be bequeathed, a stipulated sum. This arrangement we consider of the highest importance in mercantile countries, particularly to persons engaged in professional or personal occupations, where on the decease of the principal, the agency or appointment is not usually susceptible of transfer or bequest. By means of this species of insurance property is secured to descendants, who, but for some such precaution, might be left destitute. The oldest life-assurance office in London is the *Amicable*. This company was chartered in 1706, in consequence of application made to her majesty, Queen Anne, by Sir Thomas Allen and others. There are now in London nearly eighty life-assurance companies, of which about sixty are exclusively devoted to that object, and the remainder unite fire-insurance. The terms vary in the different offices, although not considerably, being founded upon recognised sets of tables. A comparative table of the annual rates of premium charged by each British office will be found in Waterston's Cyclopædia of Commerce. The premium is of course adapted to the probable duration of life; the lowest being £1 7*s*. 9*d*. per £100 on a healthy life at the entrance age of 15, the highest, at the age of 60, being about 7 per cent. A diseased condition in most incapacitates for insurance, but in some offices even diseased lives and

[1] [The publisher of the present volumes pays upwards of £200 per annum for insurance on his stock in trade, and therefore feels strongly the force of this observation.—H. G. B.]

risks of every kind are insured, of course at a proportional rate[1].

In the reign of Queen Anne several offices were opened for making insurances on marriages, births, christenings, service, &c., and fraudulent practices prevailed to such a degree that by Stat. 9 Ann. c. 6, § 37, a penalty of £500 is imposed on every person setting up such office, and £100 for any person making such assurance in any office already established.

The assurance principle has within the last few years likewise been applied, with the prospect of success, to the guaranteeing of fidelity in persons holding situations of trust. In this case the calculation is, that out of a large range of instances where individuals of good moral character are entrusted with sums belonging to their employers, a nearly regular amount of defalcation will take place annually, or within some other larger space of time. This may give an unpleasant view of human nature, but it is found to be a true one, and the question which arises with men of business is, by what means may the defalcation be best guarded against. The choice is between a guarantee from one or two persons, and from a trading company. By the former plan, the risk is concentrated upon one or two, who may be deeply injured in consequence: by the other plan, the risk is not merely diffused, it is *extinguished*, for the premiums paid by the insuring parties stand for the losses, besides affording a profit upon the business. Nor have we only thus a protection for private parties against the dangers of security; but individuals, who have the offer of situations on the condition of giving a sufficient guarantee, may now be able to take, where formerly they would have had to decline them, seeing that they might have failed to induce any friend to venture so far in their behalf. Practically, it has also been found that, so far from parties being more ready to give way to temptation when they know that the loss will fall upon a company, they are less so, seeing that the company exercises a more rigid supervision, and presents a sterner front to delinquents, than is the case with private securities in general. Guarantee companies are now established in London, Edinburgh, Glasgow, and other large cities. See Chambers' Tracts, No. 44.]

[1] Life insurances have been forbidden by the laws of France and of many other foreign states, as being of a gambling nature, and opening the door to a variety of abuses and frauds.

ADULTERATION OF WINE.

No adulteration of any article has ever been invented so pernicious to the health, and at the same time so much practised, as that of wine with preparations of lead; and as the inventor must have been acquainted with its destructive effects, he deserves, for making it known, severer execration than Berthold Schwartz, the supposed inventor of gunpowder.

The juice of the grape, when expressed, undergoes what is termed vinous fermentation and so becomes converted into wine, but very soon, if great care be not taken, it passes into a different kind of fermentation, called the acetic; its spirit then becomes changed into an acid, which renders it unfit to be drunk, and of much less utility. The progress of the fermentation may be stopped by care and attention; but to bring the liquor back to its former state is impossible. Ingenuity, however, has invented a fraudulent method of rendering the acid in spoilt wine imperceptible; so that those who are not judges are often imposed on, and purchase sweetened vinegar instead of wine. Were no other articles used for sweetening it than honey or sugar, the adulterator would deserve no severer punishment than those who sell pinchbeck for gold; but saccharine juices can be used only when the liquor begins to turn sour; and even then in very small quantities, else it would betray the imposition by its sweetish-sour taste, and hasten that change which it is intended to prevent. A sweetener therefore, has been invented much surer for the fraudulent dealer, but infinitely more destructive to the consumer; and those who employ it, undoubtedly, merit the same punishment as the most infamous poisoners.

Lead and its oxide or carbonate, dissolved in the acid which spoils wine, give it a saccharine taste not unpleasant, without any new, or at least perceptible tint, and arrest the progress of the acid fermentation. The wine, however, occasions, according as it is used in a great or small quantity, and according to the constitution of the consumer, a speedy or lingering death, violent colics, obstructions and other maladies; so that one may justly doubt whether, at present, Mars, Venus, or Saturn is most destructive to the human race.

The ancients, in my opinion, knew that lead rendered harsh wine milder, and preserved it from acidity, without being aware that it was poisonous. It was therefore long used with confidence; and when its effects were discovered they were not ascribed to the metal, but to some other cause. When more accurate observation, in modern times, fully established the noxious property of lead, and when it began to be dreaded in wine, unprincipled dealers invented an artful method of employing it, which the law, by the severest punishment, was not able wholly to prevent.

The Greeks and the Romans were accustomed to boil their wine over a slow fire, till only a half, third, or fourth part remained, and to mix it with bad wine in order to improve it. When, by this operation, it had lost part of its watery particles, and had been mixed with honey and spices, it acquired several names, such as *mustum*, *mulsum*, *sapa*, *carenum*, or *caroenum*, *defrutum*[1], &c. Even at present the same method is pursued with sack, Spanish, Hungarian, and Italian wines. In Italy, new wine, which has been thus boiled, is put into flasks, and used for salad and sauces. In Naples it is called *musto cotto*; but in Florence it still retains the name of *sapa*. Most of those authors who have described this method of boiling wine expressly say that leaden or tin vessels must be employed; because the wine, by these, is rendered more delicious and durable, as well as clearer. It is, however, certain that must and sour wine by slow boiling, for according to their directions it should not be boiled quickly, must dissolve part of these dangerous metals, otherwise the desired effect could not be produced[2]. Some also were accustomed to add to their wine, before it was boiled, a certain quantity of sea water, which by its saline particles would necessarily accelerate the solution[3].

That the acid of wine has the power of dissolving lead was not unknown to the ancients; for when the Greek and Roman wine-merchants wished to try whether their wine was

[1] Plin. lib. xxiii. cap. 2. Palladius, Octob. 18. edit. Gesneri, ii. p. 994.

[2] Proofs of this will be found in Columella De Re Rustica, lib. xii. c. 19, 20. Cato De Re Rust. cap. cv. and cap. cvii., and Plin. lib. xiv. cap. 21.

[3] Proofs that the ancients mixed their wine with sea-water may be found in Pliny, lib. xxiii. cap. 1. and lib. xiv. cap. 20. Celsus exclaims against it, lib. ii. cap. 25. Dioscorides, lib. v. cap. 7, 9, &c. p. 573. See Petri Andreæ Matthioli Commentarii in sex libros Dioscoridis de materia medica. Venetiis, in officina Erasmi Vincentii Valgrisii, 1553, fol.

spoiled, they immersed in it a plate of lead[1]. If the colour of the lead was changed, which undoubtedly would be the case when its surface was corroded, they concluded that their wine was spoiled. It cannot, however, be said that they were altogether ignorant of the dangerous effects of solutions of that metal; for Galen and other physicians often give cautions respecting white lead. Notwithstanding this, men fell upon the invention of conveying water for culinary purposes in leaden pipes[2]; and even at present at London, Amsterdam, Paris, and other places water is conveyed through lead, and collected in leaden cisterns, though that practice has, on several occasions, been attended with alarming consequences[3]. This negligence in modern times makes us not be surprised when we read that the ancients employed leaden vessels. It appears, however, that it was not merely through negligence that this practice prevailed. They were acquainted, and particularly in Pliny's time, with various processes used in regard to wine[4]; and among these was that of boiling it with lime or gypsum[5]; and the ancient physicians, who had not the assistance of our mo-

[1] Plin. lib. xiv. cap. 20. This method of proof is given more circumstantially in Geopon. lib. vii. cap. 15.

[2] Pallad. August. c. ii. vol. ii. p. 977.

[The solvent action of water upon lead is highly interesting on account of the very general use of leaden pipes and cisterns lined with this metal. From the researches of Lieut.-Col. Yorke, published in the Philosophical Magazine for August 1834 and January 1846, it would appear that a bright leaden vessel containing pure water, such as distilled water, and *exposed to the air*, soon becomes oxidized and corroded; oxide of lead being readily detected *in solution* by means of sulphuretted hydrogen and other sensitive tests; but river and spring water exert a much less or no such solvent power, the carbonates and sulphates in such water preventing it. It is on this account that leaden vessels are used with such impunity, the crust which forms upon the metal entirely preventing all further action. However, as this crust consists partially of carbonate of lead, which is a very dangerous poison, great care should be taken on cleaning or scraping such cisterns to avoid using the water in which particles of the salt may have become diffused. Leaden cisterns are sometimes rendered unsafe in consequence of iron or zinc pipes being soldered or let into them, thus giving rise to galvanic action, which greatly facilitates the solution of the lead.]

[4] Plin. lib. xiv. cap. 20. The same author relates a great many arts practised in regard to wine.

[5] Plin. lib. xiv. cap. 19. That this method was practised in Italy is confirmed by Columella, lib. xii. cap. 20, and Didymus in Geopon. lib. vi. cap. 18. It is mentioned also by Dioscorides and Theophrastus.

dern chemistry, thought it more probable that their wine was rendered noxious by the addition of these earths[1], than by the vessels in which it was boiled; and they were the more inclined to this opinion, as they had instances of the fatal effects produced by the use of them[2]. They decried them, therefore, so much, that laws were afterwards made by which they were forbidden to be used, as poisonous and destructive to the human body.

Wine which has once begun to spoil cannot be perfectly restored by lime; for it cannot bring back to it the spirituous part which it has lost, neither can it remove the acid with which it is incorporated; but it can render it imperceptible to the tongue by uniting with it, and forming an earthy salt of an almost insipid taste. This method of improving sour wine is still practised in the island of Zante[3], in Spain[4], on the coast of Africa[5], and in many other countries. It is, however, condemned by several physicians and chemists; because obstructions and other bad effects are to be apprehended from it. Some, on the contrary, consider it as harmless[6]; and I must confess that I should expect no bad consequences from such a small quantity of lime as would be necessary for that purpose. It will produce a salt which will have the same effects as that tartareous crust called wine-stone, and will act as a laxative, like the salts which our apothecaries prepare from that calcareous stone crab's-eyes, by means of vinegar or lemon-juice. The lime, which the acid of the wine cannot

[1] Plin. lib. xxiii. cap. 1. [2] Ibid. lib. xxxvi. cap. 24.

[3] "The wine of the island of Zante is almost as strong as brandy. It is supposed that this proceeds from the unslaked lime which is usually mixed with it, under the pretence that it then keeps better, and is fitter to be transported by sea."—D'Arvieux, Voyages.

[4] Christophori a Vega de Arte Medendi, lib. ii. cap. 2.

[5] "No one sells wine at Tunis but the slaves, and this wine is not under the jurisdiction of the Tunisian government. They put lime in it, which renders it very intoxicating."—Thevenot's Voyages.

[6] In Anleitung zur Verbesserung der Weine in Teutschland, Franck. and Leipsic, 1775, 8vo, the moderate use of lime is recommended. In France crude potash is put into wine instead of lime. [Acidity in wine was formerly corrected in this country by the addition of quick-lime. This furnishes a clue to Falstaff's observation that there was "lime in the sack," which was a hit at the landlord, as much as to say his wine was worth little, having its acidity thus disguised. Carbonate of soda is now most frequently used for the purpose.]

dissolve, will fall to the bottom as a sediment, and assist to clarify the wine. Used however in too great quantity, it may hasten the destruction of the still remaining spirituous part, and render the wine weak; a caution which has been given to wine-merchants by Neumann.

Gypsum is a compound of sulphuric acid with lime, and were it always pure, its effects upon wine would be imperceptible; but as the most kinds of common gypsum contain abundance of carbonate of lime, they effervesce with acids, are dissolved in part by them, and form that salt which I have before said I consider as harmless. By means of this carbonate gypsum improves sour wine, as well as common wine. I took half an ounce of that gypsum which at Osterode is pounded and used as mortar, and which is hard, white, and shining, and almost of the nature of alabaster. When I had pounded it, I put it into strong vinegar in a glass vessel, and suffered it to boil for a few minutes. I then strained it through filtering-paper; and what remained, after it was washed and dried, weighed 215 grains; so that the vinegar had dissolved 25 grains, which were precipitated afterwards by carbonated alkali. I pursued the like process with half an ounce of burnt gypsum, such as is used here for floors; and I found that two ounces of the same vinegar dissolved half a drachm of it, which was somewhat more in proportion than of the former. Every one whom I caused to taste of this vinegar remarked that both had lost a considerable share of their acidity; but that the vinegar which had been boiled with burnt gypsum had lost the most. Few kinds of native gypsum are perfectly pure; and at any rate we have no reason to suppose that the ancients sought pure gypsum for their wines. This method is not yet disused. We are told by Arvieux, that it is still employed in the island of Milo; and I shall here take occasion to observe that salt water also is added to wine there, even at present. Christopher Vega, whom I have before quoted, reproaches the Spaniards with the use of gypsum; and it has been condemned by the modern as well as the ancient physicians. An Englishman of the name of Hardy seems to suspect that gypsum contains lead and arsenical earth[1];

[1] "The properties of lead and arsenic are well understood; but what those of the ancient gypsums were, will require an explanation; as there seems to be just reason to believe, that some of them contained a portion

but it appears that this writer doubted whether our gypsum be the same as that of the ancients; and indeed it is necessary, before we use their information respecting natural objects, to examine carefully whether they understood by any name what we understand by it; and what they meant by gypsum has been determined neither by Stephanus, Ferber, nor Gesner. We however know this much, that the ancients burnt their gypsum, and that they formed and cast images of it[1]. In my opinion wine cannot be poisoned by gypsum; and wine-merchants who employ it and lime deserve no severer punishment than brewers, who, in the like manner, render sour beer fitter to be drunk and more saleable

That the ancients were accustomed to clarify their wine with gypsum, is proved by different passages of the Greek writers on husbandry. They threw gypsum into their new wine; stirred it often round, then let it stand for some time, and, when it had settled, poured off the clear liquor[2]. It would, however, appear that they had remarked that gypsum caused the spirituous part to disappear; for we read that the wine acquired by it a certain sharpness which it afterwards lost, but that the good effects of the gypsum were lasting[3]. This process in modern times has been publicly forbidden, in many countries, as it was in Spain in the year 1348.

Calcined shells were in ancient times used instead of lime[4]. Potters-earth was also thrown into wine, in order to clarify it by carrying the muddy particles with it to the bottom. This method I have seen employed in the breweries at Amsterdam, to purify the water. In the south of France it is used for clarifying wine-stone ley; and in my opinion it might be useful on many other occasions[5].

The ancients poisoned their wine with lead without knowing it; but at what period did that pernicious practice begin of employing sugar of lead and litharge? Litharge was not unknown to the ancients; for it is mentioned by Dioscorides, Aëtius, and others. Sugar of lead is, indeed, more modern; but I have found no information respecting the invention of it, except that it was known to Paracelsus, who died in 1541,

of metallic or arsenical earth."—A Candid Examination of what has been advanced on the Colic of Poitou and Devonshire, by James Hardy, London, i. 8vo, p. 84. [1] Plin. lib. xxxv. [2] Geopon. pp. 462, 483, 494. [3] Ibid. vii. 12, p. 483. [4] Ibid. p. 486. [5] Ibid. p. 486.

and who ventured to prescribe it for some disorders. It was known also to Angelus Sala, one of the most ingenious of the early chemists. In the Roman laws no particular orders occur against the adulteration or poisoning of wine; for what we read in the Institutiones[1] is applicable only to the spoiling of another person's wine, and thereby occasioning a loss to him; and this explanation is confirmed by the Digesta[2]. The German prohibitions against the adulteration of wine began in the fifteenth century, and were from time to time renewed with additional severity. In that century, we find complaints against this practice with lime, sulphur, and milk; but no instance occurs of the poisoning with lead. I however conjecture that the use of litharge was introduced in the twelfth or thirteenth century; but the framers of the laws were not acquainted with the real poison; and instead of causing it to be examined by the chemists, who it must be confessed had not advanced far in their art, they contented themselves with prohibiting the use of those things which they found considered by the ancients as dangerous.

Among the oldest German prohibitions against the adulteration of wine is that of Nuremberg in the year 1409; in which however there is no notice taken of litharge. Another of the year 1475 is mentioned by Datt[3]; but some Imperial ones of an earlier period may have been lost[4]. In the year 1487 the emperor caused an order against the adulteration of wine to be published by the governments in Swabia, Franconia and Alsace; and this practice was a subject of deliberation at the diet of Rothenburg the same year, and also at the diet of Worms, under Maximilian I., in 1495. At the diet of Lindau the use of sulphur was in particular prohibited, and also at Freyburg in Brisgau in 1498. In the year 1500 the same affair was discussed at Augsburg, and again at that city in 1548, under Charles V. It appears that this business was left afterwards to the care of the different princes, who from time to time issued prohibitions against so destructive a fraud.

Older and severer prohibitions are however to be found in other countries. By an order of William count of Hennegau,

[1] Lib. iv. tit. 3. § 13. [2] Digestor. lib. ix. tit. 2. leg. 27. § 15. Later jurists call the adulteration of wine *crimen stellionatus*.

[3] De pace imperii publica. Ulmæ 1698, p. 632.

[4] Goldast. Constit. Imper. tom. ii. p. 114.

Holland and Zeeland, of the year 1327, we find that long before that period it was customary to adulterate wine with noxious and dangerous substances. In the year 1384 the government at Brussels issued a severer order of the like kind, in which vitriol, quicksilver and lapis calaminaris are mentioned[1]. In France we find an old *ordonnance du prevôt de Paris*, for the same purpose, dated September the 20th and December the 2nd, 1371, in which no minerals are mentioned; but in that of 1696 litharge is particularly noticed[2].

Conrade Celtes, who in the year 1491 was first crowned in Germany as a poet, gives in his panegyric on Nuremberg some information respecting the adulteration of wine, from which we learn that he considered it as a new invention, and ascribed it to a monk called Martin Bayr; but his expressions are so figurative, that little can be gathered from them[3]. We are however told by Zeller, that it was believed that this dangerous

[1] Mémoires sur les questions proposées par l'Académie de Bruxelles en 1777. A Bruxelles 1778, 4to.

[2] Traité de la Police, par De la Mare, p. 514. ["In France it does not appear that lead in any form has been employed in making or altering their wines. On the 13th of March 1824, a member of the Chamber of Deputies moved for a law to punish the practice. The motion was rejected, because neither litharge nor any other preparation of lead was shown to have been used, nor was any instance cited in which it had been detected, though an ordinance was made against its use in 1696."—Redding's History and Description of Wines. Lond. 1836, p. 336.]

[3] "I wish those who adulterate wine were punished with greater severity; for this execrable fraud, as well as many more deceptions, has been invented in the present age; and a villany by which the colour, taste, smell and substance of wine are so changed as to resemble that of another country, has been spread not only through Germany, but also through France, Hungary and other kingdoms. It was invented, they say, by a monk named Martin Bayr, of Schwarzen-Eychen in Franconia. He undoubtedly merits eternal damnation for rendering noxious and destructive a liquor used for sacred purposes, and most agreeable to the human body; thus contaminating and debasing a gift of nature inferior to none called forth from the bosom of the earth by the influence of the solar rays; and for converting, like a sanguinary destroyer of the human race, that bestowed upon us by Nature to promote mirth and joy, and as a soother of our cares, into a poison and the cause of various distempers. But if the debasers of the current coin are punished capitally, what punishment ought to be inflicted upon the person who hath either killed or thrown into diseases all those who used wine? The former by their fraud injure a few, but the latter exposes to various dangers people of all ages, and of both sexes; occasions barrenness in women; brings on abortions and makes them miscarry; corrupts and dries up the milk of nurses; excites gouty

fraud was invented in France[1]. Martin Zeiler, in his Chronicle of Swabia (p. 65), says, "In the year 1453, the citizens of Augsburg began to observe this fraud in the wine-market; for during four years before, Martin Bayr, at Schwarzen-Eychen in Franconia, first taught the German tavern-keepers and the waggoners to preserve new wine from becoming sour; to clarify wine by sulphur; and likewise to counterfeit it by spices, to the great prejudice of people's health." In this passage there is no mention of litharge, but of other mixtures. The oldest account of the poisonous sweetening of wine is that which occurs in the French ordinance of 1696[2]; and Zeller's conjecture that it was invented or first remarked in France, seems to me the more probable, as it appears that it was practised at Wurtemberg about the same period. In the year 1697 it was known there that some wine-merchants, particularly Hans George Staltser at Goppingen, used litharge for refining wine, and by these means deprived many persons of life, and occasioned the loss of health to others. Staltser pleaded in excuse, that he considered the process he had employed as harmless, and that Masskosky, physician to the town of Goppingen, who was accounted a man of knowledge, had employed the same for his wine. Brugel also, physician to the town of Heidenheim, had declared that litharge was not prejudicial; and as he was a person of reputation, his opinion had tended not a little to establish the use of that practice. This report was so hurtful to the wine-trade of Wurtemberg, which at that time brought a great deal of money into the

pains in the body; causes others in the bowels and reins, than which none can be more excruciating; and produces ulcers in the intestines; in short, his poison inflames, corrodes, burns, extenuates, and dries up; nor does it allay, but increase thirst; for such is the nature of sulphur, which, mixed with other noxious and poisonous things, the names of which I should be ashamed to mention, is added to wine, before it has done fermenting, in order to change its nature. This poison we have been obliged to purchase for our friends, wives, children and selves, at a high price; as wine has been scarce for several years past; and it would seem that Nature had denied this liquor so long out of revenge against her enemies and the destroyers of the whole human race. You ought, therefore, most prudent fathers, not only to empty their vessels, by throwing this poison into your river; but to cast alive into the flames the sellers of this wine, and thus to punish poisoning as well as robbery."—Pirkheimeri Opera, Franck. 1610, fol. p. 136. [This writer was the friend and contemporary of Albert Durer.]

[1] De docimasia vini lithargyrio mangonisati. Tubingæ 1707.

[2] De la Mare, Traité de la Police, i. 615.

duchy from other countries, that the wine at Ulm remained unsold; and duke Everhard Louis was obliged to cause experiments to be made to ascertain the nature of the substances mixed with it. Solomon Keysel, the duke's physician, and J. Gaspar Harlin, physician to the court, both declared that litharge was noxious, but that sulphur besprinkled with bismuth was still more so. They strongly advised, therefore, that both these substances should be forbidden to be used, under the heaviest penalties; and this prohibition was put in force with the greater severity as some persons of the first rank had for several years before caused their spoiled and sour wine to be made sweet and clear in this manner by a weaver of Pforzheim, who resided at Stutgart. An order was issued on the 10th of May 1697, forbidding this adulteration under pain of death and confiscation of property, as well as of being declared infamous; and the duke requested the neighbouring states, particularly Bavaria and Eychstat, to keep a more watchful eye over their wine-merchants and waggoners, by which means it was supposed all danger would be avoided.

In the following year, the city of Ulm discovered a poor man at Giengen, within its own jurisdiction, who had sweetened with litharge some sour wine purchased at Wurtemberg. He was accordingly banished from the country; and several other persons in the duchy were condemned to labour at the fortifications. This example was attended with so good an effect, that for some time adulteration was not heard of; but eight years after, John Jacob Ehrni of Eslingen introduced that practice again with some variation, and not only employed it himself, but induced others to follow it in several other places. Greater severity was at length exercised. Ehrni was beheaded; the possessors of adulterated wine were fined. and the wine was thrown away. After this second example, which was followed in other parts of the country, the art of adulterating wine seems to have been more carefully concealed, or to have been entirely abandoned. But in the present century treatises have been published on the management of wine, in which the art of improving it by litharge has been taught, as a method perfectly free from danger[1].

For detecting metal in wine, the arsenical liver of sulphur

[1] William Graham's Art of making Wines from Fruit, Flowers and Herbs. Sixth edit. London, 8vo.

is commonly employed; a solution of which is called *liquor probatorius Wurtembergicus*[1]. This appellation, in my opinion, has been given to it because it was first applied for that purpose by a public order in the duchy of Wurtemberg; though the invention is ascribed to one of the duke's physicians[2]. The use of it however is not attended with certainty, because it precipitates several metals black without distinction, and lead is not the only one that we have reason to suspect in wine.

The operation of fumigating wine with sulphur is performed by kindling rags of linen dipped in melted brimstone, and suffering the vapour to enter a cask filled, or partly filled, with that liquor. I do not know at what period this process was invented; but it is worthy of remark, that we are told by Pliny[3], that in his time some employed sulphur in the preparation of wine. On this subject he quotes Cato; but the passage to which he alludes is not to be found in the works of that author handed down to us; and the method in which it was really used is consequently unknown. Reason and experience show that the vapour of sulphur stops the fermentation so hurtful to wine, and prevents it from spoiling; and many writers on the management of wine allow the free use of it for that purpose[4]. It can certainly do no injury to the health; and it was not necessary for the police in different countries to distribute prescriptions for employing it, to forbid it, or to limit the quantity[5].

Some wine-dealers are accustomed to sprinkle over with bismuth the rags dipped in sulphur used for fumigating wine, and this addition is a German invention[6]. It has been severely forbidden by express laws; and there are undoubtedly suffi-

[1] [A solution of sulphuretted hydrogen answers much better.]

[2] Anleitung zur Verbesserung der Weine in Teutschland, p. 32.

[3] Lib. xiv. cap. 20.

[4] [It acts by keeping the wine from contact with oxygen, which is essential to the acetic fermentation.]

[5] This was done at Rothenburg on the Tauber in 1497. It was ordered that half an ounce of pure sulphur should be employed for a cask containing a tun of wine; and that when wine had been once exposed to the vapour of sulphur, it should not undergo the same operation a second time.

[6] In John Hornung's Cista Medica, Norimbergæ 1625, there are two letters from German physicians (Libavius and Doldius) respecting this practice.

cient grounds for its being reprobated. At any rate this metallic addition is of no use in any point of view, as the most experienced dealers in wine have long since acknowledged.

In an old Imperial ordinance, milk also is mentioned as an article used in the adulterating of wine. This method was known to and practised by the ancient Grecians[1]. But in the opinion of Von Rohr milk cannot be employed for that purpose[2]. "One can scarcely comprehend," says he, "how the framers of laws should ever imagine that a wine-dealer would be so simple as to adulterate wine with milk; and those who do so, deserve not to be punished for their folly. As they will find no purchasers to wine adulterated by so strange a mixture, that punishment will be sufficient." The effects of milk however may be easily comprehended. It causes the wine to throw up a scum, which carries with it every impurity; and this being taken off along with it, the wine must of course be rendered much clearer. However, though this mixture cannot be called an adulteration, it is certain that wine may be refined much better by isinglass, and that method is followed at present.

I shall observe in the last place, that in the year 1472, Stum-wine, as it is called, was prohibited as a bad liquor prejudicial to the health[3]. By this term is understood wine, the fermentation of which has been checked, and which on that account continues sweet; seldom becomes clear; and, even when it clarifies, turns muddy when exposed to the air, because the fermentation, which has been stopped, again commences[4]. Wines of this kind are allowed at present. They are called *vina muta* or *suffocata*, and have a great resemblance to a sort of wine made principally at Bordeaux, to which the French give the name of *vin en rage*.

[In no country of the world has the adulteration and brewing of wines attained to such a pitch of perfection as in this "tight little island." So impudently and notoriously are these frauds practised, and so boldly are they avowed, that there are books

[1] Geopon. p. 486, 502.—Lemnius de Miraculis Occultis Naturæ, Coloniæ, 1581, 8vo, p. 291.

[2] See Haushaltungs-Recht, Leipsic, 1716, 4to, p. 1393.

[3] Von Lersner, Chronica der Stadt Frankfurt, ii. p. 683. Wine seasoned with mustard, and which was sold as boiled wine, was forbidden at the same time. See p. 684. In the year 1484 wine mixed with the herb mugwort was prohibited also.

[4] Anleitung, *ut supra*, p. 93, 128.

published called 'Publican's Guides' and 'Licensed Victuallers' Directors,' in which the most infamous receipts imaginable are laid down to swindle their customers[1]. One of these recommends port wine to be manufactured, after sulphuring a cask, with twelve gallons of strong port; six of rectified spirit; three of cognac brandy; forty-two of fine rough cider; making sixty-three gallons, which cost about eighteen shillings a dozen. Another receipt is forty-five gallons of cider; six of brandy; eight of port wine; two gallons of sloes stewed in two gallons of water, and the liquor pressed off. If the colour is not good, tincture of red sanders or cudbear is directed to be added. This may be bottled in a few days, and a tea-spoonful of powder of catechu being added to each, a fine crusted appearance on the bottles will quickly follow. The ends of the corks being soaked in a strong decoction of brazil-wood and a little alum, will complete this interesting process, and give them the appearance of age. Oak-bark, elder, brazil-wood, privet, beet, turnsole, are all used in making fictitious port wine.

The wines of Madeira are in like manner adulterated or wholly manufactured in England, which from these devices may justly claim the title of a universal wine country, where every species is made if it be not grown. The basis of the adulteration of madeira is vidonia, mingled with a little port, mountain, and cape, sugar-candy and bitter-almonds, and the colour made lighter or deepened to the proper shade, as the case may require. Even vidonia itself is adulterated with cider, rum, and carbonate of soda to correct acidity. Bucellas, cape, in short every species of wine that it is worth while to imitate, is adulterated or manufactured in this country with cheaper substances. Common Sicilian wine has been metamorphosed so as to pass for tokay and lachryma christi; even cape wine itself has been imitated by liquids, if possible inferior to the genuine article.

Gooseberry wine is often passed off for champagne; the very bottles are bought up for the purpose of filling with gooseberry wine, and are then corked to resemble champagne. It has also been made from white and raw sugar, citric or tartaric acid, water, home-made grape wine or perry and French brandy—cochineal or strawberries have been added to imitate the pink.

[1] See Redding's History and Description of Modern Wines.

In fact vegetation has been exhausted, and the bowels of the earth ransacked to supply trash for this most vicious practice.

Redding observes, in his valuable and most interesting work on the History and Description of Modern Wines, that the clumsy attempts at wine-brewing made a century ago would be scorned by a modern adept. It is said that when George the Fourth was in the "high and palmy" days of early dissipation, he possessed a very small quantity of remarkably choice and scarce wine. The gentlemen of his suite, whose taste was hardly second to their master's, finding it had not been demanded, thought it was forgotten, and, relishing its virtues, exhausted it almost to the last bottle, when they were surprised by the unexpected command that the wine should be forthcoming at an entertainment on the following day. Consternation was visible on their faces; a hope of escaping discovery hardly existed, when one of them, as a last resource, went off in haste to a noted wine-brewer in the city, numbered among his acquaintance, and related his dilemma. "Have you any of the wine left for a specimen?" said the adept; "O yes, there are a couple of bottles." "Well then, send me one, and I will forward the necessary quantity in time; only tell me the latest moment it can be received, for it must be drunk immediately." The wine was sent, the deception answered; the princely hilarity was disturbed by no discovery of the fictitious potation, and the manufacturer was thought a very clever fellow by his friends. What would Sir Richard Steele have said to so neat an imitation, when in his day he complains that sinister fabrications were coarsely managed with sloe-juice? the science of adulteration must then have been in its infancy.]

ARTIFICIAL PEARLS.

Those round calcareous[1] excrescences found both in the bodies and shells, especially on the nacreous coat, of several

[1] It was because pearls are calcareous that Cleopatra was able to dissolve hers in vinegar, and by these means to gain a bet from her lover, as we are told by Pliny, l. ix. c. 35, and Macrobius Saturn. l. ii. c. 13. She must,

kinds of shell-fish[1], have been much used as ornaments since the earliest ages[2]. The beautiful play of colours exhibited on their surface has raised them to a high value[3]; and this they have always retained on account of their scarcity and the expense arising from the laborious manner in which they are collected[4]. By the increase of luxury among the European

however, have employed stronger vinegar than that which we use for our tables, as pearls, on account of their hardness and their natural enamel, cannot be easily dissolved by a weak acid. Nature has secured the teeth of animals against the effects of acids, by an enamel covering which answers the same purpose; but if this enamel happen to be injured only in one small place, the teeth soon spoil and rot. Cleopatra perhaps broke and pounded the pearls; and it is probable that she afterwards diluted the vinegar with water, that she might be able to drink it; though dissolved calcareous matter neutralizes acids and renders them imperceptible to the tongue. We are told that the dissipated Clodius gave to each of his guests a pearl dissolved in vinegar to drink:—"Ut experiretur in gloria palati," says Pliny, "quid saperent margaritæ; atque ut mire placuere, ne solus hoc sciret, singulos uniones convivis absorbendos dedit." Horace, lib. ii. sat. 3, says the same. That pearls are soluble in vinegar is remarked in Pausanias, b. viii. ch. 18, and Vitruvius, b. viii. ch. 3.

[1] That pearls are not peculiar to one kind of shell-fish, as many believe, was known to Pliny. I have a number of very good pearls which were found by my brother in Colchester oysters. It is more worthy of remark, and less known, that real pearls are found under the shield of the sea-hare, (*Aplysia*), as has been observed by Bohadsch in his book De Animalibus Marinis, Dresdæ, 1761, 4to, p. 39.

[2] In the time of Job, pearls were accounted to be of great value. Job, chap. xxviii. ver. 18.

[3] [When the surface of pearl is examined with a microscope, it is found to be indented by a large number of delicate grooves, which by their effect upon the light give rise to the play of colours; and if impressions of them be taken upon wax, fusible metal, lead, balsam of Tolu, &c., the impressed surface exhibits the prismatic colours in the same manner as the pearl. This principle has been applied by Mr. Barton and others to the making of ornaments, in the form of buttons, artificial jewels, &c., by grooving the surface of steel with a very fine cutting machine. The theory of the production of the colours is this: the surfaces of the grooves, from their varied inclinations, reflect the incident white light at various angles, hence the correspondence of the luminous undulations is interrupted and some of them check or interfere with one another, others continue their course. Now, ordinary white light being a mixture of coloured rays, when some of these are checked or interfered with in their progress, the remainder continue their course and appear of that colour which results from the ocular impression communicated by them.]

[4] [One of the most remarkable pearls of which we have any authentic account, was bought by Tavernier at Catifa in Arabia, a fishery famous in the days of Pliny, for the enormous sum of £110,000. It is pear-shaped,

nations, the use of pearls has become more common; and even in Pliny's time they were worn by the wives of the inferior public officers, in order that they might vie in the costliness of their dress with ladies of the first rank. It is probable, therefore, that methods were early invented to occasion or hasten the formation of pearls; and as at present those who cannot afford to purchase gold, jewels, and porcelain, use in their stead pinchbeck, artificial gems, and stone-ware, so methods were fallen upon to make artificial pearls.

The art of forcing shell-fish to produce pearls was known, in the first centuries of the christian æra to the inhabitants of the coasts of the Red-sea, as we are told by the philosopher Apollonius, who thought that circumstance worthy of particular notice. The Indians dived into the sea, after they had rendered it calm and more transparent by pouring oil into it. They then enticed the fish by means of some bait to open their shells; and having pricked them with a sharp pointed instrument, received the liquor that flowed from them in small holes made in an iron vessel, in which they hardened into real pearls [1]. Olearius says that this account is to be found in no other author: but it has at least been copied by Tzetzes [2].

We are as yet too little acquainted with shell-fish to be able to determine with certainty how much truth there really may be in this relation: but there is great reason to conjecture from it that the people who lived on the borders of the Red-sea were then acquainted with a method of forcing shell-fish to produce pearls; and as the arts in general of the ancient Indians have been preserved without much variation, the process employed by the Chinese at present, to cause a certain kind of mussels to form pearls, seems to confirm the account given by Philostratus. In the beginning of summer, at the time when the mussels repair to the surface of the water and open their shells, five or six small beads, made of mother-of-pearl, and strung on a thread, are thrown into each of them. At the end of a year, when the mussels are drawn up and opened, the beads are found covered with a pearly crust, in such a

regular, and without blemish. It is rather more than half an inch in diameter at the largest part, and from two to three inches in length.—Waterston's Encyclopædia of Commerce.]

[1] Philostrat. in Vita Apollon. lib. iii. cap. 57, edit. Olearii, p. 139. Conrade Gesner, in his Hist. Nat. lib. iv. p. 634, gives a more correct translation of the passage.

[2] Tzetzes Variorum, lib. ii. segm. 373.

manner that they have a perfect resemblance to real pearls. The truth of this information cannot be doubted, though some experiments made in Bohemia for the same purpose were not attended with success[1]. It has been confirmed by various persons[2], and it is very probable that some operations and secrets, without which the process would prove fruitless even in China, may be unknown to the Europeans. Besides, many observations are known which seem to show the possibility of such an effect being produced. Fabricius says that he saw in the possession of Sir Joseph Banks, at London, large *Chamæ*[3], brought from China, in which there were several bits of iron wire, incrusted with a substance of a perfect pearly nature[4]. These bits of wire, he said, had been sharp, and it appeared as if the mussels, to secure themselves against the points of the wire, had covered them with this substance, by which means they had been rendered blunt. May not therefore the process employed by the ancients be still practised? And may not these bits of wire have been the same as those spikes used by the people in the neighbourhood of the Red-sea for pricking mussels, and which perhaps slipped from the hands of the Chinese workmen and remained in the animals?

The invention therefore of Linnæus cannot be called altogether new. That great man informed the king and council in the year 1761, that he had discovered an art by which mussels might be made to produce pearls, and he offered to disclose the method for the benefit of the kingdom. This however was not done, but he disposed of his secret to one Bagge, a merchant at Gottenburg, for the sum of eighteen thousand copper dollars, which make about five hundred ducats. In the year 1780, the heirs of this merchant wished to sell to the highest bidder the sealed-up receipt[5]: but whether the paper was purchased, or who bought it, I do not

[1] See Dr. Joh. Mayer's Bemerkungen, in the fourth part of Abhandlungen einer Privatgesellschaft in Böhmen, p. 165.

[2] Abhand. der Schwed. Akadem. der Wissenschaften, vol. xxxiv. p. 89. The author of the paper alluded to had a mussel with such artificial pearls, which had been brought from China. It was a *Mytilus cygneus*, the swan-mussel, or great horse-mussel. Mention is made also in Histoire de l'Academie des Sciences de Paris, année 1769, of a stone covered with a pearly substance which was found in a mussel.

[3] A kind of cockles.

[4] J. C. Fabricius Briefe aus London, Dessau, 1784, 8vo, p. 104.

[5] See Schlözer's Briefwechsel, number 40, p. 251.

know; for Professor Retzius at Lund, of whom I inquired respecting it, could not inform me[1]. In the year 1763, it was said in the German newspapers, that Linnæus was ennobled on account of this discovery, and that he bore a pearl in his coat of arms; but both these assertions are false, though Fabricius conjectures that the first may be true[2]. Linnæus received his patent of nobility, which, together with his arms, I have seen, in the year 1756, consequently long before he said anything respecting that discovery, of which the patent does not make the least mention. What in his arms has been taken for a pearl, is an egg, by which M. Tilas, whose business it then was to blazon the arms of ennobled families, meant to represent all nature, after the manner of the ancient Egyptians. The arms are divided into three fields, each of which, by the colour forming the ground, expresses one of the kingdoms of nature; the red signifying the animal, and the green the vegetable, &c. Over the helmet, by way of crest, is placed the *Linnæa*[3]; that beautiful little moth the *Phalæna linneella*, shining with its silvery colours, is displayed around the border instead of festoons; and below is the following motto, *Famam extendere factis*. Linnæus once showed me, among his collection of shells, a small box filled with pearl, and said, "Hos uniones confeci artificio meo; sunt tantum quinque annorum, et tamen tam magni." "These pearls I made by my art, and though so large they are only five years old." They were deposited near the *Unio margaritifera*, from which most of the Swedish pearls are procured; and the son, who was however not acquainted with his father's secret, said the experiments were made only on this kind of mussel, though Linnæus himself assured me that they would succeed on all kinds.

I conjecture that Linnæus alluded to this art in his writings

[1] Dr. Stœver, in his Life of Linnæus, vol. i. p. 360, says that the manuscript containing this secret was in the possession of Dr. J. E. Smith, at London.—TRANS. [2] In his Letters, p. 104.

[3] This pretty plant, named after the father of botany, grows in Northumberland and some woods in Scotland, also in Switzerland, Siberia, and Canada, but particularly in Norway and Sweden, in shady places amidst the thick woods. The flowers, which appear in May, June and July, are shaped like a bell, rose-coloured without, yellowish in the inside, and somewhat hairy. They have a pleasant smell, especially in the evening. In Tronheim and the neighbouring parts they are drunk as tea for medicinal purposes.

so early as the year 1746, or long before he ever thought of keeping it a secret. The passage I mean is in the sixth edition of his Systema Naturæ, where he says, "Margarita. Testæ excrescentia latere interiore, dum exterius latus perforatur[1]." I once told him that I had discovered his secret in his own works; but he seemed to be displeased, did not inquire after the passage, and changed the discourse. That pearls are produced when the shells have been pierced or injured in a certain manner, is highly probable, and has been in modern times often remarked[2]. It appears also, that the animal has the power of sometimes filling up such openings with a calcareous substance, which it deposits in them. This substance assumes the figure of the orifice, and the animal particles it contains give it its brightness and lustre[3]. Pearl-fishers have long known that mussels, the shells of which are rough and irregular, or which exhibit marks of violence, commonly contain pearls, though they are found also in others in which the same appearances are not observed[4]. I am perfectly aware that some experiments made by piercing the shells of mussels, have been unsuccessful[5]; but this does not prove that it is impossible to procure pearls in that manner Those who made them did not perhaps pierce the proper part of the shell; perhaps they made the orifice so large that it weakened the animal; and they may not have chosen the fittest season of the year. The strongest objection however which can be made on this subject, is the undeniable truth that the proper valuable pearls are not found adhering to the shell, but in the body only; and that therefore those calcareous balls which fill up holes, cannot be perfect pearls. But from the words of Linnæus above quoted, I am led to conjecture, that he only made a hole in the shell without piercing it quite through. Linnæus also may have done some injury to

[1] Pearl. An excrescence on the inside of a shell when the outer side has been perforated.

[2] See Chemnitz's theory of the origin of pearls, in the Beschäftigungen der Berlin. Naturforsch. Gesellschaft, i. p. 348.

[3] The animal part is rendered evident on distillation by the evolution of an ammoniacal odour and a somewhat inflammable oil; and on solution in muriatic acid the animal substance is left behind.

[4] Abhand. der Schwed. Akad. iv. p. 245, and xxi. p. 142.

[5] Fabricius, in his Letters, p. 105, mentions such an experiment, which was however continued only for a year.

the animal itself when it opened its shell; for it is certain that testaceous animals are strong-lived, and can easily sustain any violence. It appears by the Transactions of the Swedish Academy, that some have been of opinion that shell-fish might be made to produce pearls by a particular kind of nourishment; and Lister[1] thinks that these excrescences would be more abundant, were the mussels placed in water impregnated with calcareous matter; but Professor Linnæus seems certain that his father employed none of these methods.

Under the name of false or artificial pearls are understood at present small beads, so prepared by art as to approach very near to real pearls in shape, lustre, colour, and polish. It appears that in Pliny's time such were not known, else he certainly would have mentioned them. The invention was not easy, and this difficulty to imitate pearls has contributed, with the reasons before mentioned, to keep up their value. It would seem that at first, hopes were entertained of finding a method to make large pearls from small or broken ones. Tzetzes speaks of this imagined art, and receipts for that purpose have been still retained in various books, where they fill up room and amuse the ignorant; for it is hardly possible to give to the pulverised calcareous matter sufficient hardness, and that lustre which belongs only to the surface of real pearls, and which, when these are destroyed, is irrecoverably lost. More ingenious was the idea of making pearl-coloured glass beads of that kind called *margaritini*[2]; but it excites no wonder that this was not done earlier, although the art of making coloured glass is very old; for opal colours are obtained only by a skilful process and the addition of putty, bone-ashes, and other substances. Still earlier was the invention of making hollow glass beads, which were incrusted on the inside with a pearl-coloured varnish. This method was first pursued, as far as I have been able to learn, by some artists at Murano; but their invention seems to have been considered by the government as too fraudulent, and was therefore prohibited, as we are told by Francis Massarius, who lived in the beginning of the sixteenth century at Venice, and must therefore have had an opportunity of knowing the

[1] Exercitatio Anatom. de Cochleis. Lond. 1694, p. 183.

[2] This manner of preparing *margaritini* may be seen in my Anleitung zur Technologie, p. 307.

truth of this circumstance[1]. Some say that an amalgam of quicksilver was used for these pearls; and if that was the case, the object of the Venetian prohibition was rather of a medical nature. After this, small balls of wax or gum were covered with a pearl-coloured enamel. These were praised on account of their lustre; but as their beauty was destroyed by moisture, they did not continue long in use[2]. A French bead-maker, however, named Jaquin, at length found out the manner of preparing the glass pearls used at present, which excel all others, and which approach as near to nature as possible, without being too expensive.

Jaquin once observed, at his estate near Passy, that when those small fish called *ables* or *ablettes* were washed, the water was filled with fine silver-coloured particles. He suffered this water therefore to stand for some time, and obtained from it a sediment which had the lustre of the most beautiful pearls; and which on that account led him to the attempt of making pearls from it[3]. He scraped off the scales of the fish, and called the soft shining powder, which was diffused in the water, essence of pearl, or *essence d'orient*[4]. At first he covered with it small beads made of gypsum, or hardened paste; and, as everything new, particularly in France, is eagerly sought after, this invention was greatly admired and commended. The ladies, however, for whose use it was chiefly intended, soon found that it did not entirely answer their expectations. They were displeased because this pearly coat, when exposed to heat, separated from the beads, adhered to the skin, and gave it a brightness which they did not wish. They proposed themselves, that small hollow glass beads might be covered, in the inside, in the same manner as mirrors are silvered, with the essence of pearl; and thus was brought to perfection an art of which the following account will enable the reader to form some idea.

Of a kind of glass easy to be melted, and made sometimes

[1] Massarii in Plinii Nat. Hist. lib. ix. Castigationes. Bas. 1537, 4to, cap. 35.

[2] Mercati Metallotheca, p. 211.

[3] These silver-coloured particles were examined by Reaumur, who gave a description of them in Histoire de l'Académie, année 1716, p. 229. [In the scales of fishes, the optical effect is produced in the same manner as in the real pearl, the grooves of the latter being represented by the inequalities formed by the margins of the concentric laminæ of which the scales are composed.]

[4] The artist no doubt had in view eastern pearls.

a little bluish or dark, slender tubes are prepared, which are called *girasols*[1]. From these the artist blows, by means of a lamp, as many small hollow globules as he may have occasion for. One workman can in a day blow six thousand; but when they are required to be extremely beautiful, only twelve or fifteen hundred; and that they may have a greater resemblance to nature, he gives them sometimes blemishes, like those generally observed in real pearls. They are made of all figures; some shaped like a pear, others like an olive, and some that may be considered as *coques de perles*[2]. To overlie these thin glass bubbles he mixes the pearl essence with a solution of isinglass; and the more of the former he uses, the more beautiful and more valuable the pearls become. This varnish, when heated, he blows into each globule with a fine glass pipe, and spreads it over the whole internal surface, by shaking the pearls thus prepared in a vessel placed over the table where he is at work, and which he puts in motion by his foot, until the varnish is equally diffused all over the inside of them, and becomes dry. Sometimes he adds to

[1] *Girasol.* This word, which is wanting in most dictionaries, signifies opal, and sometimes that stone called cat's-eye, *Silex catophthalmus*, *pseudopalus*, &c. *Couleur de girasol* is applied to semitransparent milk-white porcelain.

[2] *Coques de perles* are flat on one side, and are used for ornaments, one side of which only is seen. By Pliny they are called *physemata.* Artificial pearls of this kind have, for some time past, been employed in making ear-rings. Our toymen, after the French, give these pearls the name of *perles coques*; but the following account of Pouget in Traité des Pierres Précieuses, Paris 1762, i. p. 20, makes me dubious respecting them. "*La coque de perle*," says he, "is not formed in a pearl-shell like the pearl; it is procured from a kind of snail found only in the East Indies. There are several species of them. The shell of this animal is sawn in two, and one *coque* only can be obtained from each. The *coques* are very small, and one is obliged to fill them with tears of mastic to give them a body, before they can be employed. This beautiful snail is found generally in the sea, and sometimes on the shore." May not Pouget here mean that kind of snail which others call *burgeau*, the shells of which are, in commerce, known by the French under the name of *burgaudines*? Should that be the case, the animal meant would be the *Nautilus Pompilius*, as may be concluded from Histoire des Antilles, par Du Tertre, ii. p. 239. For the author says, "C'est de leur coque que les ouvriers en nacre tirent cette belle nacre qu'ils appellent la burgaudine, plus estimée que la nacre de perle." Irregular pearls are called *baroques*, or Scotch pearls, because abundance of such were once found at Perth in Scotland. Some years ago artificial pearls of an unnatural size, called Scotch pearls, were for a little time in fashion.

the essence some red, yellow, or blue colour; but as this is a deviation from nature, it is not accounted a beauty. To give these tender globules more solidity and strength, they are filled with white wax. They are then bored through with a needle, and threaded in strings for sale. The holes in the finer sort, however, are first lined with thin paper, that the thread may not adhere to the wax[1].

The name *able*, or *ablette*, is given to several species of fish; but that which produces the pearl-essence is the *Cyprinus alburnus*, called in English the bleak. Professor Hermann, at Strasburg, was so kind as to send me one of these fish, which was caught there for the purpose of making pearl-essence, and which was dried so carefully that the species could with certainty be distinguished. It corresponded exactly with the figure given in Duhamel[2], which has almost a perfect resemblance to that given by Schoneveld[3]. May not the *alburnus* mentioned by Ausonius among the inhabitants of the Moselle, be the same? At any rate, the bleak is to be found only in fresh water; and on account of its voracity bites readily at the hook. It is caught for the use of the French manufacturers in the Seine, the Loire, the Saone, the Rhine[4], and several other rivers. To obtain a pound of scales above 4000 fish are necessary; and these do not produce four ounces of pearl essence; so that from eighteen to twenty thousand are requisite to have a pound of it. In the Chalonnois, the fishermen get for a pound of washed scales fifteen, eighteen, and twenty-five livres. The fish, which are four inches in length, and which have not a very good taste, are sold at a cheap rate, after their scales have been scraped off. At St. John de Maizel, or Mezel, in the Chalonnois, there was a manufactory in which 10,000 pearls were made daily[5].

[1] A complete account of the art of making glass pearls is contained in a book, which I have however not seen, entitled, L'Art d'imiter les perles fines, par M. Varenne de Beost. An extract from it may be found in Dictionnaire des Arts et Métiers, par M. Joubert, iii. p. 370. See also the articles *perle* and *able* in the Encyclopédie, i. p. 29; xii. p. 382.

[2] Traité Générale des Pesches, par. ii. p. 403, tab. 23, fig. 1 et 2.

[3] Ichthyologia, Hamb. 1624, 4to, p. 12, tab. 1, fig. 2, albula.

[4] In the Almanach de Strasburg for 1780, p. 76, among the commodities sold there were, Des écaillcs d'ablettes dont on tire l'essence d'orient employée pour les fausses perles.

[5] Déscription Hist. et Topogr. du Duché de Bourgogne, par M. Courtépée, tom. iv. A Dijon, 1779, 8vo, p. 534.

The first makers of these pearls must have laboured under a very great inconvenience, as they were acquainted with no method of preserving the fishy particles for any time. They were obliged to use the essence immediately, because it soon putrefied and contracted an intolerable stench. The great consumption, however, required that the scales should be brought from distant provinces. Attempts were made to preserve them in spirit of wine or brandy; but these liquors destroyed their lustre, and left them only a dull white colour. In the like manner brandy spoiled a real pearl, which, with the animal and the shell (*Mactra lutraria*), was sent to me by Dr. Taube, at Zell. It was therefore a very important discovery for this art that these animal particles can be kept for a long time in solution of ammonia, which is now alone used, and which perhaps could be used for many other purposes of the like kind.

That the inventor of these pearls was called Jaquin, and that he was a bead-maker at Paris, all agree; but the time of the invention seems to be uncertain. Some say that it belongs to the reign of Henry IV.[1]; and Reaumur mentions the year 1656. These pearls, however, in the year 1685, when Jaquin had an assistant named Breton, must not have been very common; for we are told in the Mercure Galant of that year, that a marquis possessed of very little property, who was enamoured of a lady, gained her affections and carried his point by presenting her with a string of them, which cost only three louis; and which she, considering them as real ones, valued at 2000 francs. The servant who put the marquis on this stratagem, declared that these pearls withstood heat and the moisture occasioned by perspiration; that they were not easily scratched, had almost the same weight as real ones, and that the person who sold them warranted their durability in writing. Jewellers and pawnbrokers have, therefore, been often deceived by them. Jaquin's heirs continued this business down to a late period, and had a considerable manufactory au Rue de Petit Lion at Paris.

[1] Pouget. 4to. i. p 19.

PAVING OF STREETS.

The most beneficial regulations of police, which we have inherited from our ancestors, are at present considered to be so indispensable or necessary, that many people imagine they must at all times have existed. If one, however, takes the trouble to inquire into the antiquity of these regulations, it will be found that the greater part of them are new, and that they were unknown to the largest and most magnificent cities of ancient times. Among these are posts[1], the night-watch, hackney coaches, and, besides many others, the paving of streets.

Several cities, indeed, had paved streets before the beginning of the Christian æra; but those which are at present the ornament of Europe, Rome excepted, were all destitute of this great advantage, till almost the twelfth or thirteenth century. I must nevertheless acknowledge, that in the Greek and Roman authors I have hitherto met with more proofs of paved highways than of paved streets. But we have reason to believe that the richest nations paid attention to the streets before their doors, sooner than to the roads before their gates. In all probability, the former were paved at different times, and by private persons; and required so little expense and so few regulations, that no occasion was given to remark the time when it was done. On the other hand, for the constructing of highways many miles in length, the concurrence of states, and the consent and assistance of all the inhabitants, were necessary; and, on that account, such circumstances were inserted in annals, and they were sometimes copied afterwards by historians, and mentioned in their works. In the East, where the roads are not spoiled, as among us, by snow, ice, and rain, and where many cities were built on eminences and in dry situations, the paving of streets and highways may have been later thought of than might be expected, when we con-

[1] I reckon the post among police regulations, to which its object originally belonged, as well as that of the coining of money; though in the course of time it has been made a productive source of revenue, by which it has been rendered burdensome to the public, while its utility has been lessened.

sider the refinement of the ancient people who inhabited that country, and the progress they had made in the arts. Such undertakings also were often retarded by the want of stone; an obstacle which many nations overcame with an ingenuity and patience at which we, among whom workmen are fewer, and the price of labour higher, because we have more wants, and enjoy more liberty, are not a little astonished. It is however to be conjectured, that those people who first carried on the greatest trade were the first who paid attention to have good streets and highways, in order to facilitate intercourse, so necessary to keep up the spirit of commerce.

This conjecture is in some measure confirmed by the testimony of Isidorus[1], who says that the Carthaginians had the first paved streets, and that their example was soon copied by the Romans. Long before that period, however, Semiramis paved highways, as we are told by the vain-glorious inscription which she herself caused to be put up[2]. Of the paving of the Grecian cities I know nothing further than that at Thebes the streets were under the inspection of the telearchs, who had the care of keeping them in repair, and of cleaning them. This office, which was there held in contempt, the spiteful inhabitants conferred upon Epaminondas, in order to disgrace him; but, by his prudence and attention to the public good, he rendered it so respectable, that it was afterwards sought for as an honourable employment. The streets of Thebes, therefore, were paved, else how would it have been possible to clean them[3]? Whether Jerusalem was paved I do not know; for, in the first book of Kings mention is made only of the fore-court of the temple[4]. Josephus[5] relates that the Jews proposed to Agrippa, after the building of the temple was finished, to employ the workmen who had been discharged, the number of whom, with Jewish exaggeration, he makes amount to eighteen thousand, in paving the streets; this however was not done. We read in the Talmud[6], that the streets of Jerusalem were swept every day, which undoubtedly implies a hard and solid pavement.

[1] Origin. lib. xv. cap. 16. Diodor. Sic. lib. ii. cap. 13. Polyæni Stratagem. lib. viii. cap. 26.
[2] Strabo, lib. xvi. p. 1071.
[3] Valerius Max. lib. iii. cap. 7. Plutarch. Reipublicæ Gerendæ Præcepta, p. 811.
[4] 1 Kings, chap. vii. ver. 12.
[5] Antiquit. lib. xx. cap. 9.
[6] Pesachim, fol. 71. Metzia, fol. 26.

That neither the streets of Rome nor the roads around it were paved during the time of its kings, is well known[1]. In the year 188, after the abolition of the monarchical form of government, Appius Claudius, who was then censor, constructed the first real highway, which was as properly called after him the Appian Way, as it was named on account of its excellence the queen of roads[2]. The time however when the streets began to be paved, cannot with certainty be determined; for the passage of Livy[3], from which some have endeavoured to prove that it was in the year 578 after the building of the city, is inconclusive, as it will admit of various explanations equally probable. It may be read, without forcing the sense, as if Livy said that the pavement of the streets was then covered with sand for the first time; that the streets were then first paved at the public expense, or that the paving of them was then performed for the first time by contract. Besides, we are told by Livy himself[4], that the censors in the year of the city 584 caused the streets to be paved from the Oxen-market (Forum Boarium) to the temple of Venus, and around the seats of the magistrates in the great circus: but the information of the same historian that the ædiles in the year 459 caused the streets to be paved from the temple of Mars to the Bovile, and from the Capena gate to the temple of Mars[5], does not apply here, as some have imagined; for the temple of Mars was without the city, and the author speaks not of streets, but of highways. The extravagant Heliogabalus caused the streets around the palace, or on the Palatine mount, to be paved with foreign marble[6]. The inspection of the streets belonged to the ædiles; and, under certain circumstances, occasionally to the censors. In the course of time, however, particular officers, curatores viarum, called on account of their number quatuor viri viarum, were appointed for that express purpose. Thus we are told that the two brothers, Publii Malleoli, when curule ædiles, caused the Mons Publicius to be paved, so that carriages could pass from the street Velia to Mount Aventine[7]. That streets

[1] Bergier, Hist. des Grands Chemins Rom. liv. i. chap. viii.
[2] Statius, Sylv. ii. 2, v. 12. [3] Lib. xli. cap. 27. [4] Lib. xxix. cap. 37.
[5] Lib. x. cap. 23. Equally inapplicable are the passages lib. xxxviii. cap. 28, and lib. x. cap. 47. [6] Æl. Lamprid. Vita Heliogab. cap. 24.
[7] Ovid. Fastor. lib. v. ver. 293. See also Marc. Varro, lib. iv. de L. L. Festus, p. 310. An examination of the question whether the ædiles or

paved with lava, having deep ruts made by the wheels of carriages, and raised banks on each side for the accommodation of foot-passengers, were found both at Herculaneum and Pompeii, is well known from the information of various travellers.

Of modern cities, the oldest pavement is commonly ascribed to that of Paris; but it is certain that Cordova in Spain was paved so early as the middle of the ninth century, or about the year 850, by Abdorrahman II., the fourth Spanish caliph. This prince, who knew the value of the arts and sciences, and who favoured trade so much that abundance in his reign prevailed throughout the whole land[1], caused water to be conveyed into that city, which was then his capital, by leaden pipes, and ornamented it with a mosque and other elegant buildings[2].

The capital of France was not paved in the twelfth century; for Rigord, the physician and historian of Philip II., relates, that the king standing one day at a window of his palace near the Seine, and observing that the carriages which passed threw up the dirt in such a manner that it produced a most offensive stench, his majesty resolved to remedy this intolerable nuisance by causing the streets to be paved; which was accordingly done, notwithstanding the heavy expense that had prevented his predecessors from introducing the same improvement. The orders for this purpose were issued by the government in the year 1184; and upon that occasion, as is said, the name of the city, which was then called Lutetia on account of its dirtiness, was changed to that of Paris[3]. This service rendered to Paris by that sovereign, who first also caused the cathedral to be surrounded by a wall, is confirmed by various historians[4]. Mezeray informs us, that Gerard de Poissy, then intendant of the finances, expended eleven

censors had the inspection of the streets may be found in Ducker's notes on Liv. lib. x. cap. 32 (edit. Drakenborchii).

[1] Cardonne Histoire de l'Afrique et de l'Espagne sous les Arabes, 3 vols. 12mo, Par. 1765. Translated into German, with notes, by Dr. Murr. Nurnb. 1768, i. p. 187.

[2] Rod. Ximenez, archiep. Toletani, Historia Arabum, cap. xxvi. p. 23. Printed at the end of Erpenius' Historia Saracenica, 4to. Lugd. 1625.

[3] Rigordus De Gestis Phil. Augusti, in Duchesne Hist. Script. Franc. Par. 1649, fol. p. 16.

[4] Gulielmi Armorici Hist. de Vita Phil. Augusti, in Duchesne, p. 73. Alberici Monachi Trium Fontium Chronicon, ed. a G. G. Leibnitio, Lips. 1698, 4to, p. 367.

thousand marks of silver in this undertaking. It appears that a certain income was allowed to the city for defraying the expenses; for in 1285, a hundred years after, when it was proposed that the pavement should be carried without the gate of St. Martin, the citizens excused themselves from the work, by saying that the funds assigned to them were not sufficient for that purpose[1]. It is certain, that in the year 1641 the streets in many quarters of Paris were not paved[2].

It is very probable that other opulent cities, finding the benefit which the capital derived from this improvement, were induced to follow its example. At any rate we know that Dijon, which was then reckoned one of the most beautiful, had paved streets so early as the year 1391, to which Philip the Bold, duke of Burgundy, the second husband of Margaret heiress of Flanders and other parts of the Netherlands, contributed two thousand livres; and in 1424 paviors were employed on all the streets[3]. Historians remark, that after this period, dangerous diseases, such as the dysentery, spotted fever and others, became less frequent in that city.

That the streets of London were not paved at the end of the eleventh century, is asserted by all historians. As a proof of this, they relate that in the year 1090, when the church of St. Mary-le-Bow, in Cheapside, was unroofed by a violent storm of wind, four pillars or beams, which were twenty-six feet in length, sunk so deep into the ground, that scarcely four feet of them appeared above the surface. The streets of London then, says Howel, were not paved, but consisted of soft earth[4]. I can however find no account of the time when paving was first introduced. It appears that the pavement of this immense city became gradually extended as trade and opulence increased. Several of the principal streets, such as Holborn, which at present are in the middle of the city, were paved for the first time by royal command in the year 1417[5].

[1] Felibien, Hist. de Paris, i. p. 104.

[2] A proof of this may be seen in De la Mare, iv. p. 197, who gives the best account respecting the regulations made to keep in repair the pavement of the streets of Paris. The later regulations are given by Perrot in Dictionnaire de Voierie, Paris, 1782, 4to, p. 315.

[3] Courtepée Description du Duché de Bourgogne, i. p. 233, and ii. p. 62.

[4] Anderson's Hist. of Commerce, vol. i. p. 483.

[5] In the king's order it was said, that the highway named Holbourn in London was so deep and miry, that many perils and hazards were thereby

Others were paved under Henry VIII., some in the suburbs[1] in 1544, others in 1571 and 1605, and the great market of Smithfield, where cattle are sold, was first paved in 1614[2].

Of German cities I can mention only Augsburg, which by its trade soon rose to such eminence as to be able to rival magnificent Rome, of which it was a colony, in many expensive improvements. This city from the earliest periods had small subterranean passages under the streets for conveying away filth, which in some measure resembled the Roman *cloacæ*. Hans Gwerlich, a rich merchant there, having caused a neat foot-path to be made before his house in the oxen-market in 1415, gave rise to the paving of the city; for this convenience was so much admired, that after that time all the streets were paved successively at the expense of the government. Berlin, in the first half of the seventeenth century, was not entirely paved. The new market was first paved in 1679 and the following years, and King-street before the houses in 1684. The square behind the cathedral and before the present tilt-yard remained without pavement in 1679.

When a solid bottom had been given to streets, the cleansing of them, which, as the Roman prætors said, is a continual improvement[3], was then rendered possible. At Rome were appointed *tribuni rerum nitentium*, who had the care of cleaning the streets, markets, temples, baths and other public places[4]. Strict orders were given that no filth should be thrown into the river or streets; whoever transgressed against this prohibition was subjected to punishment, and obliged to repair the damage[5]. The public sewers, *cloacæ*, under the streets contributed very much to facilitate the cleaning of them, yet they

occasioned as well to the king's carriages passing that way as to those of his subjects; he therefore ordained two vessels, each of twenty tons burthen, to be employed at his expense, for bringing stones for paving and mending the same.—Anderson's Hist. of Com. i. p. 244.

[1] In this order the streets were described "as very foul, and full of pits and sloughs, very perilous and (noyous) noisome, as well for the king's subjects on horseback as on foot, and with carriage."—Anderson, *ut supra*, p. 370.

[2] Anderson, i. p. 491. Northouck's History of London, 1773, 4to, p. 121. 217. 414. 436.

[3] Digest. lib. xliii. tit. 2.

[4] Notitia utraque dignitatum, Pancirolli. Lugd. 1608.—Notit. Imperii Occident. cap. 19. This work may be found in Grævii Thes. Antiq. Rom. vol. vii.

[5] Digestorum lib. xliii. tit. 12, and lib. ix. tit. 3.

were commonly full of mud[1], as those of Paris are at present, notwithstanding the many expensive regulations established to prevent that nuisance.

Some centuries after Paris was paved, every citizen was obliged to repair the street before his house, and to clean it at his own expense, as is expressly commanded in an order issued by Philip the Bold[2], in the year 1285. The public however are often careless and negligent respecting the most beneficial regulations, when the maintaining of them is attended with trouble and expense, be it ever so small. By this want of attention, all the streets of Paris were in the fourteenth century entirely spoiled and filled with dirt; but they were again repaired; and in 1348 a law was first made for inflicting punishment upon those who neglected to clean them[3]. This law was rendered more severe in 1388, and several times afterwards. The novelty of it, the dread of punishment, and the vigilance of the new inspectors, produced such an effect, that the inhabitants of one or more neighbouring streets joined together and kept at their common expense a dirt-cart, which at that time was called *un tombereau*; but the nobility and the clergy, who always wish for immunities, endeavoured to exempt themselves from this burthen. The markets and public squares remained therefore uncleaned, and became still dirtier, as those who resided in the neighbourhood began to throw filth into them privately in the night-time, in order to avoid the expense of having it carried away, till at length these places were rendered so impassable that the toymen who frequented them with their wares wished to abandon them. For this reason it was enacted in the year 1399, that no one should be exempted from cleaning the streets; and an order was issued in 1374, that all those who lived in the markets, together with the toymen who had booths there, should clean them at their joint expenses[4]. Many now made the removing of dirt a trade, and entered into contracts for that purpose; but they as well as the paviors turned so extravagant in their demands, that a price was set upon the labour of the former in 1396, and the latter in 1501 were united into a company,

[1] Martial, Epig. vii. 61. Juvenal, sat. iii. ver. 247.

[2] A full history of the regulations made respecting the cleaning of the streets of Paris may be found in De la Mare, iv. p. 200.

[3] De la Mare, iv. p. 202.

[4] Ibid. iv. p. 172, 203.

every member of which was obliged to subscribe to certain regulations[1].

When the city at length increased in size and population, the cleaning of the streets became too troublesome and expensive to be left any longer to the care of individuals. Besides, those who inhabited the suburbs complained, and with great justice, that the burthen lay so heavy upon them as to be intolerable; because all the carts which entered the city, or which conveyed filth from it, rendered their streets much dirtier than the rest. It was resolved therefore, in the year 1609, that the streets should be cleaned at the public expense, under the inspection of the police; and a certain revenue in wine was set apart for that purpose. The first person with whom a contract was entered into for this service, was allowed yearly, for cleaning the whole city, 70,000 livres, which sum was raised in 1628 to 80,000[2]. In 1704, the Parisians were obliged to collect 300,000 livres, for which Government undertook to maintain the lamps and clean the streets; but in 1722 this contribution was increased to 450,000. The last contract with which I am acquainted is that of the year 1748, by which the contractors were to be allowed yearly, during six years, for removing the dirt, 200,000 livres, and for clearing away the snow and ice in winter 6000 more, making in all the sum of 206,000 livres[3].

All these regulations and expenses however would undoubtedly have been attended with very little benefit, had not deliberate dirtying of the streets been strictly prohibited, and all opportunities of doing so been as much as possible prevented. As the young king Philip, whom his father Louis the Fat had united with himself as co-regent, and caused to be crowned at Rheims, was passing St. Gervais on horseback, a sow running against his horse's legs made him stumble, and the prince being thrown was so much hurt, that he died next morning, 3rd October 1131. On account of this accident an order was issued that no swine in future should be suffered to run about in the streets; but this was opposed by the abbey of St. Anthony, because, as the monks represented, it was contrary to

[1] De la Mare, p. 205. [2] Ibid. iv. p. 216, 239, 243.

[3] This contract is inserted in Perrot, Dictionnaire de Voierie, p. 305. In 1445 six carts were employed at Dijon in cleaning the streets.

the respect due to their patron to prevent his swine from enjoying the liberty of going where they thought proper. It was found necessary therefore to grant these clergy an exclusive privilege, and to allow their swine, if they had bells fastened to their necks, to wallow in the dirt of the streets without molestation[1].

A very improper liberty prevailed at Paris in the fourteenth century, which was, that all persons might throw anything from their windows whenever they chose, provided they gave notice three times before, by crying out *Gare l'eau*, which is as much as to say, Take care of water. This privilege was forbidden in 1372, and still more severely in 1395[2]. A like practice however seems to have continued longer at Edinburgh; for in the year 1750, when people went out into the streets at night, it was necessary, in order to avoid disagreeable accidents from the windows, that they should take with them a guide, who as he went along called out with a loud voice, in the Scotch dialect, *Haud your haunde*, Stop your hand[3].

This practice however would not have been suppressed at Paris, had not the police paid particular attention to promote the interior cleanliness of the houses, and the erection of privies. Some will perhaps be astonished that these conveniences should have been first introduced into the capital of France by an order from government in the sixteenth century; especially as they are at present considered to be so indispensably necessary, that few summer-houses are constructed without them. Those however to whom this affords matter of surprise must be still more astonished when they are told that the residence of the king of Spain was destitute of this improvement at the very time that the English circumnavigators

[1] Histoire de la Ville de Paris, par Sauval, vol. ii. p. 640.

[2] De la Mare, iv. p. 253. Perrot, p. 307.

[3] Letters from Scotland, 1760, 2 vols. 8vo. [At this period, when the luxury of water-closets was unknown, it was a custom for men to perambulate the streets of Edinburgh, carrying conveniences (pails) suspended from a yoke on their shoulders, enveloped by cloaks sufficiently large to cover both their apparatus and customers, crying, "Wha wants me, for a bawbee?" It has since been used against the Edinburgh people as a joke or satire upon an ancient custom. By way of a set-off, however, it may be observed that at the present day there is a water-closet in almost every house in Edinburgh.]

found privies constructed in the European manner near the habitations of the cannibals of New Zealand[1]. But Madrid is not the royal residence which has had dirty streets longest on account of this want. Privies began to be erected at Warsaw for the first time only within these few years[2].

In the Parisian code of laws, *Coûtume de Paris*, which was improved and confirmed in 1513, it is expressly ordered, that every house should have a privy[3]. This order, with the denunciation of severer punishment in case of disobedience, was renewed in 1533; and in 1538 the under officers of police were obliged to examine the houses and to report the names of those who had not complied with this beneficial regulation. It appears, however, that the order of 1533 was not the latest; for in 1697, and even in 1700, the police was under the necessity of strictly commanding "that people should construct privies in their houses, and repair those already constructed, and that within a month at furthest, under the penalty of being fined in case of neglect, and of having their houses shut up until they should be in a proper condition." This order is given in the same words in the Coûtume de Mante, Etampes, Nivernois, Bourbonnois, Calais, Tournay, and Melun[4]. That issued at Bordeaux is of the year 1585.

All these regulations of police were not much older in Germany than in Paris. The cleaning of the streets was considered there as an almost dishonourable employment, which

[1] Cook's First Voyage, 4to, vol. ii. p. 281.

[2] Whoever wishes to enter deeper into the history of this family convenience, certainly an object of police, the improvement of which the Academy of Sciences at Paris did not think below its notice, may consult the following work, Mém. de l'Acad. des Sciences, Inscriptions, Belles Lettres, Beaux Arts, etc. nouvellement établie à Troyes en Champagne. A Troyes et Paris 1756. The author, who by this piece of ridicule wished, perhaps, to avenge himself of some academy which did not admit him as a member, has collected from the Greek and Latin writers abundance of dirty passages respecting this question: "Si l'usage de chier en plein air étoit universel chez les anciens peuples." He proves from a passage of Aristophanes, Ecclesiaz. ver. 1050, that the Greeks had privies in their houses.

[3] De la Marc, i. p. 568, and iv. p. 254. "Tous propriétaires de maisons de la ville et fauxbourgs de Paris sont tenus avoir latrines et *privez* suffisans en leurs maisons." [They should also have been compelled to make use of them.]

[4] De la Mare, *ut supra*.—Coûtume de Mante, art. 107.—Etampes, art. 87.—Nivernois, chap. x. art. 15.—Bourbonnois, art. 515.—Calais, art. 179.—Tournay, tit. 17, art. 5.— Melun, art. 209.

in some places was assigned to the Jews, and in others to the executioner's servants. The Jews were obliged to clean the streets of Hamburgh before the present regulations were established. How old these may be I do not know, but in the year 1585 there were dirt carts in that city, and a tax was paid by the inhabitants for supporting them. At Spandau, in 1573, the skinners were obliged to sweep the market-place, which was not then paved, and for this service they were paid by the council [1]. In the beginning of the seventeenth century the streets of Berlin were never swept, and the swine belonging to the citizens wallowed in the increasing dirt the whole day, as well as in the kennels, which were choked up with mud. In the year 1624, when the elector desired the council to order the streets to be cleaned, they replied, that it would then be of no use, as the citizens at that time were busy with their farms. Near Peter's church there was a heap of dust so large that it almost prevented people from passing, and it was with great difficulty, and not until strict orders had been often repeated, that the elector could get the inhabitants to remove it. For a long time dirt of every kind was emptied in the new market-place, and lay there in such quantity, that an order was issued in 1671, that every countryman who came to the market should carry back with him a load of dirt. The director of the public mill made continual complaints, that, by the dirt being shot down near the long bridge, the mill-dam was prevented from flowing. Hog-sties were erected in the streets, sometimes even under the windows. This practice was forbidden by the council in 1641 [2]; but it was nevertheless continued, until the elector at length, in the year 1681, gave orders that the inhabitants should not feed swine; and this prohibition was carried into effect without any exception, as St. Anthony had no abbeys at Berlin. Privies, however, seem to have been common in the large and flourishing towns of Germany much

[1] Historische Beyträge die Preussischen und benachbarten Staaten betreffend. Berlin, 1784, 4to, iii. p. 373.

[2] Nicholai Beschreibung von Berlin, p. 26. The author quotes, from the order published at Berlin, Nov. 30, 1641, respecting the buildings of the city, section fourth, the following words: "Many citizens have presumed to erect hog-sties in the open streets, and often under the windows of bed-chambers, which the council cannot by any means suffer;" and in the seventeenth section hog-sties are forbidden to be erected in future in the small streets near the milk-market

earlier than in the capital of France; and those who are not disposed to find fault with me for introducing proofs here which historians have not disdained to record, may read what follows[1]:—In the annals of Frankfort on the Maine, where mention is made of the cheapness of former times, we are told how much a citizen there gave in the year 1477 for cleaning his privy[2]. We are informed also, that in 1496 an order was issued by the council forbidding the proprietors of houses situated in a certain place planted with trees to erect privies towards the side where the trees were growing; and that in 1498, George Pfeffer von Hell, J.U.D. and chancellor of the electorate of Mentz, fell by accident into a privy, and there perished. It appears however from the streets and houses of most of our cities, that they were constructed before such conveniences were thought of, and that these were erected through force at a later period[3].

[1] "Frivola hæc fortassis cuipiam et nimis levia esse videantur, sed curiositas nihil recusat."—Vopiscus in Vita Aureliani, cap. 10.

[2] Chronica der Stadt Frankf. von C. A. von Lersner, i. p. 512.

[3] [Berlin, strange to say, is very ill circumstanced in respect to these conveniences, even at the present day (1846). In most of the houses, small closets are located on the landings of the stairs, which require to be emptied every other night, to the no great satisfaction of the olfactory nerves. Nor are the streets kept in a very proper state,—large puddles of filth being allowed to collect before the doors even of the best houses, and which, especially in the hot months of summer, diffuse a most horrible stench. Something however must be allowed for the low situation of the town, which renders drainage next to impracticable. Laing, in his Notes of a Traveller, speaking of Berlin as he found it in 1841, says, "It is a fine city, very like the age she represents—very fine and very nasty.....The streets are spacious and straight, with broad margins on each side for foot-passengers; and a band of plain flagstones on these margins make them much more walkable than the streets of most continental towns. But these margins are divided from the spacious carriage-way in the middle by open kennels, telling the nose unutterable things. These open kennels are boarded over only at the gateways of the palaces, to let the carriages cross them, and must be particularly convenient to the inhabitants, for they are not at all particularly agreeable. Use reconciles people to nuisances which might be easily removed. A sluggish but considerable river, the Spree, stagnates through the town, and the money laid out in stucco work and outside decoration of the houses, would go far towards covering over their drains, raising the water by engines and sending it in a purifying stream through every street and sewer. If bronze and marble could smell, Blücher and Bülow, Schwerin and Ziethen, and duck-winged angels, and two-headed eagles innumerable, would be found on their pedestals holding their noses instead of grasping their swords. It is a curious illustration of the difference

[A new era in paving has been commenced by the substitution of wood for stone, but unfortunately, its vast superiority in some respects is nearly if not quite counterbalanced by its defects, so that it will probably be laid aside. An imperfect kind of wooden *pavement* has been much used in North America, and is known by the name of *corduroy road*; but the wooden pavement, properly so called, seems to have been first used in Russia, and within the last few years, on a small scale at Vienna, New York, &c. Its use in London was first suggested by Mr. Finlayson in 1825. It was originally formed of hexagonal prismatic pieces of wood, the grain of which was placed vertically. The blocks have been kept together in various ways, some by mere position, others by wooden pegs, strong iron wire, &c. The great disadvantage of wooden pavement is that it becomes slippery in wet weather. Attempts have been made to remedy this defect, by raising those in the centre above the level of the lateral ones, or grooving the surfaces of the blocks. Another objection to wooden pavement is the difficulty of laying a firm and durable foundation. The retention of water by the spaces left between the blocks and in the pores of the wood itself, whereby an atmosphere of moisture is continually preserved, has also been considered as likely to predispose to certain diseases. Whether the latter is true or not, the short duration of their adoption has hardly afforded sufficient opportunities of deciding. The checking of the vibrations communicated from vehicles constantly running in the streets, renders the wooden pavement of extreme value; its durability has also been stated on good authority to exceed that of stone, and its expense to be less. In these particulars however it has not answered expectation; and from the immense number of horses which are daily thrown down, from the want of resisting points on its surface, its use will probably be aban-

between the civilization of the fine arts and that of the useful arts, in their influences on social well-being, that Berlin as yet has not advanced so far in the enjoyments and comforts of life, in the civilization of the useful arts, as to have water conveyed in pipes into its city and into its houses. Three hundred thousand people have taste enough to be in die-away ecstasies at the singing of Madame Pasta, or the dancing of Taglioni, and have not taste enough to appreciate or feel the want of a supply of water in their kitchens, sculleries, drains, sewers, and water-closets. The civilization of an English village is, after all, more real civilization than that of Paris or Berlin."]

doned; and in several of the large thoroughfares where it had been adopted it is now being replaced by stone.

A very valuable material for the formation of foot-pavements has been found and patented in *asphalte*. That which has been most used for this purpose is the native asphalte from Seyssel; it is mixed with a small quantity of native bitumen and sand. In preparing it, 93 parts of native asphalte are reduced to powder and seven of bitumen; these are melted together and fine gravel or sand stirred in the mixture. It is then spread upon a concrete foundation in layers about an inch in thickness. Its elasticity renders it exceedingly durable. Various compositions have been substituted for this mixture, but we believe none have been found to answer so well. The application of bituminous substances to carriage-pavements has been almost exclusively limited to court-yards, but there is very good evidence of its applicability to public thoroughfares, in a piece of pavement, about 150 feet in length by 10 feet in width, laid down in 1838 at Whitehall, as a sample of Messrs. Claridge's patent. It still remains in perfect condition. The principal objection to the general adoption of asphaltic pavement in the streets of London, appears to be the difficulty of raising and relaying it, a process so constantly required to reach the innumerable gas and water-pipes beneath.

Pavements have been laid down, especially in court-yards and stables, one of the principal constituents of which is caoutchouc.]

COLLECTIONS OF NATURAL CURIOSITIES.

If it be true that the written accounts which those who had recovered from sickness caused to be drawn out of their cure, their disorder, and the medicines employed to remove it, and to be hung up in the temples, particularly that of Æsculapius, were the first collections of medical observations[1], as seems to

[1] Fragments of such inscriptions have been collected by Mercurialis in his work De Arte Gymnastica, lib. i. cap. 1.

appear by the testimony of Hippocrates, who did not disdain to make use of them in order to acquire information[1]; we have every reason to conjecture, that the rare animals, plants and minerals, generally preserved in the temples also, were the first collections of natural curiosities, and that they may have contributed as much to promote the knowledge of natural history, as those tablets to improve the art of medicine. Natural objects of uncommon size or beauty, and other rare productions, on which nature seemed to have exerted her utmost power, were in the earliest periods consecrated to the gods[2]. They were conveyed to the temples, where their value became still enhanced by the sacredness and antiquity of the place; where they continued more and more to excite respect and awaken curiosity, and where they were preserved as memorials to the latest generations, with the same reverence as the other furniture of these buildings. In the course of time these natural curiosities dedicated to the gods became so numerous, that they formed collections which may be called large for those periods, and for the infant state in which natural history then was.

When Hanno returned from his distant voyages, he brought with him to Carthage two skins of the hairy women whom he found on the Gorgades islands, and deposited them as a memorial in the temple of Juno, where they continued till the destruction of the city[3]. The horns of a Scythian animal, in which the Stygian water that destroyed every other vessel could be contained, were sent by Alexander as a curiosity to the temple of Delphi, where they were suspended, with an inscription, which has been preserved by Ælian[4]. The monstrous horns of the wild bulls which had occasioned so much devastation in Macedonia, were by order of king Philip hung up in the temple of Hercules. The unnaturally formed shoulder-bones of Pelops were deposited in the temple of Elis[5]. The horns of the so-called Indian ants were shown in the temple of Hercules at Erythræ[6]; and the crocodile found in attempting to discover the sources of the Nile was preserved in the temple of Isis at Cæsarea[7]. A large piece of the root of the

[1] Plin. lib. xxix. cap. 1. Strabo, lib. xiv. [2] Plin. lib. xii. cap. 2.
[3] Plin. lib. vi. cap. 31. [4] Hist. Anim. lib. x. cap. 40.
[5] Plin. lib. xxviii. cap. 4. [6] Plin. lib. xi. cap. 31.
[7] Plin. lib. v. cap. 9. This crocodile was still remaining in the author's time.

cinnamon-tree was kept in a golden vessel in one of the temples at Rome, where it was examined by Pliny[1]. The skin of that monster which the Roman army in Africa attacked and destroyed, and which probably was a crocodile, an animal common in that country, but never seen by the Romans before the Punic war, was by Regulus sent to Rome, and hung up in one of the temples, where it remained till the time of the Numantine war[2]. In the temple of Juno, in the island of Melita, there were a pair of elephant's teeth of extraordinary size, which were carried away by Masinissa's admiral, and transmitted to that prince, who, though he set a high value upon them, sent them back again because he heard they had been taken from a temple[3]. The head of a basilisc was exhibited in one of the temples of Diana[4]; and the bones of that sea-monster, probably a whale, to which Andromeda was exposed, were preserved at Joppa, and afterwards brought to Rome[5]. In the time of Pausanias, the head of the celebrated Calydonian boar was shown in one of the temples of Greece; but it was then destitute of bristles, and had suffered considerably by the hand of time. The monstrous tusks of this animal were brought to Rome, after the defeat of Antony, by the emperor Augustus, who caused them to be suspended in the temple of Bacchus[6]. Apollonius tells us, that he saw in India some of those nuts which in Greece were preserved in the temples as curiosities[7].

It is certain, however, that all these articles, though preserved in the temples of the ancients as rarities or memorials of remarkable events, or as objects calculated to silence unbelief, were not properly kept there for the purpose to which our collections of natural curiosities are applied; but at the same time it must be allowed that they might be of as much utility to naturalists, as the tablets, in which patients who had recovered thanked the gods for their cures, were to physicians.

[1] Lib. xii. cap. 19.

[2] Plin. lib. viii. cap. 12. Valer. Max. lib. i. cap. 8. Orosius, lib. iv. cap. 8. Jul. Obsequens de prodigiis, cap. 29. Hujus serpentis maxillæ usque ad Numantinum bellum in publico pependisse dicuntur. May not this animal have been the Boa constrictor? [3] Cicero in Verrem, iv. cap. 46. Valer. Max. lib. i. [4] Scaliger De Subtilit. lib. xv. exercit. 246. [5] Plin. lib. ix. cap. 5, and v. 13. 31. Strabo, lib. xvi. [6] Pausanias, n Arcadicis, cap. 46 and 47. [7] Philostrat. in Vita Apollon. lib. iii. cap. 5. I conjecture that these nuts were cocoa-nuts.

We are told by Suetonius, that the emperor Augustus had in his palace a collection of natural curiosities[1]. I, however, do not remember that any of the ancient naturalists make mention of their own private collections; though it is well known that Alexander gave orders to all huntsmen, bird-catchers, fishermen and others, to send to Aristotle whatever animals they could procure[2]; and although Pliny was accustomed to make observations on such as he had an opportunity of seeing. No doubt can be entertained that a collection of natural curiosities was formed by Apuleius, who, next to Aristotle and his scholar Theophrastus, certainly examined natural objects with the greatest ardour and judgement; who caused animals of every kind, and particularly fish, to be brought to him either dead or alive, in order to describe their external and internal parts, their number and situation, and to determine their characteristic peculiarities, and assign names to them; who undertook distant journeys to become acquainted with the secrets of nature; and who on the Getulian mountains collected petrifactions, which he considered as the effects of Deucalion's flood. It is much to be lamented that the zoological works of this learned and ingenious man have been lost.

The principal cause why collections of natural curiosities were scarce in ancient times, must have been the ignorance of naturalists in regard to the proper means of preserving such bodies as soon spoil or corrupt. Some methods were indeed known and practised, but they were all defective and inferior to that by spirit of wine, which prevents putrefaction, and which by its perfect transparency permits objects covered by it to be at all times viewed and examined. These methods were the same as those employed to preserve provisions, or the bodies of great men deceased. They were put into salt brine or honey, or were covered over with wax.

It appears that in the earliest periods bodies were preserved from corruption by means of salt[3], and that this practice was long continued. We are told that Pharnaces caused the body

[1] Vita Augusti, c. 72. [2] Plin. lib. viii. cap. 16.

[3] Plin. lib. xxxi. cap. 9. Isidorus Origin. lib. xvi. cap. 2. Nitre also was employed for the like purpose. Plin. lib. xxxi. cap. 10. Herodot. lib. ii. Sextus Empiricus in Pyrrhon. Hypotypos. cap. 24. The last author ascribes this custom to the Persians in particular.

of his father Mithridates to be deposited in salt brine, in order that he might transmit it to Pompey[1]. Eunapius, who lived in the fifth century, relates that the monks preserved the heads of the martyrs by means of salt[2]; and we are informed by Sigebert, who died in 1113, that a like process was pursued with the body of St. Guibert, that it might be kept during a journey in summer[3]. In the same manner the priests preserved the sow which afforded a happy omen to Æneas, by having brought forth a litter of thirty pigs, as we are told by Varro, in whose time the animal was still shown at Lavinium[4]. A hippocentaur (probably a monstrous birth), caught in Arabia, was brought alive to Egypt; and as it died there, it was, after being preserved in salt brine, sent to Rome to the emperor, and deposited in his collection, where it was shown in the time of Pliny, and in that of Phlegon[5]. Another hippocentaur was preserved by the like method, and transmitted to the emperor Constantine at Antioch[6]; and a large ape of the species called Pan, sent by the Indians to the emperor Constantius, happening to die on the road by being shut up in a cage, was placed in salt, and in that manner conveyed to Constantinople[7]. This method of preserving natural objects has been even employed in modern times to prevent large bodies from being affected by corruption. The hippopotamus described by Columna was sent to him from Egypt preserved in salt[8].

To put dead bodies in honey, for the purpose of securing them from putrefaction, is an ancient practice[9], and was used at an early period by the Assyrians[10]. The body of Agesipolis king of Sparta, who died in Macedonia, was sent home in

[1] Dion Cassius, lib. xxxvii. cap. 14. See the Life of Pompey in Plutarch, who adds that the countenance of Mithridates could no longer be distinguished, because the persons who embalmed the body in this manner had forgotten to take out the brain. [2] Eunapius in Ædesio.

[3] In Acta sancti Guiberti, cap. 6. [4] Varro De Re Rustica, lib. ii. cap. 4.

[5] Phlegon Trallian. De Mirabil. cap. 34, 35, adopts in his account the same expression as that used in the Geoponica, lib. xix. cap. 9, respecting the preservation of the flesh. Pliny however says, lib. vii. cap. 3, "Nos principatu Claudii Cæsaris allatum illi ex Ægypto hippocentaurum in melle vidimus." Perhaps it was placed in honey after its arrival at Rome, in order that it might be better preserved. [6] See Hieronymi Vita Pauli Eremitæ.

[7] Philostorgii Historia Ecclesiastica, 1643, 4to, p. 41.

[8] Columnæ Aquatil. et Terrestr. Observat. cap. 15.

[9] Plin. lib. xxii. cap. 24. [10] Strabo, lib. xvi.

honey[1], as were also the bodies of Agesilaus[2] and Aristobulus[3]. The faithless Cleomenes caused the head of Archonides to be put in honey, and had it always placed near him when he was deliberating upon any affair of great importance, in order to fulfil the oath he had made to undertake nothing without consulting his head[4]. According to the account of some authors, the body of Alexander the Great was deposited in honey[5], though others relate that it was embalmed according to the manner of the Egyptians[6]. The body of the emperor Justin II. was also placed in honey mixed with spices[7]. The wish of Demoeritus to be buried in honey[8] is likewise a confirmation of this practice. Honey was often applied in ancient times to purposes for which we use sugar. It was employed for preserving fruit[9]; and this process is not disused at present. In order to preserve fresh for many years the celebrated purple dye of the ancients, honey was poured over it[10], and certain worms useful in medicine were kept free from corruption by the like means[11]. By the same method also were natural curiosities preserved, such as the hippocentaur already mentioned; and it has been employed in later times, as is proved by the account given by Alexander ab Alexandro[12], respecting the supposed mermen.

Among the Scythians[13], Assyrians[14], and Persians[15], dead bodies were covered over with wax. That of Agesilaus, because honey could not be procured, was preserved in this

[1] Xenophon, Rer. Græc. lib. v. [2] Diodorus Siculus, lib. xv.
[3] Josephi Antiq. Jud. lib. xiv. c. 13. De Bello Jud. lib. i. c. 7.
[4] Æliani Var. Hist. lib. xii. cap. 8. [5] Statius, Silv. iii. 2.
[6] Curtius, lib. x. cap. 10. [7] Corippus De Laudibus Justini II.
[8] Varro, in Nonius, cap. iii. The following words of Lucretius, b. iii. ver. 902, "aut in melle situm suffocari," allude perhaps to the above circumstance. [9] Columella, xii. 45. Apicii Ars Coquinar. lib. i. cap. 20.
[10] Plutarch in the Life of Alexander relates, that among other valuables in the treasury at Susa, that conqueror found 5000 talents of the purple dye, which was perfectly fresh, though nearly two hundred years old, and that its preservation was ascribed to its being covered with honey. This account is well illustrated in Mercurialis Var. Lect. lib. vi. cap. 26.
[11] Plin. lib. xxix. cap. 4. [12] Dier. Genial. lib. iii. cap. 8.
[13] Herodot. lib. iv. cap. 71. [14] Θάπτουσι δ' ἐν μέλιτι, κηρῷ περιπλάσαντες. Sepeliunt in melle, cera cadavere oblito. The bodies therefore were first covered with wax, and then deposited in honey.
[15] Herodot. lib. i. cap. 140. Cicero, Tusc. Quæst. lib. i. Alexandri ab Alexan. Dier. Genial. lib. iii. cap. 2.

manner[1], which indeed ought not to be despised even at present. When the Orientals are desirous of transporting fish to any distance, they cover them over with wax[2]; and the apples carried every year to the northern parts of Siberia and Archangel, from the southern districts of Russia, are first dipped in melted wax, which, by forming a thick coat around them, keeps out the air, and prevents them from spoiling. This property has in my opinion given rise to the ancient custom of wrapping up in wax-cloth the dead bodies of persons of distinction. Linen, or perhaps silk, which had been done over with wax, was used on such occasions, but not what we at present distinguish by the name of wax-cloth, which is only covered with an oil-varnish in imitation of the real kind. The body of St. Ansbert, we are told, was wrapped up *linteo cerato*; and a *camisale ceratum*[3] was drawn over the clothes which covered that of St. Udalric. When Philip duke of Burgundy died in 1404, his body was wrapped up in thirty-two ells *de toile cirée*[4]. In an ancient record, respecting the ceremony to be used in burying the kings of England, it is ordered that the body shall be wrapped up in wax-cloth[5]. In the year 1774, when the grave of king Edward I., who died in 1307, was opened, the body was found so closely wrapped up in wax-cloth, that one could perfectly distinguish the form of the hand, and the features of the countenance[6]. The body of Johanna, mother of Edward the Black Prince, who died in 1359, was also wrapped up in *cerecloth*; and in like manner the body of Elizabeth Tudor, the second daughter of Henry

[1] Plutarchus in Vita Agesilai. The following passage of Quintilian's Institut. Orat. lib. vi. cap. 1. 40, is understood by most commentators, as if the author meant to say that a waxen image of the person deceased, made by pouring the wax into a mould of gypsum, was exhibited. "Et prolata novissime, deformitate ipsa (nam ceris cadaver attulerant infusum) præteritam quoque orationis gratiam perdidit." See Turnebi Adversar. lib. xxix. cap. 13. But in my opinion it appears very probable that the body itself, covered with wax, was carried into the court.

[2] Near Damietta are found a kind of mullets, which, after being covered over with wax, are by these means sent throughout all Turkey, and to different parts of Europe.—Pocock's Travels.

[3] Theophilus Raynaudus de incorruptione cadaverum, in vol. xiii. of the works of that learned Jesuit, Lugd. 1665.

[4] Beguillet, Déscription du Duché de Bourgogne, i. p. 192.

[5] Liber Regalis, in the article De excquiis regalibus.

[6] Archæologia, vol. iii. p. 376.

VII., was *cered by the wax-chandler*[1]. After the death of George II., the apothecary was allowed one hundred and fifty-two pounds for fine double wax-cloth, and other articles necessary to embalm the body[2]. The books found in the grave of Numa, as we learn from the Roman historians, though they had been buried more than five hundred years, were, when taken up, so entire, that they looked as if perfectly new, because they had been closely surrounded with wax-candles. Wax-cloth it is probable was not then known at Rome[3].

In those centuries usually called the middle ages, I find no traces of collections of this nature, except in the treasuries of emperors, kings and princes, where, besides articles of great value, curiosities of art, antiquities and relics, one sometimes found scarce and singular foreign animals, which were dried and preserved. Such objects were to be seen in the old treasury at Vienna; and in that of St. Denis was exhibited the claw of a griffin, sent by the king of Persia to Charlemagne; the teeth of the hippopotamus, and other things of the like kind[4]. In these collections the number of the rarities always increased in proportion as a taste for natural history became more prevalent, and as the extension of commerce afforded better opportunities for procuring the productions of remote countries. Menageries were established to add to the magni-

[1] Dart's Westminster, ii. p. 28.

[2] In the account of the funeral expenses stands the following article: "To Thomas Graham, apothecary to his majesty, for a fine double cerecloth, with a large quantity of very rich perfumed aromatic powders, &c., for embalming his late majesty's royal body, 152*l*." See Archæologia, *ut supra*, p. 402.

[3] Livius, lib. xl. cap. 29. Pliny, b. xiii. chap. 13, relates the same thing, with a little variation, respecting the annals of Cassius Hemina: "Mirabantur alii, quomodo illi libri durare potuissent. Ille ita rationem reddebat; lapidem fuisse quadratum circiter in media arca vinctum candelis quoquoversus. In eo lapide insuper libros impositos fuisse, propterca arbitrari eos non computruisse. Et libros citratos fuisse, propterea arbitrarier tineas non tetigisse."—Hardouin thinks that *libri citrati* were books in which *folia citri* were placed to preserve them from insects. The first editions however have *libri cedrati*, and even the paper itself may have been covered over with some resinous substance. The scarce edition which I received as a present from Professor Bause at Moscow, Opus impressum per Joan. Rubeum et Bernardinum Fratresque Vercellenses 1507, fol. has in page 98 the word *caedratos*, and in the margin *caeratos*.

[4] A catalogue of this collection may be found in the second volume of Valentin's Museum Museorum.

ficence of courts, and the stuffed skins of rare animals were hung up as memorials of their having existed. Public libraries also were made receptacles for such natural curiosities as were from time to time presented to them; and as in universities the faculty of medicine had a hall appropriated for the dissection of human bodies, curiosities from the animal kingdom were collected there also by degrees; and it is probable that the professors of anatomy first made attempts to preserve different parts of animals in spirit of wine, as they were obliged to keep them by them for the use of their pupils; and because in old times dead bodies were not given up to them as at present, and were more difficult to be obtained.

At a later period collections of natural curiosities began to be formed by private persons. The object of them at first appears to have been rather to gratify the sight than to improve the understanding; and they contained more rarities of art, valuable pieces of workmanship and antiquities, than productions of nature. It is certain that such collections were first made in places where many families had been enriched without much labour by trade and manufactures, and who, it is likely, might wish to procure to themselves consequence and respect by expending money in this manner. It is not improbable that such collections were formed, though not first, as Stetten thinks[1], at a very early period at Augsburg, and this taste was soon spread into other opulent cities and states.

Private collections, however, appear for the first time in the sixteenth century; and there is no doubt that they were formed by every learned man who at that period applied to the study of natural history. Among these were Hen. Cor. Agrippa of Nettesheim; Nic. Monardes, Paracelsus, Val. Cordus[2], Hier. Cardan, Matthiolus, 1577; Conrad Gesner, George Agri-

[1] Von Stettens Kunstgeschichte von Augsburg, p. 218. 362.

[2] With how much care this learned man, who died in 1544, in the twenty-ninth year of his age, collected minerals and plants is proved by his Silva Observationum Variarum, quas inter peregrinandum brevissime notavit. Walch, in his Naturgeschichte der Versteinerungen, considers it as the first general oryctography of Germany, and is surprised that so extensive a work should have been thought of at that period. Wallerius, in his Lucubratio de Systematibus Mineralogicis, Holmiæ, 1768, 8vo, p. 27, considers this Silva as a systematic description of all minerals. Both however are mistaken. Cordus undertook a journey in 1542, through some parts of Germany, and drew up a short catalogue without order, of the natural objects he met with in the course of his travels, which was published by Conrad

cola, 1555[1]; Pet. Bellon, 1564; W. Rondelet, 1566; Thurneisser[2]; Abraham Ortelius, 1598[3]; and many others. That such collections were formed also in England[4] during the above century, is proved by the catalogue which Hakluyt used for his works.

The oldest catalogues of private collections which I remember, are the following: Samuel Quickelberg, a physician from Antwerp, who about the year 1553 resided at Ingolstadt, and was much esteemed by the duke of Bavaria, published in quarto at Munich in 1565, Inscriptiones vel Tituli Theatri Amplissimi, complectentis Rerum Universitatis singulas Materias et Imagines. This pamphlet contained only the plan of a large work, in which he intended to give a description of all the rarities of nature and art. I have never had an opportunity of seeing it. I am acquainted only with a copious extract from it, which induces me to doubt whether Walch was right in giving it out as a catalogue of the author's collection[5].

The same year, 1565, John Kentmann, a learned physician in Torgau, sent a catalogue of his collection, which consisted principally of minerals and shells, to Conrad Gesner, who caused it to be printed[6]. The order observed in it is princi-

Gesner, together with the other works of this industrious man, at Strasburg in 1561. This book, which I have in my possession, has in the title page, In hoc volumine continetur Valerii Cordi in Dioscoridis libros de Medica Materia; ejusdem Historiæ Stirpium, &c. The Silva begins page 217.

[1] That Agricola had a good collection, may be concluded from his writings, in which he describes minerals according to their external appearance, and mentions the places where they are found.

[2] H. Mohsen says in his Account of Mark Brandenburg, Berlin, 1783, 4to, p. 142. Thurneisser is the first person, as far as is known at present, who in this country formed a collection of natural curiosities.

[3] "Ortelius habebat domi suæ imagines, statuas, nummos. . . . .conchas ab ipsis Indis et Antipodibus, marmora omnis coloris, spiras testudineas tantæ magnitudinis, ut decem ex iis viri in orbem sedentes cibum sumere possent; alias rursum ita angustas, ut vix magnitudinem capitelli unius aciculi adæquarent."—M. Adami Vitæ Germ. Philos. Heidelb. 1615, 8vo, p. 431.

[4] See Biographia Britannica, vol. iv. p. 2469. [The names of our early English collectors, Tradescant, Ashmole, Petiver, and Sir Hans Sloane, though a little later than the period alluded to, deserve to be recorded here.]

[5] This extract may be seen in D. G. Molleri Dissert. de Technophysiotameis, Altorfi, 1704, p. 18. Some account of Quickelberg may be found in Sweertii Athenæ Belgicæ, Antv. 1628, fol. p. 671; in Val. Andreæ Bibliotheca Belgica, Lov. 1643, 4to, p. 806; and in Simleri Bibliotheca Instituta a Gesnero, Tiguri, 1574, fol. p. 617.

[6] De Omni Rerum Fossilium Genere, op. Conr. Gesneri. Tig. 1565, 8vo.

pally borrowed from Agricola. This collection, however, was not extensive. It was contained in a cabinet composed of thirteen drawers, each divided lengthwise into two partitions, and the number of the articles, among which, besides minerals, there were various productions found in mines and marine bodies, amounted to about sixteen hundred. It must however have been considerable for that period, as the collector tells us he laid out sums in forming it which few could be able to expend[1]; and as Jacob Fabricius, in order to see it, undertook a journey from Chemnitz to Torgau[2]. About this time lived in France that ingenious and intelligent potter, Bernard Palissy, who collected all kinds of natural and artificial rarities, and published a catalogue of them, which he made his guide in the study of natural history[3]. Michael Mercati, a physician, who was contemporary, formed also in Italy a large collection of natural curiosities, and wrote a very copious description of them, which was first printed about the beginning of the last century[4]. The collection of Ferdinand Imperati, a Neapolitan, the description of which was printed for the first time in 1599, belongs to the same period; and likewise the large collection of Fran. Cal-

[1] He says in the preface, "Thesaurum fossilium multis impensis collegi, paucis comparabilem."

[2] This is related by Jacob Fabricius, in the prefacc to the treatise of his brother George Fabricius De Metallicis Rebus, which may be found in Gesner's collection before quoted.

[3] This catalogue is printed in Œuvres de B. Palissy. Par M. Faujas de Saint-Fond et Gobet. Paris, 1777, 4to, p. 691. [Quite recently a new edition of Palissy's works, together with an account of the life of this remarkable man by M. Cap, has been published at Paris. Palissy, after long devoting his services to the king and some of the royal family, was shut up in the Bastille on account of his religion. It is said that one day Henry III., having visited him in his prison, spoke to him thus: "My good man, you have been for forty-five years in my mother's and my service. We have suffered you to live in your religion amidst fires and massacres: now I am so strongly urged by the Guise party and by my people, that *I am constrained* to leave you in the hands of my enemies, and to-morrow you will be burnt if you are not converted." "Sire," replied Bernard, "I am ready to lay down my life for the glory of God. You have often told me that you pitied me; and now I pity you, who have uttered these words, '*I am constrained*!' Sire, it is not speaking like a king; and it is what you yourself, those who constrain you, the Guisards, and all your people, could never compel me to; for I know how to die." Palissy died indeed in the Bastille, but a natural death, in 1589. Thus ended a career illustrious alike for great talents and rare virtues.]

[4] Mercati Metallotheca. Romæ, 1717, fol. to which an appendix was added in 1719.

ceolari of Verona, the catalogue of which was first printed in 1584[1]. Walch and some others mention the catalogue of Brackenhoffer's collection as one of the earliest, but it was printed for the first time only in 1677.

[The TRADESCANTS, father and son, are celebrated as being among the first collectors of rarities in this country, which they deposited during their lives in a large house situate in the parish of Lambeth. This became a place of fashionable resort from the curiosities it contained, and obtained the appellation of Tradescant's ark. A catalogue of its contents was printed in 1656 under the title of Museum Tradescantium. In 1659 this collection was purchased by ELIAS ASHMOLE, who presented it, together with his books, MSS., and other rarities, to the University of Oxford in 1683, thereby commencing the now celebrated ASHMOLEAN MUSEUM.

About the same period, JAMES PETIVER, still celebrated for his curious and interesting botanical publications, made extensive collections of natural curiosities, employing captains, ship-surgeons, merchants, &c. to bring him whatever they could find suitable to his museum, at almost any cost. He kept up an extensive correspondence in pursuit of this object, and eventually formed one of the finest collections hitherto made in England. At his death it was purchased by that celebrated naturalist, Sir HANS SLOANE, and thus became the foundation of perhaps the most important collection in Europe—the BRITISH MUSEUM.

Sir Hans Sloane, after having accompanied the duke of Albemarle to Jamaica as physician, was elected on his return to this country to succeed Sir Isaac Newton as president of the Royal Society. He was born in 1660, and died on the 11th of January, 1752. Having with great labour and expense during the course of his long life collected a rich cabinet of medals, objects of natural history, &c., and a valuable library of books and MSS., he bequeathed the whole to the public on

[1] Joh. Baptistæ Olivi de reconditis et præcipuis collectaneis a Franc. Calceolario in Museo adservatis testificatio ad Hieron. Mercurialem. Venet. 1584, 4to. An edition was published also at Verona in quarto, in 1593. The complete description was however first printed at Verona in a small folio, in 1622; Musæum Calceolarianum Veronense. Maffei, in his Verona Illustrat. Veron. 1732, fol. p. 202, says, "Calceolari.....fu de' primi, che raccogliendo grandissima quantità d'erbe, piante, minerali, animali diseccati, droghe rare, cose impetrite, ed altre rarità naturali, formasse museo di questo genere."

condition that the sum of £20,000 should be paid to his executors, being little more than the intrinsic value of the medals, metallic ores and precious stones comprised in his collection. Parliament fulfilled the terms of the legacy, and in 1753 an act was passed "for the purchase of the museum or collection of Sir Hans Sloane, Bart. and of the Harleian collection of MSS., and for procuring one general repository for the better reception and more convenient use of the said collection, and of the Cottonian library and additions thereto." Such was the commencement of the British Museum, every department of which has since been vastly augmented. The printed books alone occupy TEN MILES of SHELF, and owing to our connexions with every part of the globe, it vies in the variety and number of objects of natural history with the most celebrated museums of the world. The interest taken in these collections by the public is evident from the number of persons who visited them from Christmas 1844 to Christmas 1845, amounting to no less than 685,614.

Nor should we omit to mention the collection of curiosities, &c. formed by JAMES SALTER, more commonly known by the name of Don Saltero. They were exhibited to the public at his Coffee-house, Cheyne-Walk, Chelsea, which was first opened about the year 1695. It was a very mixed collection of saints' bones, models, carved ivory, and objects of natural history. The following announcement, printed in the Weekly Journal for June 22, 1723, may be regarded as containing the most positive and authentic information concerning this establishment, inasmuch as it appears to have been sanctioned by the proprietor himself.

SIR,—Fifty years since to Chelsea Great,—
From Rodman, on the Irish Main,—
I stroll'd, with maggots in my pate,
Where, much improved, they still remain.
Through various employs I've past,—
A scraper, virtuos', projector,
Tooth-drawer, trimmer,—and at last
I 'm now a gim-crack-whim collector.
Monsters of all sorts here are seen,
Strange things in nature as they grew so:
Some relicks of the Sheba Queen,
And fragments of the famed Bob Crusoe.
Knick-knacks, too, dangle round the wall,
Some in glass-cases, some on shelf;
But, what 's the rarest sight of all,
Your humble servant shows Himself.

On this my chiefest hope depends,
Now, if you will my cause espouse,
In journals pray direct your friends
To my Museum—Coffee-house.
And, in requital for the timely favour,
I 'll gratis bleed, draw teeth, and be your shaver:
Nay, that your pate may with my noddle tarry,
And you shine bright as I do,—Marry! shall ye
Freely consult your Revelation—Molly,
Nor shall one jealous thought a huff,
For she has taught me manners long enough.
Chelsea Knackatory. DON SALTERO."

A fine engraving of Salter's house, with a description and catalogue of his collection, will be found in Smith's Historical and Literary Curiosities.]

CHIMNEYS.

NOTWITHSTANDING the magnificence of the Grecian and Roman architecture, which we still admire in those ruins that remain as monuments of the talents and genius of the ancient builders, it is very doubtful whether their common dwelling-houses had chimneys, that is, passages or funnels formed in the walls for conveying away the smoke from the fire-place or stoves through the different stories to the summit of the edifice; conveniences which are not wanting in the meanest of our houses at present, and in the smallest of our villages. This question some have pretended to determine without much labour or research. How can we suppose, say they, that the Romans, our masters in the art of building, should not have devised and invented some means to keep free from smoke their elegant habitations, which were furnished and ornamented in a splendid and costly manner? How is it possible that a people who purchased ease and convenience at the greatest expense, should suffer their apartments to be filled with smoke, which must have allowed them to enjoy scarcely a moment of pleasure? And how could their cooks dress in smoky kitchens the various sumptuous dishes with which the most refined

voluptuaries covered their tables? One must however be very little acquainted with the history of inventions and manners, to consider such bare conjectures as decisive proofs. It is undoubtedly certain, that many of our common necessaries were for many centuries unknown to the most enlightened nations, and that they are in part still wanting in some countries at present. Besides, it is probable that before the invention of chimneys, other means, now forgotten, were employed to remove smoke.

The ancient mason-work still to be found in Italy does not determine the question. Of the walls of towns, temples, amphitheatres, baths, aqueducts and bridges, there are some though very imperfect remains, in which chimneys cannot be expected; but of common dwelling-houses none are to be seen, except at Herculaneum, and there no traces of chimneys have been discovered[1]. The paintings and pieces of sculpture which are preserved, afford us as little information; for nothing can be perceived in them that bears the smallest resemblance to a modern chimney. If the writings of the ancients are to be referred to, we must collect from the works of the Greek and Roman authors whatever seems allusive to the subject. This indeed has been already done by various men of learning[2]; but the greater part of them seem to deduce more from

[1] Winkelmann in his Observations on the Baths of the Ancients.

[2] The following are the principal authors in whose works information is to be found respecting this subject:—Octavii Ferrarii Electorum libri duo. Patavii 1679, 4to. This work consists of short treatises on different subjects of antiquity. The ninth chapter of the first book, page 32, has for title, "Fumaria, seu fumi emissaria, vulgo caminos, apud veteres in usu fuisse, disputatur."

Justi Lipsii Epistolarum selectarum Chilias, 1613, 8vo. The seventy-fifth letter in Centuria tertia ad Belgas, page 921, treats of chimneys, with which the author says the Greeks and the Romans were unacquainted.

Eberharti a Weyhe Parergon De Camino. To save my readers the trouble which I have had in searching for this small treatise, I shall give them the following information: E. von Weyhe was a learned nobleman of our electorate, a particular account of whose life and writings may be found in Molleri Cimbria Litterata, vol. ii. p. 970. In the year 1612 he published Discursus de speculi origine, usu et abusu, Eberharti von Weyhe. This edition contains nothing on chimneys, nor is there any thing to be found respecting them in the second, inserted in Dornavii Amphitheatrum Sapientiæ Socraticæ Joco-seriæ, Hanoviæ 1619, fol. i. p. 733. But this treatise was twice printed afterwards, as an appendix to the author's Aulicus Politicus: Francf. 1615, and Wolfenb. 1622, in quarto; and in both these edi-

the passages they quote than can be admitted by those who read and examine them without prejudice. I shall here present them to my readers, that they may have an opportunity of judging for themselves.

We are told by Homer, that Ulysses, when in the grotto of Calypso, wished that he might see the smoke ascending from Ithaca, that is, he wished to be in sight of the island[1]. Montfaucon is of opinion that this wish is unintelligible unless it be allowed that the houses of Ithaca had chimneys. But cannot smoke be seen to rise also when it makes its way through

tions may be found at the end, Parergon de camino, inquirendi causa adjectum. In this short essay, which consists of only two pages, the author denies that the Jews, the Greeks, or the Romans had chimneys. Fabricius, in his Bibliograph. Antiquaria, does not quote Von Weyhe, either p. 1004, where he speaks of chimneys, or page 1014, where he speaks of looking-glasses.

Balthasaris Bonifacii Ludicra Historia. Venetiis 1652, 4to, lib. iii. cap. 23. De Caminis, p. 109. What this author says on the subject is of little importance.

Jo. Heringii Tractatus de molendinis eorumque jure, Francf. 1663, 4to.

P. Manutii Comment. in Ciceronis Epist. Familiar. lib. vii. epist. 10, decides against chimneys, and speaks of the manner of warming apartments.

Petronii Satyricon, cura Burmanni, Amst. 1743, 4to, i. p. 836. Burmann, on good grounds, is of opinion that the ancients had not chimneys.

Martini Lexicon Philologicum. Franc. 1655, fol. article *Caminus*.

Pancirollus De Rebus deperditis, ed. Salmuth, vol. i. tit. 33, p. 77.

Montfaucon, l'Antiquité expliquée, vol. i. p. 102. Montfaucon believes that the ancients had chimneys.

Pitisci Lexicon Antiquitatum Romanarum, fol. The whole article *Caminus* is transcribed from Lipsius, Ferrarius, and others, without the author's own opinion.

Muratori, Antiquitates Italiæ Medii Ævi, ii. p. 418.

Constantini Libri de Ceremoniis aulæ Byzantinæ, t. ii. Lipsiæ, 1754, fol. in Reiskii Commentar. p. 125.

Encyclopédie, tome troisième, Paris, 1753, fol. p. 281.

Deutsche Encyclopedie, vol. iv. Frank. 1780, 4to, p. 823.

Maternus von Cilano, Römische Alterthümer, vol. iv. Altona, 1776, 8vo, p. 945. This author is of opinion that chimneys were used by the Greeks, but not by the Romans.

Bibliothèque Ancienne et Moderne, par Jean le Clerc, tom. xiii. 1720, part i. p. 56. The author gives an extract from Montfaucon, which contains a great many new observations.

Zanetti dell' origine di alcune arti principali appresso i Veneziani. Venezia, 1758, 4to, p. 78.

Raccolta d' opuscoli scientifici e filologici. Venezia, 1752, 12mo, tom. xlvii. A Treatise on Chimneys by Scip. Maffei is to be found page 67.

[1] Odyss. lib. i. ver. 58.

doors and windows? When navigators at sea observe smoke arising, they conclude that they are in the neighbourhood of inhabited land; but no one undoubtedly will thence infer, that the habitations of the people have chimneys.

Herodotus[1] relates that a king of Lebæa, when one of his servants asked for his wages, offered him in jest the sun, which at that time shone into the house through the chimney, as some have translated the original; but it appears that what is here called chimney, was nothing more than an opening in the roof, under which, perhaps, the fire was made in the middle of the edifice. Through a high chimney, of the same form as those used at present, the sun certainly could not throw his rays on the floor of any apartment.

In the Vespæ of Aristophanes[2], old Philocleon wishes to escape through the kitchen. Some one asks, "What is that which makes a noise in the chimney?" "I am the smoke," replies the old man, "and am endeavouring to get out at the chimney." This passage, however, which, according to the usual translation, seems to allude to a common chimney, can, in my opinion, especially when we consider the illustration of the scholiasts, be explained also by a simple hole in the roof, as Reiske has determined; and indeed this appears to be more probable, as we find mention made of a top or covering with which the hole was closed.

In a passage of the poet Alexis, who lived in the time of Alexander the Great, quoted by Athenæus[3], some one asks, "Boy, is there a kitchen? Has it a chimney?" "Yes, but it is a bad one—the eyes will suffer." The question here alludes without doubt to a passage for carrying off smoke; but information is not given us sufficient to determine its form and construction. Athenæus has preserved also a passage of the poet Diphilus[4], in which a parasite says, when he is invited to the house of a rich man, he does not look at the magnificence of the building or the elegance of the furniture, but to the smoke of the kitchen. "If I see it," adds he, "rising up in abundance, quick and in a straight column, my heart is rejoiced, for I expect a good supper." In this passage, however, which according to Maternus is clearly in favour of chimneys, I can find as little proof as in the words of the poet Sosipater,

[1] Lib. viii. c. 137. [2] Ver. 139. [3] Lib. ix. p. 386. [4] Lib. vi. p. 236.

quoted likewise by Athenæus [1], who reckons the art of determining which way the wind blows to be a part of the knowledge requisite in a perfect cook. "He must know," says he, "to discover from what quarter it comes, for when the smoke is driven about it spoils many kinds of dishes." Instead of agreeing with Ferrarius that this quotation seems to show that the houses of the ancients were provided with chimneys, I conclude rather from it, that they were not; for, had there been chimneys in their kitchens, the cooks must have left the smoke to make its way through them without giving themselves any trouble; but if they were destitute of these conveniences, it would be necessary for them to afford it some other passage; it would consequently be the business of the cook to consider on what side it would be most advantageous to open a door or a window; and in this he would undoubtedly be guided by the direction of the wind. That this really was the case, appears from a Greek epigram, which by an ingenious thought, gives us an idea of the passage of smoke through a window [2].

These, as far as I know, are all the passages which have been collected from Greek authors respecting this question. But instead of proving that the houses of the ancients were built with chimneys, they seem much rather to show the contrary: especially when we consider what the Roman writers have said on the same subject; for the information of the latter, taken together, affords good grounds to believe that no chimneys were to be found in the houses at Rome, at least at the time when these authors wrote; and this certainly would not have been the case had the Romans ever seen chimneys among the Greeks. I shall now lay before my readers those passages which appear on the first view to refute my conjecture.

When the triumviri, says Appian [3], caused those who had been proscribed by them to be sought out by the military, some of them, to avoid the bloody hands of their persecutors, hid themselves in wells, and others, as Ferrarius translates the words, "in fumaria sub tecto, qua scilicet fumus e tecto evolvitur." The true translation however is "fumosa cænacula." The principal persons of Rome endeavoured to conceal them-

[1] Lib. ix. p. 378. [2] Anthолog. lib. ii. cap. 32. p. 229.
[3] De Bellis Civil. lib. iv. p. 962, edit. Tollii.

selves in the smoky apartments of the upper story under the roof, which in general were inhabited only by poor people; and this seems to be confirmed by what Juvenal [1] expressly says, "Rarus venit in cænacula miles."

Those passages of the ancients which speak of smoke rising up from houses have with equal impropriety been supposed to allude to chimneys, as if the smoke could not make its way through doors and windows. Seneca [2] writes, "Last evening I had some friends with me, and on that account a stronger smoke was raised; not such a smoke however as bursts forth from the kitchens of the great, and which alarms the watchmen, but such a one as signifies that guests are arrived." Those whose judgements are not already warped by prejudice, will undoubtedly find the true sense of these words to be, that the smoke forced its way through the kitchen windows. Had the houses been built with chimney-funnels, one cannot conceive why the watchmen should have been alarmed when they observed a stronger smoke than usual arising from them; but as the kitchens had no conveniences of that kind, an apprehension of fire, when extraordinary entertainments were to be provided in the houses of the rich for large companies, seems to have been well-founded; and on such occasions people appointed for that purpose were stationed in the neighbourhood to be constantly on the watch, and to be ready to extinguish the flames in case a fire should happen [3]. There are many other passages to be found in Roman authors of the like kind, which it is hardly necessary to mention, such as that of Virgil [4]:

Et jam summa procul villarum culmina fumant.

and the following words of Plautus [5] descriptive of a miser:

Quin divûm atque hominum clamat continuo fidem,
Suam rem periisse, seque cradicarier,
De suo tigillo fumus si qua exit foras.

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[1] Sat. x. ver. 17. [2] Epist. 64.

[3] Such fire-watchmen were appointed by the emperor Augustus.—Sueton. in Vit. Octav. August. cap. 30. That these watchmen, whom the soldiers in ridicule called Sparteoli, were stationed in the neighbourhood of houses where there were grand entertainments, is proved by Tertulliani Apologet. cap. xxxix. p. 188, edit. De la Cerda. Compare also Casaubon's annotations on the passage of Suetonius above quoted.

[4] Eclog. i. ver. 83. [5] Aulular. act. ii. sc. 4.

If there were no funnels in the houses of the ancients to carry off the smoke, the directions given by Columella to make kitchens so high that the roof should not catch fire, was of the utmost importance[1]. An accident of the kind, which that author seems to have apprehended, had almost happened at Beneventum, when the landlord who entertained Mæcenas and his company was making a strong fire in order to get some birds sooner roasted:

> . . . . . ubi sedulus hospes
> Pæne arsit, macros dum turdos versat in igne;
> Nam vaga per veterem dilapso flamma culinam
> Vulcano summum properabat lambere tectum[2].

Had there been chimneys in the Roman houses, Vitruvius certainly would not have failed to describe their construction, which is sometimes attended with considerable difficulties, and which is intimately connected with the regulation of the plan of the whole edifice. He does not, however, say a word on this subject; neither does Julius Pollux, who has collected with great care the Greek names of every part of a dwelling-house; and Grapaldus, who in later times made a like collection of the Latin terms, has not given a Latin word expressive of a modern chimney[3].

I shall here answer an objection which may be made, that the word *caminus* means a chimney; and I shall also explain what methods the ancients, and particularly the Romans, employed without chimneys to warm their apartments. *Caminus* signified, as far as I have been able to learn, first a chemical or metallurgic furnace, in which a crucible was placed for melting and refining metals. It signified also a smith's forge[4]. It signified likewise, without doubt, a hearth, or as we talk at present, a fire-place, which served for warming the apartment in which it was constructed; and for that purpose portable stoves or fire-pans were also employed. These were either filled with burning coals, or wood was lighted in them, and, when burned to coal, was carried into the apartment. In all these however there appears no trace of a chimney.

The complaints often made by the ancients respecting smoke serve also to confirm the opinion that they had no

[1] De Re Rustica, lib. i. cap. 6.
[2] Horat. lib. i. sat. 5.
[3] Grapaldus De Partibus Ædium.
[4] Plin. xxxiii. cap. 4. Virgil. Æn. iii. ver. 580. Juvenal, sat. xiv. ver. 117.

chimneys. Vitruvius[1], where he speaks of ornamenting and fitting up apartments, says expressly, that there ought to be no carved work or mouldings, but plain cornices, in rooms where fire is made and many lights burned, because they will soon be covered with soot, and therefore will require to be often cleaned. On the other hand, he allows carving in summer apartments, where the effects of smoke are not to be apprehended. The moderns, however, who use chimneys, ornament the borders of them with carving, painting and gilding, nor are they injured by the smoke; but we find that among the ancients, furniture of every kind, ceilings and walls were soon covered over with soot; and from this even the images of their ancestors, *imagines majorum*, were not secure, which, though they were to be found only in the houses of the great, and stood in niches in the *atrium*[2] or hall, became black with smoke, and on that account were justly named *fumosæ*[3]. The smoke therefore must have been blown very much about, and carried into every apartment. In the houses of the opulent, care in all probability was employed to keep them clean; but the habitations of families who did not belong to the common or poorest classes, are represented as smoky and black; and we are told that their walls and ceilings were full of soot. They were therefore called black houses, as in Russia the huts of the common people, which are furnished with paltry stoves, and which are blackened in the same manner by the smoke of the fir-wood used in them for fuel, are called black huts[4].

[1] Lib. vii. cap. 3.

[2] The name *atrium* had its rise from the walls of such places being black with smoke. Isidorus, xv. 3. This derivation is given also by Servius, Æn. lib. i. ver. 730.

[3] Seneca, ep. 44. Cicero in Pison. cap. i. Juvenal, sat. viii. ver. 6.

[4] In the *Equites* of Aristophanes the houses of the common people are called *γύπαι* and *γυπάρια*, because *γὺψ* signifies *fuliginosum* or *fuscum*. On account of the smoke they were called also *μέλαθρα*. Lycophron, 770, and 1190. *Μέλαθρον αἰθαλόεν*, domicilium fuliginosum, occurs in Homer, Iliad. ii. ver. 414, of which expression and i. ver. 204, the scholiast very properly gives the following explanation: *ἀπὸ τοῦ μελαίνεσθαι ὑπὸ τοῦ κάπνου*, quoniam a fumo reddebantur nigræ. For the same reason, according to the scholiasts, Apollonius Rhodius, lib. ii. ver. 1089, calls the middle beam of the roof *μέλαθρον*. Columella, i. 17, says, "Fuligo quæ supra focos tectis inhæret:" among us the soot adheres to the funnel of the chimney, and not to the roof or ceiling.

Tecta senis subcunt, nigro deformia fumo;
Ignis in hesterno stipite parvus erat.—Ovid. Fast. lib. v. 505.

As the houses of the ancients were so smoky, it may be easily comprehended how, by means of smoke, they could dry and harden, not only various articles used as food, but also different pieces of timber employed for making all sorts of large and small implements. In this manner was prepared the wood destined for ploughs, waggons, and ships, and particularly that of which rudders were formed[1]. For this reason pantries for flesh and wine, and also coops to hold fowls, which were said to thrive by smoke, were constructed near the kitchen, where it always abounded[2]; and on the other hand, it was necessary to remove to a distance from kitchens, apartments destined for the purpose of preserving such articles as were liable to be spoiled by smoke[3]: but among us the case is widely different, for we often have neat and elegant apartments in the neighbourhood of the kitchen.

From what has been said it will readily appear why the ancients kept by them such quantities of hard wood, which, when burning, does not occasion smoke. The same kind is even sought after at present, and on this account we value that of the white and common willow, *Salix alba* and *triandra*; because when burned in our chimneys, it makes little smoke, and throws out fewest sparks. The great trouble, however, which was taken in old times to procure wood that would

In cujus hospitio nec fumi nec nidoris nebulam vererer.—Apuleii Metam. 1.

Sordidum flammæ trepidant rotantes
Vertice fumum.—Horat. iv. od. 11.

It may be here said, that the above passages allude to the hovels of the poor, which are black enough among us. These are not, however, all so smoky and so covered with soot both without and within; for though this may be the case in some villages, the houses of the common people in our cities may be called dirty rather than smoky. These passages of Roman authors speak principally of town-houses. The house in which Horace wished to entertain his Phyllis was not a mean one, for, he tells her a little before, "Ridet argento domus." [Black huts or hovels, such as are described in the above remarks, having merely a hole in the roof, or an open window for the escape of smoke, are still common in Ireland, and in some of the less-frequented villages of the Continent. Indeed they are met with even in England. But in all cases the buildings appear to be very ancient.]

[1] Hesiodi Op. ver. 627. Virgilii Georg. lib. i. 175.

[2] Columella, i. 6, et viii. cap. 3.

[3] Columella, lib. i. cap. 6, p. 405. Artificial heat could not be employed to prevent oil from becoming clotted by being frozen; for it was liable to be hurt by soot and smoke, the constant attendants of artificial warming.—Columella, lib. i. cap. 6.

not smoke, clearly proves that this was much more necessary in those periods than at present. It was customary to peel off the bark from the wood, to let it lie afterwards a long time in water, and then to suffer it to dry[1]. This process must undoubtedly have proved of great service, for we know that wood which has been conveyed by water, in floats, kindles more readily, burns brisker, and throws out less smoke than that which has been transported from the forest in waggons. Another method, much employed, of rendering wood less apt to smoke, was to soak it in oil or oil-lees, or to pour oil over it[2]. With the like view, wood, before it was used, was hardened or scorched over the fire, until it lost the greater part of its moisture, without being entirely reduced to charcoal. This method is still employed with advantage in glass-houses and porcelain manufactories, where there are stoves made on purpose to dry wood. Such scorched wood appears to be that to which the ancients gave the name of *ligna cocta* or *coctilia*[3]. It was sold in particular warehouses at Rome, called *tabernæ coctiliariæ*, and the preparing as well as the selling of it formed an employment followed by the common people, and which, as we are told, was carried on by the father of the emperor Pertinax[4]. When it was necessary to kindle fire without wood prepared in that manner, an article probably too expen-

[1] This method of preparing wood is described by Theophrastus, Hist. Plant. lib. xv. cap. 10. [2] Cato De Re Rust. cap. 130. Pliny, lib. xv. cap. 8.

[3] Such wood in Greek was called ἄκαπτα, in Latin *acapna*, in Homer's Odyssey, book vi. κάγκανα and δανὰ, Pollux, p. 621, καύσιμα. This wood is mentioned also by Galen, in Antidot. lib. i. Trebellius Pollio in Vita Claudii, in an account of the firing allowed to him when a tribune, shows that wood was given out or sold by weight, as it is at present at Amsterdam. On the other hand, the *coctilia* were measured like coals. Martial, lib. xiii. ep. 15 : Ligna acapna :—

> Si vicina tibi Nomento rura coluntur,
> Ad villam monco, rustice, ligna feres.

It would seem that in the above-mentioned neighbourhood there was no wood proper for fuel, so that people were obliged to purchase that which had been dried. Some hence conclude that the *acapna* must not have been dear, because it is recommended to a countryman. But the advice here given is addressed to the possessor of a farm who certainly could afford to purchase dried wood.

[4] Jul. Capitol. in Vita Pertin. cap. iii. Capitolinus says before, that the father carried on *lignariam negotiationem*. See the annotations of Salmasius and Casaubon.

sive for indigent families, we find complaints of smoke which brought on a watering of the eyes; and this was the case with Horace at a paltry inn where he happened to stop when on a journey [1].

The information which can be collected from the Greek and Roman authors respecting the manner in which the ancients warmed their apartments, however imperfect, nevertheless shows that they commonly used for that purpose a large fire-pan or portable stove, in which they kindled wood, and, when the wood was well-lighted, carried it into the room, or which they filled with burning coals. When Alexander the Great was entertained by a friend in winter, as the weather was cold and raw, a small fire-bason was brought into the apartment to warm it. The prince, observing the size of the vessel, and that it contained only a few coals, desired his host, in a jeering manner, to bring more wood or frankincense, giving him thus to understand that the fire was fitter for burning perfumes than to produce heat[2]. Anacharsis, the Scythian philosopher, though displeased with many of the Grecian customs, praised the Greeks, however, because they shut out the smoke and brought only fire into their houses[3]. We are informed by Lampridius, that the extravagant Heliogabalus caused to be burned in these stoves, instead of wood, Indian spiceries and costly perfumes[4]. It is also worthy of notice, that coals were found in some of the apartments of Herculaneum, as we are told by Winkelmann, but neither stoves nor chimneys. As in Persia and other countries of the East no stoves made in the European manner are used at present, and as it is certain that the manners, customs and furniture of the early ages have been retained there almost without variation, we have reason to suppose that the methods employed by the inhabitants for warming themselves are the same as those used by the ancients. They agree perfectly with the descriptions given by the Greek and Roman authors, and serve in some measure to illustrate them. I shall therefore here insert the account given by De la Valle, as it is the clearest and most to the purpose.

"The Persians," says he, "make fires in their apartments, not in fire-places as we do, but in stoves in the earth, which

[1] Horat. lib. i. sat. 5, 79.
[2] Plutarch. Apophthegm. p. 180.
[3] Plutarch. Sympos. lib. vi. 7.
[4] Æl. Lamprid. Vita Heliogab. cap. 31.

they call *tennor*. These stoves consist of a square or round hole, two spans or a little more in depth, and in shape not unlike an Italian cask. That this hole may throw out heat sooner, and with more strength, there is placed in it an iron vessel of the same size, which is either filled with burning coals, or a fire of wood and other inflammable substances is made in it. When this is done, they place over the hole or stove a wooden top, like a small low table, and spread above it a large coverlet quilted with cotton, which hangs down on all sides to the floor. This covering condenses the heat, and causes it to warm the whole apartment. The people who eat or converse there, and some who sleep in it, lie down on the floor above the carpet, and lean, with their shoulders against the wall, on square cushions, upon which they sometimes also sit; for the *tennor* is constructed in a place equally distant from the walls on both sides. Those who are not very cold, only put their feet under the table or covering; but those who require more heat can put their hands under it, or creep under it altogether. By these means the stove diffuses over the whole body, without causing uneasiness to the head, so penetrating and agreeable a warmth, that I never in winter experienced anything more pleasant. Those, however, who require less heat let the coverlet hang down on their side to the floor, and enjoy without any inconvenience from the stove the moderately heated air of the apartment. They have a method also of stirring up or blowing the fire when necessary, by means of a small pipe united with the *tennor* or stove under the earth, and made to project above the floor as high as one chooses, so that the wind, when a person blows into it, because it has no other vent, acts immediately upon the fire like a pair of bellows. When there is no longer occasion to use this stove, both holes are closed up, that is to say, the mouth of the stove and that of the pipe which conveys the air to it, by a flat stone made for that purpose. Scarcely any appearance of them is then to be perceived, nor do they occasion inconvenience, especially in a country where it is always customary to cover the floor with a carpet, and where the walls are plastered. In many parts these stoves are used to cook victuals, by placing kettles over them. They are employed also to bake bread, and for this purpose they are covered with a large broad metal plate, on which the cake is laid; but if the bread is thick and requires

more heat, it is put into the stove itself[1]." I shall here remark, that the Jews used such stoves in their houses, and the priests had them also in the temple[2].

Those who have employed their talents on this subject before me, have collected a great many passages from the Greek and Roman writers which speak of fires made for the purpose of affording warmth; but as they contain nothing certain or decisive, I shall not here enlarge upon them[3]. Though one

[1] See also Tavernier, Voyages, vol. i.—Olearius, vol. i.—Schweigger's Reisebeschreibung nach Constantinopel und Jerusalem, p. 264.—Voyage de Chardin, 12mo, vol. iv. p. 236.—Voyage Littéraire de la Grèce, par M. Guys, Paris, 1776, 2 vols. 8vo, i. p. 34. Because this author is one of the latest who has taken the trouble to compare the manners of the ancient and modern Greeks, I shall here give his account at full length:—"The Greeks have no chimneys in the apartments of their houses; they make use only of a chaffing-dish, which is placed in the middle of the apartment to warm it, or for the benefit of those who choose to approach it. This custom is very ancient throughout all the East. The Romans had no other method of warming their chambers; and it has been preserved by the Turks. Λαμπτηρ, says Hesychius, was a chaffing-dish placed in the middle of a room, on which dry wood was burned to warm it, and resinous wood to give light. This chaffing-dish was supported, as those at present, by a tripod; lamps were not introduced till long after. To secure the face from any inconvenience, and from the heat of the chaffing-dish, oftentimes dangerous, the *tendour* was invented. This is a square table under which the fire is placed. It is covered with a carpet which hangs down to the floor, and with another of silk, more or less rich, by way of ornament. People sit around it either on a sofa or on the pavement, and they can at the same time put their hands and their feet under the covering, which, as it encloses the chaffing-dish on all sides, preserves a gentle and lasting heat. The tendour is destined principally for the use of the women, who during the winter pass the whole day around it, employed either in embroidering or in receiving the visits of their friends."

[2] As a proof of this, Faber, in his Archæologie der Hebräer, Halle, 1773, 8vo, p. 432, quotes Kelim, v. 1, and Maimonides and Bartenora, p. 36, Tamid, c. 50. Compare Othon. Lex Rabbin. p. 85.

[3] As it would be tedious to transcribe all these passages, I shall, as examples, give only the following:—

Dissolve frigus, ligna super foco
Large reponens.—Horat. lib. i. od. 9.

These lines show that the poet had an aversion to cold when enjoying his bottle, and that he wished for a good fire; but they do not inform us whether the hearth, *focus*, had a chimney. We learn as little from the advice of Cato, c. 143: "Focum purum circumversum quotidie, priusquam cubitum eat, habeat." It was certainly wholesome to rake the fire together at night, but it might have burned either with or without a chimney. Cicero, Epist. Famil. lib. vii. 10: "Valde metuo ne frigeas in hibernis; quam ob rem ca-

or more expressions may appear to allude to a chimney, and even if we should conclude from them, with Montfaucon, that the ancients were acquainted with the art of constructing in mason-work elevated funnels for conveying off the smoke, it must be allowed, when we consider the many proofs which we find to the contrary, that they were at any rate extremely rare. As they are so convenient and useful, and can be easily constructed upon most occasions, it is impossible, had they been well known, that they should have ever been forgotten. Montfaucon says, from *caminus* is derived *chiminea* of the Spaniards; *camino* of the Italians; *cheminée* of the French; and *kamin* of the Germans; and it seems, adds he, beyond a doubt, that the name, with the thing signified, has been transmitted to us from the ancients. Though this derivation be just, the conclusion drawn from it is false. The ancient name of a thing is often given to a new invention that performs the same service. The words *mill* and *moulin* came from *mola*;

mino luculento utendum censeo." Cicero perhaps understood under that term some well-known kind of stove which afforded a strong heat. Suetonius, in Vita Vitellii, cap. viii.: "Nec ante in Prætorium rediit, quam flagrante triclinio ex conceptu camini." As Vitellius was proclaimed emperor in January, a warm dining-room was certainly necessary. Du Cange in his Glossarium quotes the word *fumariolum* from the Paræneticum ad Pœnitentiam of the Spaniard Pacianus; but the latter takes the whole passage from Tertullian, who wrote more than a century before. Sidonius Apollin. lib. ii. epist. i.: "A cripto porticu in hyemale triclinium venitur, quod arcuatili camino sæpe ignis animatus pulla fuligine infecit." No one can determine with certainty the meaning of *arcuatilis caminus*. A covering made of a thin plate of metal, or a screen, was perhaps placed over a portable stove; we however learn, that even where the *arcuatilis caminus* was used, the beauty of the dining-room was destroyed by smoke and soot. Ammianus Marcell. lib. xxv. in the end of the life of Jovian: "Fertur recente calce cubiculi illiti ferre odorem noxium nequivisse, vel extuberato capite periisse succensione prunarum immensa." This in an apartment where there was a stove or a chimney would have been impossible.

The passage of Athenæus, lib. xii. p. 519, which speaks of πύελοι, will admit of various explanations. Dalechamp thinks that they were the *poëles* of the French (something like our stoves). Casaubon says they were bathing-tubs. This opinion is in some measure confirmed by Suidas, who gives that meaning to πύελος; and by Jul. Pollux, in whom it occurs in the same sense more than once. Lipsius however rejects these explanations, and considers πύελοι to have been *thecæ*, or vessels similar to those which in low German are called *riken*, and which, instead of our stoves, are much used in Holland by the women, who seldom approach the chimney.

and yet our mills were unknown to the ancients. Guys relates, that a Greek woman, seeing an European lady covered with a warm cloak, said, "That woman carries her *tennor* about with her."

Besides the methods already mentioned, of warming apartments, the ancients had another still more ingenious, which was invented and introduced about the time of Seneca[1]. A large stove or several smaller ones were constructed in the earth under the edifice; and these being filled with burning coals, the heat was conveyed from them into dining-rooms, bed-chambers, or other apartments which one wished to warm[2] by means of pipes inclosed in the walls. The upper end of these hot-air pipes was often ornamented with the representation of a lion's or a dolphin's head, or any other figure according to fancy, and could be opened or shut at pleasure. It appears that this apparatus was first constructed in the baths, and became extended afterwards to common use. These pipes sometimes were conducted around the whole edifice[3], as I have seen in our theatres. Palladius advises a branch of such pipes to be conveyed under the floor of an oil-cellar, in order that it may be heated without contracting soot[4]. Such a mode of warming apartments, which approaches very near to that employed in our German stoves, would have been impossible, had the houses been without windows; and it is worthy of remark, that transparent windows, at the time Seneca lived, were entirely new. These pipes, like those of our stoves, could not fail in the course of time to become filled with soot; and as they were likely to catch fire by being overheated, laws were made forbidding them to be brought too near to the wall of a neighbouring house[5], though there were other reasons also for this regulation. As what is here said will be better elucidated by a description of the still existing ruins of some ancient baths, I shall transcribe the following passage from Winkelmann:—

"Of chimneys in apartments," says this author, "no traces are to be seen. Charcoal was found in some of the rooms in the city of Herculaneum, from which we may conclude that the inhabitants used only charcoal fires for warming themselves. In the houses of the common citizens at Naples, there are no

[1] Seneca, ep. 90. [2] Senec. De Provident. p. 138. Cicero ad Fratrem, lib. iii. ep. i. Plin. lib. ii. ep. 17. [3] Statii Sylv. lib. i. 5, 17. [4] Pallad. De Re Rust. lib. i. 20, p. 876. [5] Digestor. lib. viii. tit. 2, 13.

chimneys at present; and people of rank there as well as at Rome, who strictly adhere to the rules laid down by physicians for preserving health, live in apartments without chimneys, and which are never heated by coal-fires. In the villas, however, which were situated without Rome, on eminences where the air was purer and colder, the ancients had *hypocausta* or stoves, which were more common perhaps than in the city. Stoves were found in the apartments of a ruined villa, when the ground was dug up to form a foundation for the buildings erected there at present. Below these apartments there were subterraneous chambers, about the height of a table, two and two under each apartment, and close on all sides. The flat top of these chambers consisted of very large tiles, and was supported by two pillars, which, as well as the tiles, were joined together, not with lime but some kind of cement, that they might not be separated by the heat. In the roofs of these chambers there were square pipes made of clay, which hung half-way down into each, and the mouths of them were conveyed into the apartment above. Pipes of the like kind, built into the wall of this lower apartment, rose into another in the second story, where their mouths were ornamented with the figure of a lion's head, formed of burned clay. A narrow passage, of about two feet in breadth, conducted to the subterranean chambers, into which coals were thrown through a square hole, and the heat was conveyed from them by means of the before-mentioned pipes into the apartment immediately above, the floor of which was composed of coarse mosaic-work, and the walls were incrusted with marble. This was the sweating-apartment (*sudatorium*). The heat of this apartment was conveyed into that on the second story by the clay pipes enclosed in the wall, which had mouths opening into the former, as well as the latter, to collect and afford a passage to the heat, which was moderated in the upper apartment, and could be increased or lessened at pleasure." Such a complex apparatus would have been unnecessary had the Romans been acquainted with our stoves[1].

[1] A passage from And. Baccii Liber de thermis, fol. p. 263, contains information much of the same kind. See also Robortelli Laconici seu sudationis, explicatio, in Grævii Thes. Antiq. Rom. xii. p. 385. Vitruvius, cum annotat. G. Philandri, Lugd. 1586, 4to, p. 279. Philander says that the ancients conveyed from subterranean stoves, into the apartments above, the steam of boiling water; but of this I have found no proof. If this be true, the Roman baths must have been like the Russian sweating-baths. [Many

I have, as yet, made no mention of a passage of the emperor Julian, which is too remarkable to be entirely omitted; though, at the same time, it is so corrupted that little can be collected from it[1]. Julian relates, that during his residence at Paris the winter was uncommonly severe; but that he would not allow the house in which he lived to be heated, though it had the same apparatus for that purpose as the other houses of the city. His reason for this was, that he wished to inure himself to the climate; and he was apprehensive also, that the walls by being heated might become moist and throw out a damp vapour. He suffered, therefore, burning coals only to be brought into his apartment, which, however, occasioned pains in his head, and other disagreeable symptoms. What apparatus the houses of Paris then had for producing heat, no one can conjecture from the passage alluded to. In my opinion, they were furnished with the above-described subterranean stoves: but even if these should not be here meant, I cannot help thinking that the emperor's relation confirms that they had not chimneys like ours; for, had the case been otherwise, the cautious prince would not have exposed himself to the vapour of charcoal, the noxious quality and effects of which could not be unknown to him.

Though the great antiquity of chimneys is not disputed, too little information has been collected to enable us to determine, with any degree of certainty, the period when they first came into use. If it be true, as Du Cange, Vossius, and others affirm, that apartments called *caminatæ* were apartments with chimneys, these must, indeed, be very old; for that word occurs as early as the year 1069, and perhaps earlier[2]; but it is always found connected in such a manner as contradicts entirely the above signification. Papias the grammarian, who wrote about 1051, explains the word *fumarium* by *caminus per quem exit fumus*; and Johannes de Janua, a monk, who about 1268 wrote his Catholicon, printed at Venice, says "Epicaustorium, instrumentum quod fit super ignem caussa emittendi

of the large establishments and work-shops in this country are now heated by means of hot air, hot water, or steam circulating through a ramified system of pipes.]

[1] Juliani op. Lips. 1696, fol. p. 341.

[2] Zanetti, p. 78, quotes a charter of that year, in which the following words occur: "Cum tota sua cella et domo, et caminatis cum suo solario, et alüs caminatis."

fumum." But these *fumaria* and *epicaustoria* may have been pipes by which the smoke, as is the case in our vent-furnaces, was conveyed through the nearest wall or window: at any rate, this expression, with its explanations, can afford no certain proof that chimneys are so old[1]; especially as later writers give us reason to believe the contrary. Riccobaldus de Ferrara[2], Galvano Fiamma or Flamma, a Dominican monk from Milan[3], who died in 1344 professor at Pavia, and Giovanni de Mussis, who about 1388 wrote his Chronicon Placentinum[4], and all the writers of the fourteenth century, seem either to have been unacquainted with chimneys, or to have considered them as the newest invention of luxury.

That there were no chimneys in the tenth, twelfth, and thirteenth centuries, seems to be proved by the so-called *ignitegium*, or *pyritegium*, the curfew-bell of the English, and *couvre-feu* of the French. In the middle ages, as they are termed, people made fires in their houses in a hole or pit in the centre of the floor, under an opening formed in the roof; and when the fire was burnt out, or the family went to bed at night, the hole was shut by a cover of wood. In those periods a law was almost everywhere established, that the fire should be extinguished at a certain time in the evening; that the cover should be put over the fire-place; and that all the family should retire to rest, or at least be at home[5]. The time when this ought to be done was signified by the ringing of a bell. William the Conqueror introduced this law into England in the year 1068, and fixed the *ignitegium* at seven in the evening, in order to prevent nocturnal assemblies[6]; but this law was abolished by Henry I., in 1100. From this ancient practice has arisen, in my opinion, a custom in Lower Saxony of saying, when people wish to go home sooner than the com-

[1] Such is the opinion of Muratori, Antiq. Ital. Med. Æv. ii. p. 418.
[2] In Muratori, Script. Ital. vol. ix. [3] Ibid.
[4] Ibid, vol. xvi. p. 582. [5] Reiske ad Ceremon. aulæ Byzant. p. 145.
[6] The following passages of old writers, collected by Du Cange, allude to this law. Statuta Leichefeldensis ecclesiæ in Anglia: "Est autem ignitegium qualibet nocte per annum pulsandum hora septima post meridiem." Statuta Massil. lib. v. cap. 4: "Statuimus hac præsenti constitutione perpetuo observandum, quod nullus de cætero vadat per civitatem Massiliæ vel suburbia civitatis contigua de nocte, ex quo campana, quæ dicitur Salvaterra, sonata fuerit, sine lumine." Charta Johannis electi archiepisc. Upsaliensis, an. 1291: "Statuimus, ut nullus extra domum post ignitegium seu coverfu exeat."

pany choose, that they hear the *Bürgerglocke*, burghers' bell. The ringing of the curfew-bell gave rise also to the prayer-bell, as it was called, which has still been retained in some protestant countries. Pope John XXIII., with a view to avert certain apprehended misfortunes, which rendered his life uncomfortable, gave orders that every person, on hearing the *ignitegium*, should repeat the *Ave Maria* three times[1]. When the appearance of a comet and a dread of the Turks afterwards alarmed all Christendom, Pope Calixtus III. increased these periodical times of prayer by ordering the prayer-bell to be rung also at noon[2].

The oldest certain account of chimneys with which I am acquainted, occurs in the year 1347; for an inscription which is still existing or did exist at Venice, relates that at the above period a great many chimneys (*molti camini*) were thrown down by an earthquake[3]. This circumstance is confirmed by John Villani, the historian, who died at Florence in 1348, and who calls the chimneys *fumajuoli*[4]. Galeazzo Gataro, who in the Dictionary of Learned Men is named De Gataris, and who died of the plague in 1405, says in his History of Padua, which was afterwards improved and published by his son Andrew, that Francesco da Carraro, lord of Padua, came to Rome in the year 1368, and finding no chimneys in the hotel where he lodged, because at that time fire was kindled in a hole in the middle of the floor, he caused two chimneys, like those which had been long used at Padua, to be constructed, and arched by masons and carpenters whom he had brought along with him. Over these chimneys, the first ever seen at Rome, he affixed his arms, which were still remaining in the time of Gataro[5].

While chimneys continued to be built in so simple a manner, and of such a width as they are still observed to be in old houses, they were so easily cleaned that this service could be performed by a servant with a wisp of straw, or a little brush-wood fastened to a rope; but after the flues, in order to save

[1] Pol. Vergil. De Rer. Invent. lib. vi. c. 12. Lugd. 1664, 12mo, p. 460.
[2] The year is probably 1457; Calixtus was elected to the papal chair in 1455. [3] Dell' origine di alcune arti principali appresso i Veneziani. Venezia, 1758, 4to, p. 80. [4] Historie Fiorentine, lib. xii. cap. 121.
[5] This Chronicon Patavinum may be found in Muratori, Scriptor. Rerum Ital. vol. xvii.

room, were made narrower, or when several flues were united together, the cleaning of them became so difficult, that they required boys, or people of small size, accustomed to that employment. The first chimney-sweepers in Germany came from Savoy, Piedmont, and the neighbouring territories[1]. These for a long time were the only countries where the cleaning of chimneys was followed as a trade; and I am thence inclined to conjecture that chimneys were invented in Italy[2], rather than that the Savoyards learned the art of climbing from the marmots or mountain-rats, as some have asserted[3]. These needy but industrious people chose and appropriated to themselves, perhaps, this occupation, because they could find no other so profitable. The Lotharingians, however, undertook this business also, and on that account the duke of Lotharingia was styled the Imperial Fire-master. The first Germans who condescended to clean chimneys appear to have been miners; and our chimney-sweepers still procure boys from the Hartz forest, who may be easily discovered by their language. The greater part of the chimney-sweepers (*ramoneurs de cheminées*) in Paris, at present, are Savoyards; and one may see there everywhere in the streets large groups of their boys[4], many of whom are not above eight years of age, and who, clad in linen frocks, will, when called upon, scramble up at the hazard of their lives, with their besoms and other instruments, through a narrow funnel often fifty feet in length, filled with soot and smoke, and in which they cannot breathe till they arrive at the top, in order to gain five sous; and even of this small pittance they are obliged to pay a part to their avaricious masters[5].

[1] Gazoni Piazze Universale, Venet. 1610, 4to, p. 364.

[2] A writer in the German Encyclopedie conjectures that the Italian architects employed in Germany to build houses and palaces of stone, brought with them people acquainted with the art of constructing larger and more commodious chimneys than those commonly used.

[3] Dictionnaire des Arts et des Métiers, par Jaubert, vol. iv. p. 534.

[4] ..... Ces honnêtes enfans
Qui de Savoye arrivent tous les ans,
Et dont la main légèrement essuye
Ces longs canaux, engorgés par la suie.—VOLTAIRE.

[5] "C'est ainsi que se ramonent toutes les cheminées de Paris; et des régisseurs n'ont enrégimenté ces petits malheureux, que pour gagner encore sur leur médiocre salaire. Puissent ces ineptes et barbares entrepreneurs se ruiner de fond en comble; ainsi que tous ceux qui ont sollicité des pri-

HUNGARY WATER.

HUNGARY WATER is spirit of wine distilled upon rosemary, and which therefore contains the essential oil and powerful aroma of that plant. To be really good the spirit of wine ought to be very strong and the rosemary fresh; and if that be the case, the leaves are as proper as the flowers, which according to the prescription of some should only be employed. It is likewise necessary that the spirit of wine be distilled several times over the rosemary; but that process is too troublesome and expensive to admit of this water being disposed of at the low price for which it is usually sold; and it is certain that the greater part of it is nothing else than common spirit, united with the essence of rosemary in the simplest manner. In general, it is only mixed with a few drops of the oil. For a long time past this article has been brought to us principally from France, where it is prepared, particularly at Beaucaire, Montpelier, and other places in Languedoc, where that plant grows in great abundance.

The name, *l'eau de la reine d'Hongrie*, seems to signify that this water, so celebrated for its medicinal virtues, is an Hungarian invention; and we read in many books that the receipt for preparing it was given to a queen of Hungary by a hermit, or as others say, by an angel, who appeared to her in a garden all entrance to which was shut, in the form of a hermit or a youth[1]. Some call the queen St. Isabella[2]; but those who pretend to be best acquainted with the circumstance affirm that Elizabeth wife of Charles Robert king of Hungary, and daughter of Uladislaus II. king of Poland, who died in 1380 or 1381, was the inventress. By often washing with this spirit of rosemary, when in the seventieth year of her age, she was cured, as we are told, of the gout and an

vileges exclusifs!"—Tableau de Paris. Hamburg, 1781, tom. ii. p. 249. [Owing to many serious accidents which attended the climbing of chimneys, this practice was put down in this country by Act of Parliament, (3 & 4 Victoria, c. 85. sec. 2.). The use of machinery is now substituted, but does not perform the operation so effectively as the old mode, especially where the flues are in angles.]

[1] Universal Lexicon, vol. xlix. p. 1340.

[2] Traité de la Chemie, par N. le Febure. Leyde, 1669, 2 vols. 12mo, i. p. 474.

universal lameness; so that she not only lived to pass eighty, but became so lively and beautiful that she was courted by the king of Poland, who was then a widower, and who wished to make her his second wife.

John George Hoyer[1] says that the receipt for preparing this water, written by queen Elizabeth's own hand, in golden characters, is still preserved in the Imperial library at Vienna. But it has been already remarked by others[2] that Hoyer is mistaken, and that he does not properly remember the account given of the receipt. It is to be found for the first time, as far as I know, in a small book by John Prevot, which, after his death in 1631, was published by his two sons at Frankfort in 1659[3].

[1] In his notes to Blumentrost's Haus und Reise-apotheke. Leipzig, 1716, 8vo, cap. 16, p. 47.

[2] Succincta Medicorum Hungariæ et Transilvaniæ Biographia, ex adversariis St. Wespremi. Wien. 1778, 8vo, p. 213.

[3] Selectiora remedia multiplici usu comprobata, quæ inter secreta medica jure recenseas. In page 6 the following passage occurs: "For the gout in the hands and the feet. As the wonderful virtue of the remedy given below has been confirmed to me by the cases of many, I shall relate by what good fortune I happened to meet with it. In the year 1606 I saw among the books of Francis Podacather, of a noble Cyprian family, with whom I was extremely intimate, a very old breviary, which he held in high veneration, because, he said, it had been presented by St. Elizabeth, queen of Hungary, to some of his ancestors, as a testimony of the friendship which subsisted between them. In the beginning of this book he showed me a remedy for the gout written by the queen's own hand, in the following words, which I copied:—

"'I Elizabeth, queen of Hungary, being very infirm and much troubled with the gout in the seventy-second year of my age, used for a year this receipt given to me by an ancient hermit whom I never saw before nor since; and was not only cured, but recovered my strength, and appeared to all so remarkably beautiful, that the king of Poland asked me in marriage, he being a widower and I a widow. I however refused him for the love of my Lord Jesus Christ, from one of whose angels I believe I received the remedy. The receipt is as follows:

"'℞. Take of aqua vitæ, four times distilled, three parts, and of the tops and flowers of rosemary two parts: put these together in a close vessel, let them stand in a gentle heat fifty hours, and then distil them. Take one dram of this in the morning once every week, either in your food or drink, and let your face and the diseased limb be washed with it every morning.

"'It renovates the strength, brightens the spirits, purifies the marrow and nerves, restores and preserves the sight, and prolongs life.' Thus far from the Breviary."—Then follows a confirmation which Prevot gives from his own experience.

One may easily see that Prevot mistook this Elizabeth for St. Elizabeth, the daughter of king Andrew II., who was never queen of Hungary, but died wife of a landgrave of Thuringia in 1235. But respecting Elizabeth, the wife of king Charles Robert, we know from the information of Hungarian writers [1], that in her will she really did mention two breviaries, one of which she bequeathed to her daughter-in-law, and the other to one Clara von Pukur, with this stipulation, however, that after her death it should belong to a monastery at Buda. It is not impossible, therefore, that one of these books may have come into the hands of Podacather's ancestors.

I must however confess, that respecting this pretended invention of the Hungarian queen I have doubts; it may be readily conjectured that this Elizabeth must have been extremely vain; but when she wished to make posterity believe that in the seventieth, or seventy-second year of her age she became so sound and so beautiful that a king, at that time a widower, grew enamoured of her, we may justly conclude that she was more than vain—that she was perhaps childish. I have taken the trouble to search for the king, then a widower, who paid his addresses to Elizabeth, but my labour has proved fruitless. This proposal of marriage must have been made about the year 1370; but Casimir III., brother of the Hungarian Elizabeth, reigned in Poland till that year, and was succeeded by her son Louis, who died after her in 1382; and the throne then remained vacant for three years.

It is rather singular that the name of aqua-vitæ, and the practice of distilling spirit of wine upon aromatic herbs, should be known in Hungary so early as the fourteenth century, though I will not pretend to affirm the contrary. But I consider it as more remarkable that the botanists of the seventeenth century should have spoken of and extolled the various properties of rosemary without mentioning Hungary water. It cannot however be denied, that in the sixteenth century, long before Prevot, Zapata [2], an Italian physician, taught the

[1] Medicorum Hungariæ Biographia, *ut supra*, p. 214.

[2] The book of Zapata, who is not noticed in the Gelehrten Lexicon, was printed at Rome, as Haller says in his Biblioth. Botan. vol. i. p. 368, in the year 1586; and other editions are mentioned in Boerhavii Methodus Studii Medici, p. 728 and 869. I have now before me, Joh. Bapt. Zapatæ, Medici Romani, Mirabilia seu Secreta Medico-chirurgica—per Davidem Spleissium. Ulmiæ, 1696. The passage above alluded to occurs in page 49.

method of preparing rosemary-water: and he has even told us that it was known, though imperfectly, to Arnoldus de Villa Nova; but he does not say that it was an Hungarian invention. It appears to me most probable, at present, that the name *l'eau de la reine d'Hongrie*, was chosen by those who in later times prepared rosemary-water for sale, in order to give greater consequence and credit to their commodity; as various medicines, some years ago, were extolled in the gazettes under the title of Pompadour, though the celebrated lady from whose name they derived their importance, certainly neither ever saw them nor used them.

CORK.

Those who are accustomed to value things used in common life only according to the price for which they can be purchased, will perhaps imagine that my subject must be nearly exhausted when I think it worth my while to entertain my readers with a matter so inconsiderable. Cork, however, is a substance of such a singular property, that no other has yet been found which can be so generally employed with the same advantage; and before the use of it was known, people were obliged on many occasions to supply the want of it by means which to us would appear extremely troublesome.

Cork is a body remarkably light, can be easily compressed, expands again by its elasticity as soon as the compressing power is removed, and therefore fills or stops up very closely that space into which it has been driven by force. It may be easily cut into all forms; and though it abounds with pores, which are the cause of its lightness, it suffers neither water, beer, nor any common liquid to escape through it, and it is only very slowly and after a considerable length of time that it can be penetrated even by spirits. Its numerous pores seem to be too small to afford a passage to the finest particles of water and wine, which can with greater facility ooze through more compact wood that has larger or wider pores [1].

[1] What is here observed in regard to the pores of cork has been stated, in general, by Lucretius, vi. 5984.

Cork is the exterior bark of a tree, belonging to the genus of the oak, which grows wild in the southern parts of Europe, particularly France, Spain, Portugal and Italy[1]. When the tree is about twenty-six years old it is fit to be barked, and this can be done successively every eight years[2]. The bark always grows up again, and its quality improves with the increasing age of the tree. It is commonly singed a little over a strong fire or glowing coals, and laid to soak a certain time in water, after which it is placed under stones in order to be pressed straight.

This tree, as well as its use, was known to the Greeks and the Romans. By the former it was called *phellus*. Theophrastus reckons it among the oaks, and says that it has a thick fleshy bark, which must be stripped off every three years to prevent it from perishing. He adds, that it was so light as never to sink in water, and on that account could be used with great advantage for a variety of purposes[3]. The only circumstance which on the first consideration can excite any doubt of the *phellus* being our cork-tree, is, that he expressly says it lost its leaves annually, whereas our cork-tree retains them. In another passage however he calls it an evergreen[4]. This apparent contradiction several commentators have endeavoured to clear up, but their labour seems unnecessary; for there is a species of our cork-tree which really drops its leaves. Linnæus did not think this species worth his notice; but it has been accurately observed by Clusius and Matthiolus[5],

[1] Duhamel, Traité des Arbres et Arbustes, Tozzetti, Viaggi, iv. p. 278.

[2] [In MacCulloch's Dictionary the word *every* is changed into *for*, and the author then proceeds to observe, that "This erroneous statement having been copied into the article Cork in Rees' Cyclopædia, has thence been transplanted into a number of other works!" The mistake, however, is wrongly attributed to Beckmann.]

[3] Histor. Plantar. lib. iii. cap. 16. He repeats the same thing lib. iv. cap. 18, where he remarks as an exception, that the cork-tree does not die after it has lost its bark, but becomes more vigorous. In the southern parts of France the cork-trees are barked every eight, nine or ten years.

[4] Lib. iii. cap. 4. This difficulty the commentators have endeavoured to remove by reading here φελλόδρυς instead of the two words φελλὸς and δρῦς which are separated; and indeed φελλόδρυς occurs in other parts of the same work among the evergreens, lib. i. cap. 15.

[5] Clusius in Rar. Plantar. Histor. lib. i. cap. 14, describes this tree as he found it without leaves in the month of April in the Pyrenees near Bayonne. Theophrastus, p. 234, says, "The cork-tree, φελλὸς, which drops its leaves γίνεται ἐν Τυρρηνίᾳ:" but the Aldine manuscript and that of Basle

and its existence is confirmed by Miller [1]. As Theophrastus [2], Pliny [3], Varro [4] and others mention a common oak which always retains its leaves, it appears clear to me that the first-mentioned author, where he speaks of evergreens, meant our common species of the cork-tree, and that extraordinary kind of oak; but in the other passage that species which drops its leaves in winter.

That the *suber* of the Romans was our cork-tree, is generally and with justice admitted. Pliny relates of it, in the clearest manner, every thing said by Theophrastus [5] of the *phellus* [6]; and we find by his account, that cork at the period when he wrote was applied to as many purposes as at present [7].

have Πυῤῥηνίᾳ. The latter reading is condemned by Robert Constant. and others: but though the cork-tree is indeed indigenous in Tyrrhenia or Etruria, I see no reason why Πυῤῥηνίᾳ should not be retained, as it is equally certain that the tree grows in the Pyrenees, and that it there loses its leaves according to the observation of Clusius. If, on the other hand, we read Τυῤῥηνίᾳ, this is opposed by the experience of Theophrastus; for in Italy, as well as in France and Spain, the tree keeps its leaves the whole winter through. Stapel therefore has preferred the word Πυῤῥηνίᾳ. Labat, who saw the tree both in the Pyrenees and in Italy, says that in the former it drops its leaves in winter, and in the latter preserves them. According to Jaussin (Mémoires sur les évènemens, arrivés dans l'Isle de Corse. Lausanne, 1759, 8vo, ii. p. 398) it is in Corsica an evergreen; and Carter (Reise von Gibraltar nach Malaga, Leipsic, 1799, 8vo, p. 196) says that the case is the same in Spain, but he expressly adds that beyond the Alps it loses its leaves in autumn.

[1] In his Gardener's Dictionary. Bauhin, in his Pinax, p. 424, mentions this species particularly. [2] Hist. Plant. lib. i. cap. 15.

[3] Lib. xvi. cap. 21. [4] De Re Rustica, i. cap. 7. [5] Lib. xvi. cap. 8.

[6] The botanists of the seventeenth century, who paid more attention to the names of the ancients than those of the present time, say that the cork-tree is in Greek called also ἴψος, or ἰψὸς, which word is not to be found in Ernesti's dictionary. I have found it only once in Theophrastus, Histor. Plantar. lib. iii. cap. 6, where those plants are named which blow late. Because Pliny, lib. xvi. cap. 25, says tardissimo germine suber; ἰψὸς is considered to be the same as φελλός. Hesychius however says that ἰψὸς in some authors signifies ivy.

[7] Our German word *Kork*, as well as the substance itself, came to us from Spain, where the latter is called *chorcha de alcornoque*. It is, without doubt, originally derived from *cortex* of the Latins, who gave that appellation to cork without any addition. Horace says, Od. iii. 9, "Tu levior cortice;" and Pliny tells us, "Non infacete Græci (suberem) corticis arborem appellant." These last words are quoted by C. Stephanus in his Prædium Rusticum, p. 578, and Rnellius De Natura Stirpium, p. 174, and again p. 256, as if the Greeks called the women, on account of their cork soles, of which I shall speak hereafter, *cortices arborum*. This gives me reason

At that time fishermen made floats to their nets of cork, that is, they affixed pieces of cork to the rope which formed the upper edge of the net, and which it was necessary should be kept at the surface of the water, in the same manner as is done at present [1]. The use of cork for fishing-nets is mentioned by Ausonius [2]; and Alciphron describes so abundant a capture that the net and the cork floats sunk by the weight. This use, however, was much limited by the high price of cork; and small boards of light wood, such as that of the pine, aspen-tree, lime-tree, and poplar, were employed in its stead [3]. The wood of the *Marum arborescens* is used as floats in Guiana, and that of the *Hibiscus cuspidatus* in Otaheite [4]. The German and Swedish fishermen, and also the Cossacks, use for the same purpose the bark of the black poplar; but the Dutch and Hanoverians, who fish on the Weser, employ for their nets a kind of wood called in Holland *toll-hout.* It is a wood of a reddish-brown colour, extremely light, and of a very fine grain, which the Dutch, who export it to Germany, procure from the Baltic. At Amsterdam it costs a stiver per pound; but I have not yet been able to learn what wood it properly is.

Another use to which cork was applied, according to Pliny, was for anchor-buoys. "Usus ejus ancoralibus maxime navium." These words Hardouin has not explained; and Scheffer [5], where he speaks of anchors, and what belongs to them, takes no notice of cork. Gesner, however, has attempted an explanation [6], but what he says is, in my opinion, not satisfactory. He certainly could not mean that it was employed to render anchors lighter. According to my idea, they may be easily made light enough without cork, and perhaps they can never be made too heavy. The true explanation of this passage is, that it was used for making buoys, called *ancoralia*, which

to conjecture a different reading in Pliny, and indeed I find in the same edition already quoted, the words *cortices arborum.* This variation ought to have been remarked by Hardouin.

[1] Plin. p. 7. [2] Mosella, 246.

[3] Linnæi Flora Suec. p. 358. Gmelin's Reise durch Russland, i. p. 138. It is a mistake in Duroi, Harbkescher Baumzucht, ii. p. 141, that ropes for fishng-nets are prepared from this bark.

[4] Parkinson's Voyage to the South Seas, 1773, 4to.

[5] De Militia Navali Veterum. Upsaliæ, 1654, 4to, lib. ii. cap. 5.

[6] In Stephens's Thesaurus he says, "Usus ancoralibus navium; int. sustinendis, et minuendo pondere ancorarum."

were fixed to the cable, and by floating on the surface of the water, over the anchor, pointed out the place where it lay [1]. Our navigators use for that purpose a large but light block of wood, which, in order that it may float better, is often made hollow [2]. A large cask also is sometimes employed. The Dutch sailors call these blocks of wood *boei* or *boeye*; and hence comes their proverb, "Hy heeft een kop als een boei," he has a head like a buoy; he is a blockhead.

A third use of cork among the Romans was its being made into soles, which were put into their shoes in order to secure the feet from water, especially in winter; and as high heels were not then introduced, the ladies who wished to appear taller than they had been formed by nature, put plenty of cork under them [3].

The practice of employing cork for making jackets to assist one in swimming, is also very old; for we are informed that the Roman whom Camillus sent to the Capitol when besieged by the Gauls, put on a light dress, and took cork with him under it, because, to avoid being taken by the enemy, it was necessary that he should swim through the Tiber. When he arrived at the river, he bound his clothes upon his head, and, placing the cork under him, was so fortunate as to succeed in his attempt [4].

The most extensive and principal use of cork at present, is for stoppers to bottles. This was not entirely unknown to the Romans, for Pliny says expressly, that it served to stop vessels of every kind; and instances of its being employed for that purpose may be seen in Cato [5] and Horace [6]. Its application to this use, however, seems not to have been very common, else cork-stoppers would have been oftener mentioned by the

[1] Pausanias, viii. 12, p. 623, where he speaks of the different kinds of oak in Arcadia. When any one had the misfortune to fall into the sea, the cork affixed to the anchor, *ancoralia*, was thrown overboard, in order that the person in danger might catch hold of it. This we learn from the account of Lucian (Epist. i. 1, p. 7), when two men, one of whom had fallen into the sea and another who jumped after him to afford him assistance, were both saved by these means.

[2] And to conceal contraband goods in them, of which I have seen instances during my travels.

[3] Xenophon De Tuenda Re Famil. and Clemens Alexand. lib. iii. Pæda.

[4] Plutarchus in Vita Camilli.

[5] De Re Rustica, cap. 120.

[6] Lib. iii. od. 8, 10.

authors who have written on agriculture and cookery, and also in the works of the ancient poets. We everywhere find directions given to close up wine-casks and other vessels with pitch [1], clay, gypsum or potters-earth, or to fill the upper part of the vessel with oil or honey, in order to exclude the air from those liquors which one wished to preserve [2]. In the passages therefore already quoted, where cork is named, mention is made also of pitching. The reason of this I believe to be, that the ancients used for their wine large earthen vessels with wide mouths, which could not be stopped sufficiently close by means of cork. Wooden casks were then unknown, or at least scarce, as Italy produced little timber, otherwise these vessels would have been stopped with wood, as is the case at present. The practice of drawing off wine for daily consumption, from the large vessels into which it is first put, into such smaller vessels as can be easily corked, was then not prevalent [3]. The ancients drew off from their large jars into cups or pitchers whatever quantity of wine they thought necessary for the time, instead of which the moderns use bottles. It appears to have been customary at the French court, about the year 1258, when grand entertainments were given, and more wine-vessels had been opened than were emptied, that the remainder became a perquisite of the *grand-bouteiller* [4].

[1] Before cork came to be used for this purpose pitching was more necessary, and therefore mention of pitch occurs so often in the Roman writers on agriculture. When the farmer, says Virgil (Georg. i. 275), has brought his productions to the city, he carries back articles of every kind, such, for example, as pitch. On such occasions our poets would have mentioned articles entirely different. Strabo (lib. v. p. 334) also extols Italy, because together with wine it had a sufficiency of pitch, so that the price of wine was not rendered dearer.

[2] As proofs of this may everywhere be found, it is hardly worth while to quote them. Columella, xii. 12, teaches the manner of preparing cement for stopping up wine-casks. The earthen wine-jars found at Pompeii appear to have had oil poured over them, and to have had no other care bestowed upon them. In Italy, even at present, large flasks have no stoppers, but are filled up with oil.

[3] Alexand. ab Alex. Dier. Gen. v. 21, p. 302. When the Romans went out to the chase, they carried with them some wine in a laguncula.—Plin. Epist. i. 6. p. 22. I do not know however that these flasks were of glass; all those I have seen were made of clay or wood. See Pompa De Instrum. Fundi, cap. 17, in the end of Gesner's edition of Scriptores Rei Rust. ii. p. 1187.

[4] Le Grand d'Aussy, Histoire de la Vie Privée des François, ii. p. 367.

Stoppers of cork seem to have been first introduced after the invention of glass-bottles, and of these I find no mention before the fifteenth century; for the *amphoræ vitreæ diligenter gypsatæ* of Petronius [1], to the necks of which were affixed labels, containing the name and age of the wine, appear to have been large jars, and to have formed part of the many uncommon articles by which the voluptuary Trimalchio wished to distinguish himself. It is however singular, that these convenient vessels were not thought of at an earlier period, especially as among the small funeral urns of the ancients, many are to be found which in shape resemble our bottles [2]. In the figure of the Syracusan wine-flasks, I think I can discover their origin from these urns. Charpentier [3] quotes from a writing of the year 1387, an expression which seems to allude to one of our glass bottles; but, when attentively considered, it may be easily discovered that cups or drinking-glasses are meant. The name *boutiaux* or *boutilles*, occurs in the French language for the first time in the fifteenth century; but were it even older it would prove nothing, as it signified originally, and even still signifies, vessels of clay or metal, and particularly of leather [4]. Such vessels filled with wine, which travellers were accustomed to suspend from their saddles, could be stopped with a piece of wood, or closed by means of wooden or metal tops screwed on them, which are still used for earthen-pitchers. In the year 1553, when C. Stephanus wrote his Prædium Rusticum, cork stoppers must have been very little known, else he would not have said that in his time cork in France was used principally for soles (p. 578). In the time of Lottichius, rich people however had glass flasks with tin mouths, which could be stopped sufficiently close without cork; and these flasks

[1] Petron. Sat. cap. xxxiv. p. 86. In the paintings of Herculaneum I find many wide-mouthed pitchers, with handles, like decanters, but no figure that resembles our flasks.

[2] Aringhi Roma Subterranea. Romæ, 1651. fol. i. p. 502, where may be seen an account of a flask with a round body and a very long neck.

[3] Glossarium Novum, i. p. 1182: "le dit Jaquet print un conouffle de voirre, ou il avoit du vin. . . . .et de fait en but."

[4] Grand d'Aussy quotes from Chronique Scandaleuse de Louis XI. "Des bouteilles de cuyr." That word however is of German extraction, though we have received it back from the French somewhat changed, like many other German things. It is evidently derived from *butte, botte, buta, buticula, buticella,* which occur in the middle ages. See C. G. Schwarzii Exercitat. de Butulariis. Altorfii, 1723, 4to, p. 5.

appear to have been as thin as the Syracusan wine-bottles; for he adds, that it was necessary to wrap them round with rushes or straw [1].

Flasks covered with basket-work must have been common among the Greeks, if it be certain that *πυτίνη* signifies a flask of this kind. It appears indeed to do so, because Hesychius says it was a plaited wine-vessel, like the baskets which prisoners were accustomed to make. Suidas, however, states that it was a vessel woven of twigs, named in his time *φλασκεῖον*, from which is derived our word *flask*. It is probable that these wine-vessels covered with basket-work were only of earthenware, as glass ones were at that time costly and scarce. But I do not think it can be proved that a flask of this kind was called by the Romans *tinia*.

In the shops of the apothecaries in Germany, cork stoppers began first to be used about the end of the seventeenth century. Before that period they used stoppers of wax, which were not only much more expensive, but also far more troublesome.

That the use of cork for stoppers was not known in the sixteenth century may be proved from this circumstance, that it is mentioned neither by Ruellius [2] nor Aldrovandi [3], though they describe all the other purposes to which this substance was applied. How great the consumption of it is at present, will appear from the quantity used by the directors of the springs at Niederselters alone; who in the year 1781 employed 2,208,000 stoppers, each thousand of which cost four florins, making a total of 8832 florins. They were furnished by a merchant at Strasburg, who was obliged to take back the refuse, which he then caused to be cut on his own account into smaller stoppers, and many of these could be used by the people at the springs. The experiment also was once made of causing the corks to be cut on account of the directors of the springs; but the carriage of the refuse became too dear, and there was no sale for the stoppers of the apothecary phials which were made of them.

In later times, some other vegetable productions have been found which can be employed instead of cork for the last-mentioned purpose. Among these is the wood of a tree common in South America, particularly in moist places, which is

[1] See his Observations on Petronius, p. 259.
[2] De Natura Stirpium, p. 256. [3] Dendrologia, p. 194.

called there *monbin* or *monbain*, and by botanists *Spondias lutea*. This wood was brought to England in great abundance for that use. The spongy root of a North American tree, known by the name of *nyssa*, is also used for the same end, as are the roots of liquorice, which on that account is much cultivated in Sclavonia, and exported to other countries, and likewise the black poplar, for its bark is employed by the Cossacks [1] as stoppers to their flasks, and the *Æschynomene lagenaria*, which is used instead of cork in Cochin-China [2].

[That most useful substance, caoutchouc, now replaces cork for numerous purposes, and is superior to it in almost every respect, especially in its greater elasticity, in being subject to less injury from the action of many substances, and but slightly affected by moisture or dryness. It also keeps better, and is not much more expensive. The quantity of stoppers now manufactured by the Patent Caoutchouc Company is perfectly astonishing.]

APOTHECARIES.

The history of the materia medica is a subject fit to be undertaken only by physicians like Baldinger, Hensler, Mohsen [3], and Gruner, who to an intimate acquaintance with what belongs to their own profession, have united a knowledge of every other branch of science. By making this acknowledgment, I wish to guard against the imputation of vanity, which I might incur as attempting to encroach on the province of such learned men. That however is not the case. My intention is only to lay before the public what I have collected respecting this subject, because I have reason to flatter myself, that, however

[1] Gmelin's Reise durch Russland, i. p. 138. Pallas, Flora Russica, i. p. 66.

[2] Loureiro Flora Cochin-Chin. p. 447.

[3] Dr. Mohsen has already published a considerable part of what belongs to this subject in his Geschichte der Wissenschaften in der Mark Brandenburg, besonders der Arzneywissenschaft. Berlin, 1781, 4to, p. 372. Some information also respecting the history of apothecaries may be found in Thomassii Dissert. de Jure circa Pharmacopolia Civitatum, in his Dissertationes Academicæ, Halle, 1774, 4 vols. quarto.

trifling, it may be of some use until a complete history be obtained; and because I may have met with some scattered information, which, without my research, might have escaped the notice of abler writers. Whoever is acquainted with such labour, will at any rate allow that this is possible; and I hope the following essay towards a history of apothecaries will not prove unacceptable to my readers.

That the medicines prescribed by the Greek and Roman physicians for their patients were prepared by themselves is so well known, that I think it unnecessary to produce proofs with which no one can be unacquainted who has read Theophrastus, Hippocrates, and Galen. They caused those herbs, of which almost the whole materia medica then consisted, to be collected by others; and we have reason to believe that the gathering and selling of medicinal plants must have at an early period been converted into a distinct employment, especially as many of them being exotics, it was necessary to procure them from remote countries, which every physician had not an opportunity of visiting; and as some of them were applied to a variety of purposes, they were sought after by others as well as by medical practitioners. Several of them were employed in cookery and for seasoning different dishes; many in dyeing and painting, some of them as cosmetics, others for perfumes, some for ointments, which were much used in the numerous baths, and not a few of them may have been employed also in other arts and manufactures. It must have been very convenient for the physicians to purchase from these dealers in herbs, such articles as they had occasion to use; but it is probable, and can even be proved, that these people soon injured them in their profession, by encroaching on their business. In the course of time they acquired a knowledge of the healing virtues of their commodities, and of the preparation they required, which was then extremely simple: and many of them began to sell compounded medicines, and to boast of possessing secrets more beneficial to mankind. To these dealers in herbs belong the *pigmentarii*, *seplasiarii*, *pharmacopolæ*, *medicamentarii*, and others who were perhaps thus distinguished by separate names on account of some very trifling circumstances in which they differed, or by dealing in one particular article more than in another. Some of these names also may possibly have been used only at certain periods, or in some

places more than in others; and perhaps it would be fruitless labour to attempt to define their difference correctly. That the *pigmentarii* dealt in medicines is proved by the law which established a punishment for such as sold any one poison through mistake [1]. The herbs which Vegetius [2] prescribes for the diseases of cattle were to be bought from the *seplasiarii*; and that they sold also medicines ready prepared is proved by the reproach thrown out by Pliny against the physicians of his time, that instead of making up their medicines themselves as formerly, they purchased them from the *seplasiarii*, without so much as knowing of what they were composed [3]. That the *pharmacopolæ* carried on a like trade appears evident from their name; but people of judgement placed no confidence in them, and they were despised on account of their impudent boasting, and the extravagant praises they bestowed on their commodities [4]. The *medicamentarii* do not often occur, but we are given to understand by Pliny [5], that they followed an employment of the same nature; and it appears that they must have been very worthless, for in the Theodosian code, male and female poisoners are called *medicamentarii* and *medicamentariæ* [6].

It may be readily perceived that these herb-dealers had a greater resemblance to our grocers, druggists, or mountebanks, than to our apothecaries. It is well known that the word *apotheca* signified any kind of store, magazine, or warehouse, and that the proprietor or keeper of such a store was called *apothecarius* [7]. It would be a very great mistake, therefore, if in writings of the thirteenth and fourteenth century, where these expressions occur, we should understand under the latter apothecaries such as ours are at present [8]. At these periods,

[1] Digest. lib. xlviii. tit. 8, 3, 3. [2] De Mulomedic. iii. 2, 21, p. 1107.
[3] Plin. lib xxxiv. cap. 11. [4] Maximus Tyrius, Dissert. x. p. 121. Aulus Gellius, lib. i. cap. 15. [5] Lib. xix. cap. 6. [6] Cod. Theodos. iii. tit. 16.
[7] Proofs of this may be found in Glossarium Manuale, vol. i. p. 298. From the word *apotheca* the Italians have made *boteca*, and the French *boutique*.
[8] In the Nurnberger Bürgerbuch mention is made of Mr. Conrade Apotheker, 1403; Mr. Hans Apotheker, 1427; and Mr. Jacob Apotheker, 1433. See Von Murr's Jornal der Kunstgeschichte, vi. p. 79. Henricus Apothecarius occurs as a witness at Gorlitz, in a charter of the year 1439; and one John Urban Apotheker excited an insurrection against the magistrates of Lauban in 1439. See Buddæi Singularia Lusatica, vol. ii. p. 424, 500. One cannot with any certainty determine whether these people were properly apothecaries, which must be borne in mind in reading the following passage of Von Stetten in his Kunstgeschichte der Stadt Augsburg, p. 242:

those were often called apothecaries who at courts and in the houses of great people prepared for the table various preserves, particularly fruit incrusted with sugar, and who on that account may be considered as confectioners. What peculiarly distinguishes our apothecaries is, that they sell drugs used in medicine, and prepare from them different compounds according to the prescriptions given by physicians and others. But here arises a question: When did physicians begin to give up entirely the preparation of medicines to such apothecaries, who must now be more than herb-dealers, and must understand chemistry? And when did the apothecaries acquire an exclusive title to that business and to their present name? It is probable that physicians gradually became accustomed to employ such assistance for the sake of their own convenience, when they found in their neighbourhood a druggist in whose skill they could confide, and whose interest they wished to promote, by resigning in his favour that occupation.

Conring asserts, without any proof, but not however without probability[1], that the physicians in Africa first began to give up the preparation of medicines after their prescriptions to other ingenious men; and that this was customary so early as the time of Avenzoar in the eleventh century. Should that be the case, it would appear that this practice must have been first introduced into Spain and the lower part of Italy, as far as the possessions of the Saracens then extended, by the Arabian physicians who accompanied the Caliphs or Arabian princes. It is probable, therefore, that many Arabic terms of art were by these means introduced into pharmacy and chemistry, for the origin of which we are indebted to that nation, and which have been still retained and adopted. Hence it may be explained why the first known apothecaries were to be found in the lower part of Italy; but at any rate we have reason to conclude, that they obtained their first legal establishment by the well-known medical edict of the emperor Frederic II., issued for the kingdom of Naples, and from which Thomasius deduces the privileges they enjoy at present[2]. By

"In very old times there was a family here who had the name of Apotheker, and it is very probable that some of this family had kept a public apothecary's shop. Luitfried Apotheker, or in der Apothek, lived in the year 1285, and Hans Apotheker was, in 1317, city chamberlain."

[1] De Hermetica Medicina libri duo. Helmst. 1669, p. 293.

[2] This edict may be found in Lindenbrogii Codex Legum Antiquarum,

that edict it was required that the *confectionarii* should take an oath to keep by them fresh and sufficient drugs, and to make up medicines exactly according to the prescriptions of the physicians; and a price was fixed at which the *stationarii* might vend medicines so prepared, and keep them a year or two for sale in a public shop or store. The physicians at Salerno had the inspection of the *stationes*, which were not to be established in every place, but in certain towns. The *confectionarii* appear to have been those who made up the medicines or *confectiones*. The *statio* was the house where they were sold, or, according to the present mode of expression, the apothecary's shop; and the *stationarii* seem to have been the proprietors, or those who had the care of selling the medicines. The word *apotheca* seldom occurs in that edict; when it does, it signifies the warehouse or repository where the drugs were preserved. I however find no proof in it that the physicians at that time sent their prescriptions to the *stationes* to be made up. It appears rather that the *confectionarii* prepared medicines from a general set of prescriptions legally authorised, and that the physicians selected from these medicines, kept ready for use, such as they thought most proper to be administered to their patients. A physician who had passed an examination, and obtained a licence to practise, was obliged to swear that he would observe *formam curiæ hactenus observatam*; and if he found *quod aliquis confectionarius minus bene conficiat*, he was obliged to give information to the *curia*. The *confectionarii* swore that they would make up *confectiones, secundum prædictam formam*. It was necessary that electuaries, syrups, and other medicines, should be accompanied with a certificate from a physician to show that they were properly prepared. I must acknowledge that the edict alludes here only to some medicines commonly employed; and I am surprised that the recipes are not mentioned, if such were then in use. I have never had the good fortune to meet with the word *Receptum* used to signify a prescription in any works of the above century. The practice of physicians writing out, almost at every visit, the method of preparing the medicines which they order, may perhaps have been introduced at a

p. 809. The law properly here alluded to, *de probabili experientia medicorum*, is by most authors ascribed to the emperor Frederic I., but by Conring to his grandson Frederic II. See Conring De Antiquitatibus Academicis. Gottingæ, 1739, 4to, p. 60.

later period. The book of receipts most in use, by which the medicines of that time were made up, was the Antidotarium, which the physicians of Salerno caused to be collected and translated into Latin from the works of the Arabian physician Mesues, and from those of Avicenna, Galen, Actuarius, Nicolaus Myrepsius, and Nicolaus Præpositus, by the celebrated professor in that city, Nicolaus di Reggio, a native of Calabria.

If it be true that the separation of pharmacy from medicine first took place in Africa, it is highly probable that the well-known Constantinus Afer may have contributed to introduce it also into Italy. This man, who was a native of Carthage, having learned the medical art from the Arabians, made it known in that country, particularly after the year 1086, when he was a Benedictine monk in a monastery situated on Mount Cassino; and the service which he rendered to the celebrated school of physic in the neighbouring city of Salerno, is well known. After his time, the monks in many of the monasteries applied to the preparing of medicines, which they sold to the wealthy, but distributed gratis to the poor, and by these means were much benefited in various respects.

It is well known that almost all political institutions on this side the Alps, and particularly every thing that concerned education, universities, and schools, were copied from Italian models. These were the only patterns then to be found; and the monks, despatched from the papal court, who were employed in such undertakings, clearly saw that they could lay no better foundation for the Pontiff's power and their own aggrandizement, than by inducing as many states as possible to follow the examples set them in Italy. Medical establishments were formed, therefore, everywhere at first according to the plan of that at Salerno. Particular places for vending medicines were more necessary, however, in other countries than in Italy. The physicians of that period used no other drugs than those recommended by the ancients; and as these were to be procured only in the Levant, Greece, Arabia, and India, it was necessary to send thither for them. Besides, according to the astrological notions which then prevailed, herbs, to be confided in, could not be gathered but when the sun and planets were in certain constellations, and certificates of their being so were requisite to give them reputation. All this was impossible to be done without a distinct employment, for phy-

sicians were otherwise engaged. It was found convenient therefore to suffer some of the principal dealers in drugs gradually to acquire monopolies. The preparation of drugs was becoming always more difficult and expensive. After the invention of distillation, sublimation, and other chemical processes, laboratories, furnaces, and costly apparatus were to be constructed, and it was proper that men who had regularly studied chemistry should alone follow pharmacy; and that they should be indemnified for their expenses by an exclusive trade. These monopolists also could be kept under closer inspection, by which the danger of their selling improper drugs or poison was lessened or entirely removed. It would appear that no suspicions were at first entertained, that apothecaries could amass riches by their employment, so soon and so easily as they do at present; for they were allowed many other advantages, and particularly that of dealing in sweetmeats and confectionary, which were then the greatest delicacies. In many places they were obliged on certain festivals to give presents of such dainties to the magistrates, by way of acknowledgment, and hence probably has arisen the custom of sending new-years gifts of marchepanes and other things of the like kind.

In many places, and particularly in opulent cities, the first apothecaries' shops were established at the public expense, and belonged to the magistrates. A particular garden also was often appropriated to the apothecary, in order that he might rear in it the necessary plants, and which therefore was called the apothecary's garden[1]. Apothecaries' shops for the use of courts were frequently established and directed by the consorts of princes; and it is a circumstance well-known, that many of the fair sex, when they have lost the power of wounding, devote themselves much to the healing and curing art, and to the preparation and dispensing of medicines. [Such indeed is the case at present in France, medicines being both prepared and dispensed by the Sisters of Charity, who attend the sick at the public hospitals, much to the annoyance of the chemists and druggists, who have frequently petitioned the

[1] These gardens in most cities have been revoked, but they still retain their ancient names, though applied to other purposes. In this manner the œconomical garden at Göttingen is called by the common people the apothecary's garden.

government to interfere to protect their interests.] Dr. Mohsen says that the first apothecaries in Germany came from Italy. This may be probable, but I know no proof of it. I shall now proceed to give some account of the oldest mention made of apothecaries, which will serve to confirm what I have said above.

Of English apothecaries I know nothing more than what has been stated by Anderson[1], who says that king Edward III., in the year 1345, gave a pension of sixpence a day to Coursus de Gangeland, an apothecary of London, for taking care of and attending his majesty during his illness in Scotland; and this is the first mention of an apothecary in the Fœdera.

Of apothecaries in France no mention occurs before the year 1484; when they received their statutes in the month of August from Charles VIII.[2] They received others in 1514 under Louis XII.; in 1516 and 1520 under Francis I.; in 1571 under Charles IX.; in 1583 under Henry III.; and in 1594 under Henry IV. These regulations were renewed and confirmed by Louis XIII., in the years 1611, 1624, and 1638.

For the most copious information respecting German apothecaries, we are indebted to Sattler. In the beginning of the fifteenth century an apothecary's shop was established at Stuttgard by a person named Glatz, which, as the only one in the country, was first sanctioned by the count of Wirtemberg in 1458. In the patent given on that occasion it was said that Glatz's ancestors had for many years kept an apothecary's shop at Stuttgard, and had furnished it as a proper apothecary ought. In the year 1457 count Ulric gave to John Kettner, whom the year before he had appointed to be his domestic physician, leave also to establish an apothecary's shop at Stuttgard, and promised to allow no other in his dominions. The apothecary received yearly from the count a certain quantity of wine, barley and rye; but, on the other hand, he engaged to supply the court with as much confectionary as might be necessary, at the rate of twelve schillings per pound[3]. Both these shops seem afterwards to have been abandoned, and the count and the apothecary to have entertained the same opi-

[1] Hist. of Commerce, i. 319.

[2] Histoire de Paris, par Sauval, ii. p. 474.—Histoire de Paris, par Felibien, ii. p. 927.—Traité de la Police, par De la Mare, i. p. 618.

[3] Sattlers Geschichte Würtenberg, v. p. 159. Addenda, p. 329.

nion, that each could renounce his contract when he pleased. In the year 1468, one Albrecht Mulsteiner, or Altumsteiner, from Nuremberg, was appointed apothecary, with a promise that no other private or public shop should be tolerated except that at Wirtemberg. The patent is almost like that given to Kettner; but it deserves to be remarked that it contains, in an additional clause, a catalogue of all the different articles, with their prices. An apothecary's shop is mentioned at Tubingen, under count Everhard, as an hereditary fief, the possessor of which bound himself to serve as physician and apothecary to the army in time of war. In the year 1500 duke Ulric of Wirtemberg allowed one Syriax Horn to establish an apothecary's shop at Stuttgard, and appointed him his apothecary for six years. He was obliged to swear that he would supply government and all public officers, as well as the duke's subjects, with medicines; and the body physician was enjoined to visit the shop once every year, in order to examine whether Horn conducted himself according to the regulations laid down for him, and sold his medicines at the fixed prices. In 1559 four apothecaries were appointed in the duchy, viz. at Stuttgard, Goppingen, Kalw and Bintigheim, which are still called the land-apothecaries. At the same period there was an apothecary's shop in the ducal palace at Stuttgard, which the consort of duke Christopher caused to be furnished at her own expense; and from which the poor received gratis whatever medicines they stood in need of.

That there were apothecaries' shops at Augsburg so early as the thirteenth and fourteenth centuries, according to the conjecture of Von Stetten, has been mentioned already. By the records of that city it appears that a public shop was kept there by a female apothecary in the year 1445; and at that period a salary was paid by the city to the person who followed that occupation. In 1507 an order was passed that the apothecaries' shops should be from time to time inspected; and in 1512 a price was set upon their medicines, and all others were forbidden to deal in them.

The antiquity of the first apothecary's shop at Hamburg, which belonged to the council, cannot be determined; but it is with certainty known that one existed there before the sixteenth century. It was situated in the middle of the city, near the council-house and the exchange, and had a garden be-

longing to it, in the new town. Before the year 1618 there was at Hamburg also a private apothecary's shop. In 1529 a city physician was appointed, and quacks and mountebanks were then banished. The annual visitation by the city physician was established in 1557. The oldest regulation respecting apothecaries is of the year 1586.

Apothecaries' shops, legally established, existed without doubt at Frankfort on the Maine before the year 1472; for at that period the magistrates of Constance requested to know what regulations were made there respecting the prices of medicines. In 1489 the city physician was instructed to inspect them carefully, and to see that the proper prices were affixed to the different articles. In 1500 all the apothecaries were obliged to take an oath that they would observe the regulations prescribed for them; and in 1603 a decree was passed that no more apothecaries' shops should be allowed for twelve years than the four then existing; and yet we are told that the fourth was first built in 1629[1].

In the police regulations drawn up at Basle in the year 1440, by which it was ordered that a public physician should be established in every German imperial city, with the allowance of an ecclesiastical benefice or canonry, in order that he might exercise his art gratis, it is said, "What costly things people may wish to have from the apothecary's shop they must pay for[2]." Dr. Mohsen hence concludes that common roots and herbs were not then sold in the apothecaries' shops, but expensive compounds brought from other countries.

The first apothecary's shop at Berlin, of which any certain and authentic account can be found in the king's feudal records, was established in 1488. At that period the magistrates gave one Hans Zehender a right to the hereditary possession of a shop, and promised to allow him yearly, to enable him to support it, a certain quantity of rye, with a free house, and engaged also to exempt him from all contributions, watching and other public burthens, and to permit no other apothecary to reside in the city. This agreement was confirmed in 1491 by the elector John; and in 1499 the elector Joachim I., on his coming to the government, gave the apothecary a new pa-

[1] Lersner's Frankfurter Chronik, i. p. 26, 493; ii. pp. 57, 58.
[2] Goldasti Constitutiones Imperiales. Francof. 1607, fol. p. 192.

tent, in which his body physician was charged to take care that the shop should be furnished with proper drugs; that the medicines for the elector and his court should be made up according to the prescriptions; and that they should not be charged too high, contrary to the regulated prices [1]. In the year 1573 there was an apothecary's shop in the palace for the use of the court; but Mr. Nicolai [2] conjectures that it was only a portable one, and consisted of some chests filled with medicines. The present one was founded in 1598 by Catharine, consort of the elector Joachim Frederick; but the establishment, as it now stands, began to be formed in the year 1605, when Crispin Haubenschmid, the first apothecary to the court, was brought from Halle to Berlin. Catharine, widow of the margrave John of Custrin, caused an apothecary's shop for the use of the court to be established at Krossen, under the inspection of her physician Wigands, because there was then no shop of that kind in the place; and at her death in 1574 she bequeathed it to the magistrates.

In Halle there was no apothecary's shop till the year 1493. Before that period medicines were sold only by grocers and barbers. In the above year however the council, with the approbation of the archbishop, permitted one Simon Puster to establish an apothecary's shop, in order, as stated in the patent, that the citizens might be supplied with confections, cooling liquors, and such like common things, at a cheap rate and that, in cases of sickness, they might be able to procure readily fresh and well-prepared medicines. Puster was exempted by it from all taxes and contributions for ten years, but with this proviso, that during that period he should furnish yearly at the council-house for two collations in the time of the festivals, eight pounds of good sugar confections, fit and proper to be used at such entertainments. It stated, on the other hand, that in future no kind of preserves made with sugar, or what was called confectionary, or theriac, should be kept for sale or sold either in the market or in booths, shops or stalls, except at the annual fair. This apothecary's shop was the only one in Halle till the year 1535, when the archbishop gave his physician, J. N. von Wyhe, liberty to establish

[1] Mohsens Geschichte, p. 379.
[2] Beschreibung von Berlin, i. p. 39 and 87.

a new one; but with an assurance, that to eternity, no more apothecaries' shops should be permitted in Halle; and this declaration was confirmed by the chapter. Notwithstanding the archbishop's promise, strengthened by that of his clergy, one Wolf Holzwirth, a skilful apothecary, who returned from Italy, found means to procure permission in 1555 to establish a third apothecary's shop[1].

In the year 1409, when the university of Prague was transferred to Leipsic, and every thing at the latter was put on the same footing as at the former, an apothecary's shop was also established, which, as that at Prague had been, was known by the sign of the Golden Lion.

In the year 1560 there was no apothecary's shop at Eisenach, and even in the time of duke John Ernest, who died in 1638, there was none for the court; but the place of apothecary was supplied by one of the yeomen of the jewellery.

In the year 1598, count John von Oldenburg caused an apothecary's shop to be established at Oldenburg for the common good of the country[2].

In Hanover the first apothecary's shop was established by the council in 1565, near the council-house[3]. The consort of duke Philip II. of Grubenhagen, a princess of Brunswick, who was married in 1560, supported at her court an apothecary's shop and a still-house, for the benefit of her servants and the poor[4]. Duke Julius, who came to the government of Brunswick in 1568, caused apothecaries' shops to be established in his territories; and his consort, a daughter of the elector of Brandenburg, kept, for the use of the poor, an expensive apothecary's shop in her palace; and the citizens of the new Heinrichstadt, near Wolfenbuttel, were allowed when afflicted

[1] Von Dreyhaupts Beschreibung des Saal-Creyses, ii. 561.

[2] Hamelmanns Oldenburgische Chronik, 1599, fol. p. 491.

[3] Grupens Origines Hannoverenses. Gott. 1740, 4to, p. 341.

[4] "By her apothecary's shop and still-house one may discover what real compassion the Christian-like electress showed towards the poor who were sick or infirm; for, by having medicines prepared, and by causing all kinds of waters to be distilled, she did not mean to assist only her own people and those belonging to her court, but the poor in general, whether natives or foreigners, and not for the sake of advantage or gain, but gratis and for the love of God."—Letzners Dasselsche und Eimbecksche Chronica.—Erfurt, 1596, fol. p. 104.

by any epidemic disease, the dysentery, quinsy, scurvy, or stone, to be supplied with medicines from it free of all expense [1].

The apothecary's shop at the court of Dresden was founded by the electress Ann, a Danish princess, in the year 1581. In 1609 it was renewed by Hedwig, widow of the elector Christian I.; and in 1718 it received considerable improvement.

Gustavus Erickson, king of Sweden, was the first person in that country who attempted to establish an apothecary's shop. On the 20th of March, 1547, he requested Dr. John Audelius of Lubeck, to send him an experienced physician and a good apothecary. On the 5th of May, 1550, his body-physician, Henry von Diest, received orders to bring a skilful apothecary into the kingdom. When the king died in 1560, he had no other physicians with him than his barber master Jacob, an apothecary master Lucas, and his confessor Magister Johannes, who, according to the popish mode, practised physic, and prescribed for his majesty. Master Lucas, as appears, was the first apothecary at Stockholm. On the 21st of March, 1575, one Anthony Busenius was appointed by king John apothecary to the court [2]; and in 1623, Philip Magnus Schmidt, a native of Langensalz in Thuringen, was chosen to fill that office. In the year 1675 there were five apothecaries' shops in Stockholm; since 1694 the number has been nine. The first apothecary's shop at Upsal was established in 1648 by Simon Wolimhaus, who came from Konigsee in Thuringen, and from whom the present family of count Gyllenborg are descended. The first apothecary's shop at Gottenburg was established about the same time. Towards the end of the sixteenth century physicians and apothecaries were invited into Russia by the czar Boris Godunow [3].

I shall here take occasion to remark the following circumstance: at the Byzantine court the keeper of the wardrobe,

[1] This account is taken from the learned information collected by Professor Spittler, in his Geschichte Hannover. Gött. 1786, 8vo, p. 275. That the council of Göttingen began very early to pay great attention to medical institutions, is proved by the following passage from the Göttingischen Chronike of Franciscus Lubecus :—"Anno 1380, the city procured a surgeon from Eschwege, who with his servant was to be exempted from contributions and watching; and to receive clothes yearly from the council." [2] Von Dalins Geschichte Schweden, übersetzt von Dahnert. 4 vols. 4to, p. 318 and 394. [3] Backmeister, Essai sur la Biblioth. à St. Pétersb. 1776, 8vo, p. 37.

as the yeoman of the jewellery at Eisenach in the sixteenth century, had the care of the portable apothecary's shop when the emperor took the field. It was called *pandectæ*, and contained theriac and antidotes, with all kinds of oils, plasters, salves, and herbs proper for curing men and cattle[1].

[In England, in 1543, an act was passed for the toleration and protection of the numerous irregular practitioners, who were neither surgeons nor physicians. It was entitled "An Act that persons being no common surgeons may minister outward medicines;" the persons thus tolerated comprehending those who kept shops for the sale of drugs, to whom the name of apothecaries was then exclusively applied. On the 9th of April, 1606, king James I. incorporated the apothecaries of London and united them with the grocers; they remained so until 1617, when they received a new charter, forming them into a separate company under the designation of the master, wardens, and society of the art and mysteries of apothecaries of the city of London. It appears that the apothecaries of London did not begin generally to prescribe as well as to dispense medicines until a few years before the close of the seventeenth century.]

I must add a few observations also respecting the earliest *Dispensatorium*. It is almost generally admitted that the first was drawn up by Valerius Cordus, or at least that his was the first sanctioned by the approbation of public magistrates. Haller has remarked one older; but it is now known only from the title mentioned by Maittaire[2]. Cordus however appears to have first used the word *dispensatorium* for a collection of receipts, containing directions how to prepare the medicines most in use. This book it is well known has been often printed with the additions of other physicians; but, in my opinion, Conring [3] is in a mistake when he says that it was improved and enlarged by Matthiolus. I have in no edition found any additions of Matthiolus; and the error seems to have arisen from the christian name of Matthias Lobelius, which stands

[1] Constantinus Porphyrogen. de Ceremoniis Aulæ Byzantinæ. Lipsiæ, 1751, fol. i. p. 270.

[2] Bibliotheca Botan. i. p. 244. Ricettario di dottori dell' arte e di medicina del collegio Fiorentino, all' instantia delli Signori Consoli della università delli speciali. Firenz. 1498, fol. Maittaire. Primum, quantum repperi, dispensarium.

[3] Introductio in Artem Medicam. Helmstadii, 1687, 4to, p. 375.

in the title of some editions, because his annotations are added to them. It is very singular that Kestner [1] also has fallen into this mistake, who, however, says that the name of Matthiolus is only in the title, for in the book itself he found no appearance of his having had any concern with it.

CLOCKS AND WATCHES.

A PAPER on this subject was read by Professor Hamberger, in the year 1758, before the Society of Göttingen; but as the publication of the Transactions of the Society was interrupted, it was never printed. I however procured the manuscript from the professor's son, Secretary Hamberger, at Gotha, and I here insert it, corrected in a few places, where necessary, but without any other alteration [2].

"Weidler [3] and Chambers [4] are, doubtless, both mistaken when they place the invention of automatous clocks about the end of the fifteenth or beginning of the sixteenth century. The latter says, 'It is certain that the art of constructing clocks, such as those now in use, was first invented or at least revived in Germany about two hundred years ago.' The same account is given by Weidler, whom Chambers perhaps copied. But, however flattering this opinion may be to the ingenuity of the Germans, it is so apparently false in regard to the time, that one cannot assent to it; nor is it even probable in regard to the country, though it must be allowed that the art of clockmaking flourished very much in Germany, particularly at Nuremberg, about the beginning of the sixteenth century.

"As these two authors make the invention of clocks too modern, others, on the contrary, carry it back to a period too early. Without entering into any dissertation on the machines of Archimedes and Posidonius, which are said to have measured the hours of the day, I shall only observe that a cer-

[1] C. G. Kestneri Bibliotheca Medica, Jenæ, 1746, 8vo, p. 638.

[2] The author says that the principal writers on this subject are Alexander, a monk of the order of St. Benedict; Paute, his countryman; and our Derham. [3] Histor. Astron. [4] Encyclopædia, art. Clock.

tain writer pretends to have found mention made of a clock in the third century[1]. In support of this assertion he refers to the Acts of St. Sebastian, the martyr, where Chromatius, the governor of Rome, says, when about to be cured by him, 'I have a glass chamber in which the whole learning and science of the stars is constructed mechanically, in making which my father Tarquinius is known to have expended more than two hundred pounds of gold.' St. Sebastian answers, 'If you have made your choice to keep this whole, you destroy yourself.' To which Chromatius replies, 'How so? do we employ any sacrificial rights in the construction of an almanac or ephemeris, when merely the courses of the months and years are distinguished numerically for every hour; and the full and new moon is, by means of certain calculations, foreshown by a motion of the fingers[2].' This valuable machine, however, can hardly be called a clock; for if it had been an automaton, it would not have required to be moved with the fingers in order to show the time of full moon. If I understand the author's words properly, it was not calculated to point out the hours; but to exhibit the sun's course through the twelve signs of the zodiac, the motion of the rest of the planets, and their relative situation in every month, or at any period of the year. That the signs of the zodiac and the planets were represented on the machine, appears from what follows. St. Polycarp (the companion of St. Stephen) said, 'There are the signs of the Lion, of Capricorn, Sagittarius, Scorpio and the Bull; in Aries the moon, in the Crab an hour, in Jupiter a star, in Mercury the tropics, in Venus Mars, and in all those monstrous demons is seen an art hostile to God[3].' But whatever this machine

[1] Bona De Div. Psalmod. cap. 3. s. 2.

[2] Act. SS. cap. 16. 20 Jan. p. 273. *Chrom.* "Habeo cubiculum holovitrum, in quo omnis disciplina stellarum ac mathesis mechanica est arte constructa, in cujus fabrica pater meus Tarquinius amplius quam ducenta pondo auri dignoscitur expendisse." *St. Sebast.* "Si hoc tu integrum habere volueris, te ipsum frangis." *Chrom.* "Quid enim? Mathesis aut ephemeris aliquo sacrificiorum usu coluntur, cum tantum eis mensium et annorum cursus certo numero per horarum spatia distinguuntur; et lunaris globi plenitudo, vel diminutio, digitorum motu, rationis magisterio, et calculi computatione praevidetur?"

[3] "Illic signa Leonis, et Capricorni, et Sagittarii, et Scorpionis, et Tauri sunt; illic in Ariete Luna, in Cancro hora, in Jove stella, in Mercurio tropica, in Venere Mars, et in omnibus istis monstruosis daemonibus ars Deo inimica cognoscitur."

might have been, it was of no use to others, or to posterity: it was broken to pieces by these saints, so that, even allowing it to have been a clock, the knowledge of it must have been then lost.

"We find also, that Bernardus Saccus[1] ascribes the invention of clocks to Boëthius, in the fifth century; but Bernardus seems to have forgotten what he quoted a little before from Cassiodorus[2], respecting the clock of Boëthius, that it determined the hours *guttis aquarum*. It must, therefore, have been a water-clock, and not a clock moved by wheels and weights. The same Cassiodorus had provided his monks at the monastery of St. Andiol[3], in Languedoc, with machines of the like kind: 'I am known,' says he, 'to have constructed for you a time-picce which the light of the sun indexes; moreover another acting by water which marks the hours both day and night; as frequently upon some days there is no sunshine[4].' We are to understand also, as alluding to such clocks, what is said by the writer of the life of St. Leobin, bishop of Chartrain, about the year 556[5], when he tells us, that to him (St. Leobin) was committed the duty of regulating the course of the hours and the vigils.

"I come now to the seventh century. In Du Cange's Glossary we find the word *Index*, which is explained to be the index or hand of a clock, or the small bell which announces the hours by its sound; and this opinion is adopted by Muratori[6]. Du Cange quotes in support of his assertion a monkish work called *Regula Magistri*, the author of which is not certainly known[7], but which Mabillon[8] asserts to have been written before the year 700. The passages to which he refers are, 'Cum advenisse divinam horam percussus in oratorio index *monstraverit*.' (When the index being struck in the oratory shall have shown that the hour for prayer had come.) 'Cum *sonuerit index*;' and 'Cum ad opus divinum

[1] Hist. Ticin. lib. vii. c. 17. [2] Var. lib. i. in fine.

[3] In the original, Monasterium Vivariense.—TRANS.

[4] "Horologium vobis unum, quod solis claritas indicet, praeparasse cognoscor; alterum vero aquatile, quod die noctuque horarum iugiter indicat quantitatem; quia frequenter nonnullis diebus solis claritas abesse cognoscitur."—De Institut. Div. Litter. c. 29.

[5] Mabil. Annales St. O. B. sec. i. p. 123. [6] Antiq. Med. Ævi, Diss. 24, p. 392. [7] Lucæ Holstenii Codex Regularum. Paris, 1663, p. 172. [8] Annales.

oratorii *index sonaverit*[1].' But Du Cange might have perceived, had he quoted the whole passage from the fifty-fifth chapter, that allusion is not here made to a clock; for it is said, not merely 'cum sonuerit index,' but 'cum sonuerit index ab Abbate percussus.' (When the index struck by the Abbot shall sound). It was a *scilla* or *skella*, perhaps only a board; and Martene[2] seems to understand the word *index* in the true sense when he explains it the signal by which the brethren were called to divine service.

"That machine which was sent as a present to Charlemagne by the king of Persia, in the year 807, is supposed also to have been a clock like those used at present; and if we follow the Chronicon Turonense, one may easily fall into the same opinion: 'The king of the Persians sent a time-piece in which the twelve hours were marked by the performance of a cymbal and of certain horsemen who at each hour went out through the windows, and on their return in the last hour of the day shut the windows as they marched back[3].' The description of it however, to be found in Annales Francorum, ascribed to Eginhard, shows clearly that it was far different from our clocks. The author says, 'Likewise a time-piece wonderfully constructed of brass with mechanical art, in which the course of the twelve hours was turned towards a clepsydra, with as many brass balls which fell down at the completion of the hour, and by their fall sounded a bell placed under them[4].' It was evidently therefore a water-clock, furnished with some ingenious mechanism, but having nothing in common with our clocks.

"About the same period lived Pacificus, archdeacon of Verona, who is celebrated for having invented a clock[5].

[1] Capp. 54, 55. 95.

[2] Index Onomasticus ad tom. iv. De Antiq. Eccl. Rit.

[3] Martene, Coll. ampl. tom. v. p. 960. "Misit rex Persarum—horologium, in quo XII horarum cursus cognoscebantur, cymbalo ibi personante et equitibus, qui per singulas horas per fenestras exibant, et in ultima hora diei redeuntes, in regressione sua fenestras apertas claudebant."

[4] Ad a. 807. Calmet, Hist. de Lorraine, vol. i. p. 582. "Nec non et horologium, ex aurichalco arte mechanica mirifice compositum, in quo duodecim horarum cursus ad clepsydram vertebatur, cum totidem æreis pilulis, quæ ad completionem horarum decidebant, et casu suo subjectum sibi cymbalum tinnire faciebant."

[5] Panuvini Antiq. Veron. lib. vi. p. 153. Scip. Maffei Degli Scrittori Veronesi, p. 32. Muratori, Ant. Ital. Med. Ævi, Diss. 24. p. 392.

His epitaph, besides relating other services which he did, says,—

> Horologium nocturnum nullus ante viderat.
> En invenit argumentum et primus fundaverat;
> Horologioque carmen sphæræ cœli optimum,
> Plura alia graviaque prudens invenit.

Scipio Maffei endeavours to prove, that we are here to understand a clock moved by wheels and weights; but, in my opinion, his arguments are extremely weak. 'This *horologium*,' says he, 'the like of which had been never seen, and which was different from a sun-dial, because it showed the hours in the night-time, could not be a clepsydra or water-clock, for clocks of that kind were not only known to the ancients, but even to the inhabitants of Italy in latter times, so that it could have been nothing but a clock like ours.' But even if we allow, with this learned man, that water-clocks were known in Italy at that period, it cannot be denied that they were scarce, and used only by few, as may be evidently gathered from what is said of these machines by Cassiodorus. The greater part of the people might have been unacquainted with them at the above-mentioned time; and there is no necessity for adhering so closely to the words of the epitaph, 'nullus ante vidcrat,' as Maffei has done. Besides, Maffei himself destroys the foundation on which he rests his opinion; for he relates that a *horologium nocturnum* was sent to Pepin, king of France, by pope Stephen II. This appears from the pope's own letter; but Maffei is under a mistake respecting the name, for it was Paul, and not Stephen. The letter, which may be found in the Codex Carolinus[1], is dated in the year 756. Maffei thinks that this machine was of a construction different from that of a water-clock; but if it pointed out the hours in the day-time, as well as in the night, according to his supposition, there is no reason, as Muratori observes, why it should have been called *horologium nocturnum*. In my opinion, we ought here to understand a clepsydra, or water-clock, such as that used by Cassiodorus for the like purpose, and which Hildemar recommended in the ninth century to the monks, who were obliged to observe the

[1] Bouquet, Recueil des Historiens de la Gaule, tom. v. p. 513.

hours. Hildemar says, 'He who wishes to do this properly, must have *horologium aquæ*[1].'

"That these water-clocks however were then scarce, as well as in the following centuries, we have reason to conclude from their being so little spoken of in the writings of those periods. In the ancient customs of the monastery of St. Viton, at Werden[2], written as is said in the tenth century, no mention of them occurs; and the monks regulated their prayers by the crowing of the cock; for it is said, 'Cum lucem ales nunciaverit, dabuntur omnia signa in resurrectione Domini nostri,' &c. I find as little mention of them in the eleventh century, even in passages where they could not have been omitted, had they been known. Thus, in a little work by Pet. Damiani, De Perfectione Monachorum, where the author speaks of the *significator horarum*, he does not so much as allude to a clepsydra. That the reader may know what he means by *significator horarum*, I shall here quote his own words: 'He could not find time for idle fables, nor hold long conversations, nor finally could he trouble himself about what was done by the laity, but always intent on the duties of his office, always provident, always anxious, he felt a desire to construct a voluble sphere that should never stop, should show the passage of the stars and the flight of time. He also had a custom of singing to himself whenever he wished to have a notion as to the quantity of time; that, whenever the brightness of the sun or the position of the stars was obscured by the weather he might form a certain time-measurer by the quantity of psalmody he had accomplished[3].'

"Some ascribe the invention of our modern clocks to Gerbert, who, in the tenth century, was raised to the pontifical chair at Rome, under the name of Sylvester II., and who was reckoned to be the first mathematician and astronomer of his

[1] See Martene De Ritib. Eccl. tom. iv. p. 5. [2] Martene, tom. iv. p. 853.

[3] "Non fabulis vacet, non longa cum aliquo misceat, non denique, quid a secularibus agatur, inquirat; sed commissæ sibi curæ semper intentus, semper providus, semperque sollicitus, volubilis sphæræ necessitatem, quiescere nescientem, siderum transitum, et elabentis temporis meditetur semper excursum. Porro psallendi sibi faciat consuetudinem, si discernendi horas quotidianam habere desiderat notionem; ut, quandocunque solis claritas, sive stellarum varietas nubium densitate non cernitur, illic in quantitate psalmodiæ, quam tenuerit, quoddam sibi velut horologium metiatur."

time[1]. This opinion however is supported only by mere conjecture, and appears to be false from the account of Dithmar, who says, 'Gerbert, on being expelled from his country, sought the emperor Otho, and after a long conversation with him, made the time-piece in Magdeburg, constructing it correctly by taking as guide the polar star[2].' No mention is made here of wheels or weights, and this horologium seems to have been a sun-dial, which Gerbert fixed up by observing the polar star. It appears, indeed, that Gerbert was acquainted with no other kind of *horologia*; for those who speak of his book De Astrolabio, in which he explains the method of constructing dials for various latitudes, produce no further proofs[3]. Some, according to the testimony of Kircher, consider this horologium to have been a portable dial, which showed the hour when properly set by the help of a needle touched with a magnet; but even this opinion is not warranted by the words of Dithmar.

"The anonymous author of the Life of William, abbot of Hirshau[4], who lived in the eleventh century, and who was a very learned man for his time, says, 'Naturale horologium ad exemplum cælestis hæmispherii excogitasse.' Though this passage is so short, that no idea can be formed from it of the construction of the machine, it is evident that it alludes neither to a sun-dial nor to a water-clock, but to some piece of mechanism which pointed out the hours and exhibited the motion of the earth and other planets. As more frequent mention of *horologia* occurs afterwards, and as, in speaking of them, expressions are used which cannot be applied to sun-dials or water-clocks, I am induced to think that the invention of our clocks belongs to this period. In the Constitutiones Hirsaugienses, or Gengebacenses, of the same William, it is said of the sacristan, 'eum horologium dirigere et ordinare.' In the like manner Bernardus Monachus, a writer of the same century, says, in the Ordo Cluniacensis, 'apocrisiarium horologium dirigere et diligentius temperare.' The same author, in the

[1] Journal des Sçavans, 1734, p. 773. [2] Chron. lib. vi. p. 83. Franc. 1580. fol. "Gerbertus, a finibus suis expulsus, Ottonem petiit imperatorem, et cum eo diu conversatus, in Magdaburg horologium fecit, illud recte constituens, considerata per fistulam quadam stella nautarum duce."

[3] Le Beuf. Rec. de div. écrits, &c. vol. ii. p. 89.

[4] Published by Car. Stengelius. Aug. Vind. 1611, p. 1.

Ancient Customs, &c. of the Monastery of St. Victor, at Paris, written also about the same time, says that the registrar (*matricularius*), the sacrist's companion, ought 'horas canonicas nocte et die ad divinum celebrandum custodire, signa pulsare, *horologium temperare*.'

"The unequal hours then in use rendered this regulating of the *horologia* necessary. The days and the nights consisted of twelve hours each; but were sometimes shorter and sometimes longer. The reason of this is explained in the sixty-fourth chapter of the before-mentioned Customs, where it is said, 'From the solstice of summer to the solstice of winter, the time-piece is regulated thus: as much as that space of night which precedes the matins gradually increases according to the increments of the nights through the several months, it, slowly increasing, makes that space in the winter solstice which is before matins to that which follows, twice. On the contrary, from the winter solstice to that of spring it is thus regulated: it decreases that space which it had got in advance according to the decrease of the nights through the several months, until scarcely decreasing, it at length in the summer solstice passes over in the same time that space which is before matins and that which follows[1].' Such was the regulating of the *horologia*, and I much doubt whether it could be applied to water-clocks.

"These *horologia* not only pointed out the hours by an index, but emitted also a sound. This we learn from Primaria Instituta Canonicorum Præmonstratensium[2], where it is ordered that the sacristan should regulate the *horologium* and make it sound before matins to awaken him. I dare not however venture thence to infer, that these machines announced the number of the hour by their sound, as they seem only to have given an alarm at the time of getting up from bed. I have

[1] "Ab æstivali solstitio usque ad solstitium hiemale sic horologium temperetur, quatenus illud noctis spatium, quod matutinas præcedat, per singulos menses secundum incrementa noctium aliquantulum crescat, donec paulatim crescendo tandem in hiemali solstitio spatium illud, quod est ante matutinas, ad illud quod sequitur, duplum fiat. Similiter per contrarium ab hiemali solstitio usque ad æstivale solstitium sic temperetur, quatenus spatium, quod præcedit, secundum noctium decrementum per singulos menses decrescat, donec paulatim decrescendo, tandem in solstitio æstivali spatium, quod est ante matutinas, et quod post sequitur, æquale fiat."

[2] Diss. ii. c. 8. ap. Martene De Ant. Rit. tom. iii. p. 909.

indeed never yet found a passage where it is mentioned that the number of the hour was expressed by them; and when we read of their emitting a sound, we are to understand that it was for the purpose of wakening the sacristan to morning-prayers. The expression 'horologium cecidit,' which occurs frequently in the before-quoted writers, I consider as allusive to this sounding of the machine. Du Cange, in my opinion, under the word *horologium*, conceives wrongly the expression 'de ponderibus in imum delapsis,' because the machine was then at rest, and could rouse neither the sacristan nor any one else whose business it was to beat the *scilla*.

"I shall now produce other testimony which will serve further to confirm what I have here said of the origin of clocks. Calmet, in his Commentary on the Regulæ S. Benedicti, quotes from a book on the usages of the Cistercians, three passages which I shall give as he has translated them, because I have not access at present to the original. 'We read,' says he, 'in chap. 21 of the first part of their Customs, compiled about the year 1120, that the bells will not be sounded for any service, not even for the clock, from the mass of Holy Thursday, to that of Holy Saturday; and in chap. 114, the sacristan is ordered to regulate the clock that it may strike and wake him during winter before matins or before the nocturns; and in chaps. 68 and 114, that when the brethren have risen too early the sacristan give notice to him who reads the last lesson to continue it until the clock strikes, or till signal be made to the reader to leave off[1].'

"The use of these machines must have been continued from that period, for we find them mentioned in the thirteenth century, in the commentary of Bernardus Cassinensis (Bernard of Cassino) on the unpublished Regulæ S. Benedicti, from the eighth chapter of which Martene gives the following quotation: 'But the eighth hour being already come, there was

[1] "On lit, au chap. 21 de la première partie de leurs Usages, compilez vers l'an 1120, qu'on ne fera sonner les cloches pour aucun exercice, pas même pour l'Horloge, depuis la messe du Jeudi saint jusqu'à celle du Samedi saint; et au chap. 114, il est ordonné au sacristain de regler l'Horloge, en sorte qu'elle sonne, et qu'elle l'éveille pendant l'hyver avant matines, ou avant les nocturnes; et au chap. 68 et 114, que quand on s'est levé trop tôt, le sacristain avertît celui qui lit la dernière leçon, de la prolonger jusqu'à ce que l'Horloge sonne, ou qu'on fasse signe au lecteur de cesser."

sufficient interval,—from the middle of the night, when he who had care of the clock rose to strike it and to light the lamps of the church which might have gone out on account of the length of the night, and to ring the bells in order to wake the sleeping brothers,—that he was able to get through half the eighth hour before the brothers had risen[1].' It is said also in the Chronicon Mellicense, in Du Cange, 'Some one, deputed by the superior who had the care of the *striking clock*, struck; and also carried light to all the cells[2].'

"As all arts are at first imperfect, it is observed of these clocks that they sometimes deceived; and hence, in the Ordo Cluniacensis Bernardi Mon., the person who regulated the clock is ordered, in case it should go wrong, 'ut notet in cereo, et in cursu stellarum vel etiam lunæ, ut fratres surgere faciat ad horam competentem.' The same admonition is given in the Constitutiones Hirsaugienses.

"From what has been said I think it is sufficiently apparent that clocks moved by wheels and weights began certainly to be used in the monasteries in Europe, about the eleventh century. I do not, however, think that Europe is entitled to the honour of this invention; but that it is rather to be ascribed to the Saracens, to whom we are indebted for most of the mathematical sciences. This conjecture is supported by the *horologium*, which, as Trithemius tells us, was sent by the sultan of Egypt, in the year 1232, to the emperor Frederic II. 'In the same year,' says he, 'the Saladin of Egypt sent by his ambassadors as a gift to the emperor Frederic a valuable machine of wonderful construction worth more than five thousand ducats. For it appeared to resemble internally a celestial globe in which figures of the sun, moon, and other planets formed with the greatest skill moved, being impelled by weights and wheels, so that performing their course in certain and fixed intervals they pointed out the hour night and day with infallible certainty; also the twelve signs of the zodiac with certain appropriate characters, moved with the

[1] Rit. Ant. tom. iv. p. 5. "Facta autem jam hora octava, modicum erit amplius de media nocte quando surrexerit, *horologio excitante*, qui habet horologium custodire, et accensis lucernis ecclesiæ, quæ poterant propter prolixitatem noctis fuisse obscuratæ, ac pulsatis campanis ad dormientium fratrum excitationem, potuit transire dimidia octavæ horæ antequam surrexerint fratres." [2] Cap. 774. "Excitabit aliquis a superiore deputatus, qui *horologium excitatorium* habeat; ad omnes quoque cellas lumen deferat."

firmament, contained within themselves the course of the planets[1].'

"The writers of this century speak in such a manner of clocks that it appears they must, at that period, have been well-known. Gulielmus Alvernus, disputing against those who deny the existence of the soul, after producing various arguments, thus obviates one which might be used against him. 'Neither,' says he, 'do the motions of those clocks which are moved by water or weights give you uneasiness, both kinds of which move but for a short and moderate time, require frequent repair, the arranging of their parts, and the perfect skill of the astronomer who has a thorough knowledge of his art. But in the bodies of animals and vegetables the motive power is entirely internal, which moderates and regulates the movements of their parts and renders it in all ways perfect[2].' And Dante, the Italian poet, says[3],

> E come cerchi in tempra d' orivoli
> Si giran, si che 'l primo, a chi pon mente
> Quieto pare, e l' ultimo che voli, &c.

"In the fourteenth century mention is made of the machine of Richard de Wallingford, which has been hitherto considered as the oldest clock known. The description of it I shall give in the words of Leland: 'Being chosen superior of the monastery, as he was now enabled by his ample fortune, he resolved to show by means of some glorious work a miracle not only of genius, but also of excelling knowledge. He there-

[1] "Eodem anno, Saladinus Egyptiorum Frederico imperatori dono misit per suos oratores tentorium pretiosum, mirabili arte compositum, cujus pretii æstimatio quinque ducatorum millium procul valorem excessit. Nam ad similitudinem sphærarum cælestium intrinsecus videbatur constructum, in quo imagines solis, lunæ, ac reliquorum planetarum artificiosissime compositæ movebantur ponderibus et rotis incitatæ; ita videlicet, quod, cursum suum certis ac debitis spatiis peragentes, horas tam noctis quam dici infallibili demonstratione designabant; imagines quoque xii signorum zodiaci certis distinctionibus suis motæ cum firmamento cursum in se planetarum continebant."

[2] De Anima, c. i. p. 7, 72. "Nec te conturbant, inquit, motus horologiorum, qui per aquam fiunt et pondera, quæ quidem ad breve tempus et modicum fiunt, et indigent renovatione frequenti, et aptatione instrumentorum suorum, atque operatione forinsecus, astrologi videlicet qui peritiam habet hujus artificii. In corporibus vero animalium vel etiam vegetabilium totum intus est, intra ea scilicet, quod motus eorum atque partium suarum moderatur, et regit, ac modis omnibus perficit."

[3] Parad. cant. xxiv. ver. 13.

fore with great labour, with greater expense and with the utmost art, constructed such a clock as, in my opinion, exists nowhere else in Europe; whether we observe the course of the sun and moon, or the fixed stars, again, whether we consider the ebb and flow of the tide, or the lines together with the figures and demonstrations various almost to infinity: and when he had brought to perfection this work so worthy of eternity, he drew up rules for it, as he was the first man of his age in mathematical learning, which he published in this book, lest so excellent a machine should fall into disrepute through the mistakes of the monks, or should become silent from the law of its structure being unknown[1].' This machine, if I remember right, was called by the inventor Albion (all by one).

"Clocks hitherto had been, as it were, shut up in monasteries; but they now began to be employed for the common use and convenience of cities, though no instance of this is to be found before the above period. Hubert, prince of Carrara, caused the first clock ever publicly erected, to be put up at Padua, as we are told by Peter Paul Vergerius: 'He caused to be built at the top of the tower, a clock, in which, during day and night, the four-and-twenty hours pointed themselves out[2].' It is said to have been made by James Dondi, whose family afterwards got the name of *Horologio*[3]. In remembrance of this circumstance the following verses were inscribed on his tombstone:—

> Quin procul excelsæ monitus de vertice turris
> Tempus, et instabiles numero quod colligis horas,
> Inventum cognosce meum, gratissime lector.

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[1] "Electus in monasterii præsidem—cum jam per amplas licebat fortunas, voluit illustri aliquo opere non modo ingenii, verum etiam eruditionis ac artis excellentis miraculum ostendere. Ergo talem horologii fabricam magno labore, majore sumtu, arte vero maxima compegit, qualem non habet tota, mea opinione, Europa secundam; sive quis cursum solis ac lunæ, seu fixa sidera notet, sive iterum maris incrementa et decrementa, seu lineas una cum figuris ac demonstrationibus ad infinitum pene variis consideret: cumque opus æternitate dignissimum ad umbilicum perduxisset, canones, ut erat in mathesi omnium sui temporis facile primus, edito in hoc libro scripsit, ne tam insignis machina errore monachorum vilesceret, aut incognito structuræ ordine sileret."—See Tanneri Biblioth. Brit. Hibern. p. 629.

[2] In Vit. Princip. Carrar. ap. Murator. tom. xvi. p. 171. "Horologium, quo per diem et noctem quatuor et viginti horarum spatia sponte sua designarentur, in summa turri constituendum curavit."

[3] See Scardeonius De Antiq. Urbis Patavii, lib. ii. class. 9, p. 205, ed. Basil, 1560, fol. and the authors which he quotes.

"John Dondi, son of the former, acquired no less fame by a clock which he constructed also, and which is thus described: 'In which was the firmament and all the planetary globes, so that the movements of all the stars were comprised as in the heavens; it shows the days appointed for festivals and many other things wonderful to be seen: so great was the admirable construction of this clock, that after his death no one knew how to correct it, nor to assign the suitable weights. At length a skilful artist from France, attracted by the fame of this clock, came to Pavia, and employed many days in arranging the wheels, which he succeeded in putting together in proper order, and gave it the right motion[1].'

"We are informed by the Chronica Miscella Bononiensis, that the first clock at Bologna was fixed up in the year 1356: 'On the 8th day of April the great bell of the tower, which was in the palace called della Biada, belonging to Giovanni, lord of Bologna, was removed; and was conveyed into the Corte del Capitano, and was drawn up and placed on the tower del Capitano on Holy Wednesday; and this was the first clock which the state of Bologna ever possessed, and it began to strike on the 19th of May, which Messer Giovanni caused it to do[2].'

"Some time after the year 1364, Charles V., surnamed the Wise, king of France, caused a large clock to be placed in the tower of his palace, by Henry de Wyck[3], whom he invited from Germany, because there was then at Paris no artist of that kind, and to whom he allowed a salary of six sols per day, with free lodging in the tower.

[1] "In quo erat firmamentum, et omnium planetarum sphæræ, ut sic siderum omnium motus, veluti in cœlo, comprehendantur; festa edicta in dies monstrat, plurimaque alia oculis stupenda; tantaque fuit ejus horologii admiranda congeries, ut usque modo post ejus relictam lucem corrigere, et pondera convenientia assignare sciverit astrologus nemo. Verum de Francia nuper astrologus et fabricator magnus, fama horologii tanti ductus, Papiam venit, plurimisque diebus in rotas congregandas elaboravit; tandemque actum est, ut in unum, eo quo decebat ordine, composuerit, motumque ut decet dederit."—These are the words of Mich. Savanarola in Comm. de Laud. Patav. in Muratori, vol. xxiv. col. 1164.

[2] In Muratori, tom. xviii. p. 444. "A dì 8 di Aprile fu tolta via la campana grossa della torre, ch' era nel palazzo di Messer Giovanni signor di Bologna, il qual palazzo dicevasi della Biada; e fu menata nella Corte del Capitano, e tirata e posta sulla Torre del Capitano nel Mercoledì Santo; e questo fu l' orologio, il quale fu il primo, che avesse mai il Commune di Bologna, e si commincio a sonare a dì 19 di Maggio, il quale lo fece fare Messer Giovanni."

[3] Moreri, Diction. art. Horloge du Palais.

"Towards the end of the century, about the year 1370, Strasburg also had a clock, a description of which is given by Conrad Dasypodius[1].

"Courtray, about the same period, was celebrated for its clock, which was carried away by the duke of Burgundy, in the year 1382. This circumstance is thus related by Froissart, a contemporary writer: 'The duke of Burgundy took away a clock (which struck the hours), one of the best to be found, either here or beyond the sea: and he caused this clock to be taken to pieces and placed upon carriages and the bell also. This clock was conveyed to the town of Dijon in Burgundy; and was there put together again and set up; and there it strikes the four-and-twenty hours in the course of day and night[2].'

"We are told by Lehmann[3], that a public clock was put up at Spire in the year 1395. 'That year,' says he, 'the clock was erected on the Altburg gate. The bell for calling the people together to divine worship was cast by a bell-founder from Strasburg.—The works of the clock cost fifty-one florins.'

"The greater part however of the principal cities of Europe were at this period without striking-clocks, which could not be procured but at a great expense. Of this we have an instance in the city of Auxerre. In the year 1483, the magistrates resolved to cause a clock to be constructed; but as it would cost a larger sum of money than they thought they had a right to dispose of by their own authority, they applied to Charles VIII. to request leave to employ a certain part of the public funds for that purpose.

"The great clock in the church of the Virgin Mary at Nuremberg was erected in the year 1462.

"A public clock was put up at Venice in the year 1497[4].

"In the same century an excellent clock, which is described in a letter of Politian[5] to Francis Casa, in the year 1484, was

[1] In the account of the astronomical clock at Strasburg, to be found in Iac. von Königshovens Elsass und Strasb. Chronik. p. 574.

[2] "Le duc de Bourgogne fit oster un horloge (qui sonnoit les heures), l'un des plus beaux qu'on seust trouver deçà ne delà la mer: et celui horloge fit tout mettre, par membres et pieces, sur chars, et la cloche aussi. Lequel horloge fut amené et charroyé en la ville de Digeon en Bourgogne: et fut là remis et assis: et y sonne les heures vingt-quatre, entre jour et nuit."—Vol. ii. c. 128, p. 229.

[3] Lib. vii. c. 69, towards the end.

[4] Thes. Ital. iii. p. 3, p. 308.

[5] Politiani Op. 1533, 8vo, p. 121.

constructed by one Lorenzo, a Florentine, for Cosmo I. of Medici.

"Towards the end of this century clocks began to be in use among private persons. This appears from a letter of Ambrosius Camaldulensis to Nicolaus, a learned man of Florence: 'When I received your letter I immediately made ready your clock, and should have sent it had any one been at hand to have taken it. I have caused it to be cleaned, for it was full of dust, and thus as it could not go freely it was retarded; and because it could not thus run correctly, I gave it to that illustrious youth Angelo, who is most skilful in these things[1].'

"About this period also, mention is made of watches. Among the Italian poems of Gaspar Visconti, there is a sonnet with the following title: 'Si fanno certi orologii piccioli e portativi, che non poco di artificio sempre lavorano, mostrando le ore, e molti corsi de pianeti, e le feste, sonando quando il tempo lo ricerca. Questo sonetto è facto in persona de uno inamorato, che, guardando uno delli predicti orologii, compara se stesso a quello, &c.[2]

"It appears, therefore, that Doppelmayer is mistaken when he says that watches were invented by Peter Hele, at Nuremberg, in the sixteenth century; and that because they were

[1] "Horologium tuum mox, ut tuas accepi literas, paravi, misissemque, si fuisset præsto qui afferret. Ipsam mundari feci, nam erat pulvere obsitum, atque ideo, ne libere posset incedere. retardabatur. Et quia ne sic quidem recte currebat, Angelo illi illustri adolescenti harum rerum peritissimo dedi."

[2] This sonnet I shall here transcribe from A. Saxii Hist. Litterario-typographica Mediolan.:—

Hò certa occulta forza in la secreta
Parte del cor, qual sempre si lavora
De sera a sera, e d'una a l'altra aurora,
Che non spero la mente aver mai quieta.
Legger ben mi potria ogni discreta
Vista nel fronte, ove amor colora
D'affanno e di dolore il punto e l'ora,
E la cagion, che riposar mi vieta.
L'umil squilletta sona il pio lamento,
Che spesso mando al cielo, e la fortuna,
Per disfogar cridando il fier tormento.
De le feste annual non ne mostro una,
Ma pianeti iracondi, e di spavento,
Eclipsati col sole, e con la luna.

Dominico Maria Manni, in his book De Florentinis Inventis, chap. 29, calls the artist Lorenzo a Vulparia, and says that he was a native of Florence.

shaped like an egg, they were called *Nuremberg animated eggs*. I. Cocleus, in his Description of Germany, speaking of this Hele, says, 'This young man has performed works which the most skilful mathematicians may admire. For he makes small watches of steel with numerous wheels, which, as they move without any weight, both point out and strike forty hours, even though they are contained in the bosom or in the pocket[1].' "

CLOCKS AND WATCHES[2] (ADDITIONAL).

THE term *Horologia* occurs very early in different parts of Europe; but as this word, in old times, signified dials as well as clocks, nothing decisive can be inferred from it, unless it can be shown by concomitant circumstances or expressions, that it relates to a clock rather than a dial. Dante seems to be the first author who hath introduced the mention of an *orologio* that struck the hour, and which consequently cannot be a dial, in the following lines:—

> Indi come horologio che *ne chiami*,
> Nel hora che la sposa d'Idio surge,
> Amattinar lo sposo, perche l'ami[3].

Dante was born in 1265, and died in 1321, aged fifty-seven; striking-clocks therefore could not have been very uncommon in Italy, at the latter end of the thirteenth century or the beginning of the fourteenth.

But the use of clocks was not confined to Italy at this period; for we had an artist in England about the same time, who furnished the famous clock-house near Westminster Hall,

[1] Added to his Comm. in Pomp. Melam, cap. de Noriberga. "Eum juvenem adhuc admodum, opera efficere, quæ vel doctissimi admirentur mathematici. Nam ex ferro parva fabricat horologia plurimis digesta rotulis, quæ, quocunque vertantur, absque ullo pondere, et monstrant et pulsant xl horas, etiam si in sinu marsupiove contineantur."

[2] This article was written by the Hon. Daines Barrington. It is here given with the addition of Professor Beckmann's notes, which are distinguished by the initials of his name.

[3] Dante, Paradiso, c. x.

with a clock to be heard by the courts of law, out of a fine imposed on the Chief Justice of the King's Bench, in the sixteenth year of Edward I., or in 1288[1]. Blackstone in his Commentaries has observed, that this punishment of Radulphus de Hengham is first taken notice of in the Year Book[2], during the reign of Richard III., where indeed no mention is made of a clock being thus paid for; but if the circumstances stated in the report of this case are considered, it was highly unnecessary, and perhaps improper, to have alluded to this application of the Chief Justice's fine.

It appears by the Year Book, that Richard III. had closeted the judges in the *Inner* Star Chamber, to take their opinions upon three points of law; the second of which was, "Whether a justice of the peace, who had enrolled an indictment, which had been negatived by the grand-jury, amongst the *true bills*, might be punished for this abuse of his office." On this question a diversity of opinion arose amongst the judges, some of whom supposed that a magistrate could not be prosecuted for what he might have done, whilst others contended that he might, and cited the case of Hengham, who was fined eight hundred marks for making an alteration in a record, by which a poor defendant was to pay only six shillings and eightpence, instead of thirteen shillings and fourpence. Thus far the answer of the judges to the question was strictly proper; but the application of the fine to build a clock-house was not the least material[3]; besides, that it was probably a most notorious fact to every student, upon his first attending Westminster-hall, as we find judge Southcote, so much later, in the early part of queen Elizabeth's reign, not only mentioning the tradition, but that the clock still continued there, which had been furnished out of the Chief Justice's fine[4]. Sir Edward Coke likewise adds, that the eight hundred marks were actually entered on the roll, so that it is highly probable he had himself seen the record[5].

[1] Selden, in his preface to Hengham. [2] Mic. 2 Ric. III.

[3] We find that this clock was considered, during the reign of Henry VI., to be of such consequence, that the king gave the keeping of it, with the appurtenances, to William Warby, dean of St. Stephens, together with the pay of sixpence per diem, to be received at the Exchequer. See Stow's London, vol. ii. p. 55. The clock at St. Mary's, Oxford, was also furnished in 1523, out of fines imposed on the students of the university.

[4] III. Inst. p. 72. [5] IV. Inst. p. 255.

But we have remaining to this day some degree of evidence, not only of the existence of such a clock, but that it is of the antiquity already ascribed to it, viz. the reign of Edward I. On the side of New Palace-yard, which is opposite to Westminster-hall, and in the second pediment of the new buildings from the Thames, a dial is inserted with this remarkable motto upon it, "*Discite justitiam moniti*," which seems most clearly to relate to the fine imposed on Radulphus de Hengham being applied to the paying for a clock. But it may be said that this inscription is on a dial and not upon a clock; which though it appears upon the first stating it to be a most material objection, yet I conceive it may receive the following satisfactory answer. The original clock of Edward the First's reign was probably a very indifferent one, but from its great antiquity, and the tradition attending it, was still permitted to remain till the time of queen Elizabeth, according to the authorities already cited. After this, being quite decayed, a dial might have been substituted and placed upon the same clock-house, borrowing its very singular motto; which whether originally applied in the time of Edward I. or in later reigns, most plainly alludes to Hengham's punishment for altering a record. It should also be mentioned that this dial seems to have been placed exactly where the clock-house stood according to Strype[1].

Mr. Norris, secretary to the Society of Antiquaries, hath been likewise so obliging as to refer me to the following instance of a very ancient clock in the same century: *Anno* 1292, *novum orologium magnum in ecclesia* (Cantuariensi), *pretium* 30*l.*[2].

I shall now produce a proof, that not only clocks but watches were made in the beginning of the fourteenth century. Seven or eight years ago, some labourers were employed at Bruce Castle, in Fifeshire, where they found a watch, together with some coin, both of which they disposed of to a shopkeeper of St. Andrews, who sent the watch to his brother in London, considering it as a curious piece of antiquity. The outer case is silver, raised in rather a handsome pattern over a ground of blue enamel; and I think I can distinguish a cypher of R. B.

[1] p. 55, in his Additions to Stow. This clock-house continued in a ruined state till the year 1715.—Grose's Antiquarian Repertory, p. 280.

[2] Dart's Canterbury, Appendix, p. 3.

at each corner of the enchased work. On the dial-plate is written *Robertus B. Rex Scotorum*, and over it is a convex transparent horn, instead of the glasses which we use at present. Now *Robertus B. Rex Scotorum* can be no other king of Scotland than Robert Bruce, who began his reign in 1305, and died in 1328; for the Christian name of Baliol, who succeeded him, was Edward; nor can *Robertus B.* be applied to any later Scottish king. This very singular watch is not of a larger size than those which are now in common use; at which I was much surprised till I had seen several of the sixteenth century in the collection of Sir Ashton Lever and Mr. Ingham Forster, which were considerably smaller.

As I mean to deduce the progress of the art of clock-making in a regular chronological series, the next mention I find of *horologia* is in Rymer's Fœdera, where there is a protection of Edward III., in the year 1368, to three Dutchmen, who were *Orlogiers*. The title of this protection is, "De horologiorum artificio exercendo;" and I hope to have sufficiently proved that there was no necessity of procuring mere dial-makers at this time.

Clock-makers however were really wanted at this period of the fourteenth century, as may be inferred from the following lines of Chaucer, when he speaks of a cock's crowing:—

> Full sikerer was his crowing in his loge,
> As is a *clock*, or any abbey orloge[1]:

by which, as I conceive at least, our old poet means to say, that the crowing was as certain as a *bell* or abbey-*clock*[2]. For though we at present ask so often, "What is it *o'clock*?" meaning the time-measurer, yet I should rather suppose, that in the fourteenth century the term *clock* was often applied to a *bell* which was rung at certain periods, determined by an hour-glass or a sun-dial. Nor have I been able to stumble

[1] Chaucer was born in 1328, and died in 1400.

[2] To the time of queen Elizabeth clocks were often called *orologes*:

> He 'll watch the *horologe a double set*,
> If drink rock not his cradle.—Othello, act ii. sc. 3.

by which the double set of twelve hours on a clock is plainly alluded to, as not many more than twelve can be observed on a dial; and in the same tragedy this last time-measurer is called by its proper name:

> More tedious than the dial eight score times.—*Ibid.* act iii. sc. 4.

The clock of Wells cathedral is also, to this day, called the *horologe*.

upon any passage which alludes to a clock, by that name, earlier than the thirteenth year of the reign of Henry VIII[1]. The abbey *orloge* (or clock) however must have been not uncommon when Chaucer wrote these lines; and from clocks beginning to be in use we might have had occasion for more artificers in this branch, though it should seem that we had Englishmen, who pretended at least to understand it, because the protection of Edward III. above-cited, directs that the persons to whom it was granted, should not be molested whilst they were thus employed.

I now pass on to a famous astronomical clock, made by one of our countrymen in the reign of Richard II., the account of which I have extracted from Leland. Richard of Wallingford was son of a smith, who lived at that town, and who, from his learning and ingenuity, became abbot of St. Albans. Leland, speaking of him, says, "Cum jam per amplas licebat fortunas, voluit illustri aliquo opere, non modo ingenii, verum etiam eruditionis, ac artis excellentis, miraculum ostendere. Ergo talem *horologii* fabricam magno labore, majore sumtu, arte vero maxima, compegit, qualem non habet tota Europa, *mea opinione*, secundam, sive quis cursum solis ac lunæ, seu fixa sidera notet, sive iterum maris incrementa et decrementa[2]." Richard of Wallingford wrote also a treatise on this clock, "Ne tam insignis machina vilesceret errore monachorum, aut incognito structuræ ordine silesceret." From what hath been above stated, it appears that this astronomical clock continued to go in Leland's time, who was born at the latter end of Henry VII.'s reign, and who speaks of a tradition, that this famous piece of mechanism was called *Albion* by the inventor.

Having thus endeavoured to prove that clocks were made in England from the time of Edward I. to that of Richard II., it is not essential to my principal purpose to deduce them lower through the successive reigns; but when I have shortly stated what I happened to have found with regard to this use-

[1] See Dugdale's Origines Jurid. Lydgate, therefore, who wrote before the time of Henry VIII., says,

I will myself be your *orologere*
To-morrow early.—Prologue to the Storye of Thebes.

[2] Leland de Script. Brit. [The translation of this passage will be found at p. 350.]

ful invention in other parts of Europe, I shall attempt to show why they were not more common in the thirteenth and fourteenth centuries.

The citation from Dante, which I have before relied upon, shows that they were not unknown in Italy during that period; and M. Falconet, in Mémoires de Litterature, informs us, that a James Dondi, in the fourteenth century, assumed from a clock made by him for the tower of a palace, the name of *Horologius*, which was afterwards borne by his descendants.

In France, or what is now so called, Froissart mentions, that during the year 1332, Philip the Hardy, duke of Bur gundy, removed from Courtray to his capital at Dijon a famous clock which struck the hours, and was remarkable for its mechanism[1]. The great clock at Paris was put up in the year 1370, during the reign of Charles V., having been made by Charles de Wic[2] a German. Carpentier, in his supplement to Du Cange, cites a decision of the parliament of Paris in the year 1413, in which Henry Bye, one of the parties, is styled *Gubernator Horologii palatii nostri Parisiis*[3]. About the same time also the clock at Montargis was made, with the following inscription:—

Charles le Quint (sc. de France)
Me fit par Jean de *Jouvence.*

The last word seems to be the name of a Frenchman

Though I have not happened to meet with any mention of very early clocks in Germany, yet from the great clock at Paris in 1370 being the work of De Wic, as also from the protection granted by Edward III. to three clock-makers from Delft, it should seem that this part of Europe[4] was not without

[1] Froissart, vol. ii. ch. 127. [2] Falconet, Mémoires de Litt. vol. xx.
[3] See Carpentier, art. *Horologiator.*
[4] Mr. Peckett, an ingenious apothecary of Compton Street, Soho, hath shown me an astronomical clock which belonged to the late Mr. Ferguson, and which still continues to go. The workmanship on the outside is elegant, and it appears to have been made by a German in 1525, by the subjoined nscription in the Bohemian of the time:

Iar. da. macht. mich. Iacob. Zech.
Zu. Prag. ist. bar. da. man. zalt. 1525.

The above Englished:

Year. when. made. me. Jacob. Zech.
At. Prague. is. true. when. counted. 1525.

The

this useful invention; and the same may be inferred with regard to Spain from the old saying, "Estar como un relox[1]."

Having now produced instances of several clocks, and even a watch, which were made in different parts of the fourteenth century, as also having endeavoured to prove that they were not excessively uncommon even in the thirteenth, it may be thought necessary that I should account for their not being more generally used during those periods, as in their present state at least they are so very convenient. For this it should seem that many reasons may be assigned.

In the infancy of this new piece of mechanism, they were probably of a very imperfect construction, perhaps never went tolerably, and were soon deranged, whilst there was no one within a reasonable distance to put them in order. To this day the most musical people have seldom a harpsichord in their house, if the tuner cannot be procured from the neighbourhood. We find therefore that Henry VI. of England, and Charles V. of France, appointed clock-makers, with a stipend, to keep the Westminster and Paris clocks in order.

It need scarcely be observed also, that, as the artists were so few, their work must have been charged accordingly, and that kings only could be the purchasers of what was rather an expensive toy than of any considerable use. And it may perhaps be said, that they continued in a great measure to be no better than toys till the middle of the seventeenth century. Add to this, that in the thirteenth and fourteenth centuries, there was so little commerce, intercourse, or society, that an hour-glass, or the sun, was very sufficient for the common purposes, which are now more accurately settled by clocks of modern construction. Dials and hour-glasses likewise wanted no mending.

Having now finished what hath occurred to me with regard

The diameter of the clock is nine inches three-fourths, and the height five inches.

[I have transposed the words, as I find them in the original; but *war* seems to have stood in the place of *bar*, at least Barrington has translated it by *is true*, and we must read,

Da man zält 1525 *jar*
Da macht mich Iacob Zech zu Prag ist wahr.—I. B.]

[1] I am also referred by the Rev. Mr. Bowle, F.S.A., to the following passage in the Abridged History of Spain, vol. i. p. 568: "The first clock seen in Spain was set up in the cathedral of Seville, 1400."

to the first introduction of clocks, I shall conclude by a few particulars, which I have been enabled to pick up, in relation to those more portable measurers of time, called *watches*, the earliest of which, except that of Robert Bruce, king of Scotland, seems to be one in Sir Ashton Lever's most valuable museum, the date upon which is 1541[1].

Derham, in his Artificial Clock-maker [2], published in 1714, mentions a watch of Henry VIII. which was still in order; and Dr. Demainbray informs me, that he hath heard both Sir Isaac Newton and Demoivre speak of this watch [3]. The emperor Charles V., Henry's contemporary, was so much pleased with these time-measurers, that he used to sit after his dinner with several of them on the table, his bottle being in the centre [4]; and when he retired to the monastery of St. Just, he continued still to amuse himself with keeping them in order, which is said to have produced a reflection from him on the absurdity of his attempt to regulate the motions of the different powers of Europe.

Some of the watches used at this time seem to have been strikers; at least we find in the Memoirs of Literature, that such watches having been stolen both from Charles V. and Lewis XI. whilst they were in a crowd, the thief was detected by their striking the hour [5]. In most of the more ancient watches, of which I have seen several in the collection of Sir Ashton Lever and Mr. Ingham Forster, catgut supplied the place of a chain [6], whilst they were commonly of a

[1] The oldest clock we have in England that is supposed to go tolerably, is of the preceding year, viz. 1540, the initial letters of the maker's name being N. O. It is in the palace at Hampton Court.—Derham's Artificial Clock-maker.

[2] A German translation of this book is added to Welper's Gnomick.—I. B.

[3] That distinguished antiquary Horace Walpole has in his possession a clock, which appears by the inscription to have been a present from Henry VIII. to Anne Boleyn. Poynet, bishop of Winchester, likewise gave an astronomical clock to the same king.—Godwyn de Præsul.

[4] Mémoires de Litt. vol. xx. See also Hardwicke's Collection of State Papers, vol. i. p. 53.

[5] Vol. xx.

[6] A clockmaker of this city (Göttingen) assured me that several watches which had catgut instead of a chain, were brought to him to be repaired. I. B. [Sir Richard Burton, of Sackets Hill, Isle of Thanet, has now in his possession an early silver watch, presumed to be of the time of queen Elizabeth, in which catgut is a substitute for chain.

A similar watch is also in the possession of Sir Thomas Dick Lauder, Bart., which formerly belonged to the unfortunate queen Mary, and descended to

smaller size than we use at present, and often of an oval form [1].

From these and probably many other imperfections, they were not in any degree of general request till the latter end of queen Elizabeth's reign. Accordingly in Shakspeare's Twelfth Night, Malvolio says, "I frown the while, and perchance *wind up my watch*, or play with some rich jewel." Again, in the first edition of Harrington's Orlando Furioso, printed in 1591, the author is represented with what seems to be a watch, though the engraving is by no means distinct, on which is written "Il tempo passa [2].

In the third year of James I., a watch was found upon Guy Fawkes, which he and Percy had bought the day before, "to try conclusions for the long and short burning of the touch-wood, with which he had prepared to give fire to the train of powder [3]."

In 1631, Charles I. incorporated the clock-makers; and the charter prohibits *clocks*, *watches*, and *alarms*, from being imported; which sufficiently proves that they were now more commonly used, as well as that we had artists of our own who were expert in this branch of business.

About the middle of the seventeenth century, Huygens made

him from the Seton family. It is made of silver in the form of a death's head, with open work for the escape of sound, the other parts covered with emblematical engraving. It appears originally to have been constructed with catgut, but now has a chain. It goes extremely well, but requires winding-up every twenty-six hours to keep it accurately to time. Queen Mary bequeathed it to Mary Seton, February 7, 1587. An engraving with a very full description of this curious watch, will be found in Smith's Historical and Literary Curiosities, Lond. 1845, 4to, plate 96.—H. G. B.]

[1] Barrington says here, in a note, "Pancirollus informs us, that about the end of the fifteenth century watches were made no larger than an almond, by a man whose name was Mermecide.—Encyclop." The first part of this assertion is to be found, indeed, in Pancirollus, edition of Frankfort, 1646, 4to, ii. p. 168; but Myrmecides was an ancient Greek artist, whose *παραναλώματα*, or uncommonly small pieces of mechanism, are spoken of by Cicero and Pliny. He is not mentioned by Pancirollus, but by Salmuth, p. 231. It is probable that this error may be in the Encyclopédie; at least Barrington refers to it as his authority.—I. B.

[2] Somner's Canterbury, Supplement, No. xiv. p. 36. See also, in an extract from archbishop Parker's will, made April 5th, 1575: "Do et lego fratri meo Ricardo episcopo Eliensi baculum meum de canna Indica, qui *horologium* habet in summitate." As likewise in the brief of his goods, &c., No. xiv. p. 39, a clock valued at 54*l.* 4*s.* [3] Stow's Chron. p. 878; and Introduct. to Mr. Reuben Burrow's Almanac for 1778.

his great improvement in clock-work, which produced many others from our own countrymen [1]; the latest of which was the introduction of repeating watches, in the time of Charles II., who, as I have been informed by the late lord Bathurst, sent one of the first of these new inventions to Lewis XIV. The former of these kings was very curious with regard to these time-measurers; and I have been told by an old person of the trade, that watchmakers, particularly East, used to attend whilst he was playing at the Mall; a watch being often the stake.

But we have a much more curious anecdote of royal attention to watches in Dr. Derham's Artificial Clock-maker (p. 107). Barlow had procured a patent, in concert with the Lord Chief Justice Allebone, for *repeaters*; but Quare making one at the same time upon ideas he had entertained before the patent was granted, James II. tried both, and giving the preference to Quare's, it was notified in the gazette. In the succeeding reign, the reputation of the English work in this branch was such, that in the year 1698, an act passed, obliging the makers to put their names on watches, lest discreditable ones might be sold abroad for English [2].

Letter on the pretended Watch of King Robert Bruce [3].

You will remember that I formerly mentioned something to you in reference to the observations made by the Hon. Daines Barrington, on the earliest introduction of clocks, published in the Annual Register for 1779, under the article Antiquities, p. 133. According to your desire, I will communicate what circumstances come within my personal knowledge, about a watch that corresponds very much to one described by him as once the property of king Robert Bruce. I must be indulged, although in some particulars I cannot speak with absolute

[1] More particularly Dr. Hook, Tompion, &c.

[2] The ninth and tenth of William III. ch. 28, s. 2.

[3] This letter, signed John Jamieson,. and dated Forfar, August 20th, 1785, is taken from the Gentleman's Magazine, vol. ii. p. 688.

One of my literary friends in London, to whom I am indebted for much learned information, says in a letter which I received from him, "I had never believed the story of Robert Bruce's watch, mentioned in your translation of Barrington's History of Clocks, the more as Mr. Barrington is famous for being in the wrong; but in the Gentleman's Magazine there is a full account of the origin of this imposition." As this error occurs in a paper which I have endeavoured to render more public by a translation, I consider myself bound to give a translation of this letter also.—B.

certainty, as so much time hath elapsed since the transaction I am going to relate.

Being early fond of anything ancient or uncommon, I used to purchase pieces of old coin from a goldsmith who wrought privately in Glasgow, and sometimes went about as a hawker. Having often asked him from the curiosity of a boy, if he had ever been at the castle of Clackmannan, or heard of any antiquities being found there, he told me that he had purchased from Mrs. Bruce, who is the only survivor of that ancient family in the direct line, an old watch, which was found in the castle, and had an inscription, bearing, that it belonged to king Robert Bruce. I immediately asked a sight of it; but he told me it was not at hand. He fixed a time for showing me this invaluable curiosity; but even then it could not be seen. My avidity produced many anxious calls, although by that time I began to suspect he meant to play upon me, especially as I did not think it altogether credible that Mrs. Bruce would sell such a relict of her family if she had ever had it in her possession. At length I was favoured with a sight of it. The watch, as far as I can recollect, almost entirely answered the one described. It had a ground of blue enamel. It had a horn above the dial-plate instead of a glass. The inscription was on the plate. But whether it was *Robertus B.* or *Robertus Bruce*, I cannot remember. The watch was very small and neat, and ran only, to the best of my knowledge, little more than twelve hours, at least not a complete day. The Hon. Mr. Barrington does not mention anything about this circumstance. It is about twelve years since I saw it. Whether there be any castle in Fife properly called Bruce castle, I know not; but the castle of Clackmannan hath always been the residence of the eldest branch of the family; and although the town in which it stands now gives name to a small county, yet in former times, and still in common language, that whole district receives the name of Fife, as distinguishing it from the county on the other side of the firths of Forth and Tay. The first thing that occurred to me about the watch itself, was in regard to the inscription. Observing that all the coins of king Robert's age bore Saxon characters, I could not believe the inscription to be genuine, because the characters were not properly Saxon, but a kind of rugged Roman, or rather Italic characters, like those commonly engraved, but evidently done

very coarsely, to favour the imposition. He valued it at 1*l.* 10*s.*, but I would have nothing to do with it. The first time I had an opportunity of seeing Mrs. Bruce of Clackmannan, after this, I asked her if such a watch had ever been found. She told me that she never so much as heard of any such thing. This confirmed the justness of my suspicion.

I paid no further regard to this story till about seven years ago, when I received a letter from a friend, informing me, that a brother of his in London, who had a taste for antiquity, had desired him, if possible, to procure some intelligence from Glasgow about a watch, said to be king Robert Bruce's, which had thence found its way to London, and was there making a great noise among the antiquaries. I then applied to my former goldsmith, who was then in a more respectable way, and mentioned the old story. He immediately fell a-laughing, and told me, that he did it merely for a piece of diversion, and thought the story would take with me, as I had been often asking about the place. He said that it was an old watch brought from America; that, to get some sport with my credulity, he had engraved the inscription upon it in a rough, antiquated-like form; that he had afterwards sold it for two guineas; he had learned that it was next sold for five, and had never more heard of it.

However early the invention of clocks might be, I am greatly mistaken if any authentic documents can be produced of the art of making pocket-watches being discovered so early as the beginning of the fourteenth century. Lord Kaimes, somewhere in his Sketches of Man, asserts, that the first watch was made in Germany, so far as I can remember, near the close of the fifteenth century [1]. If any watch had been made so early as R. Bruce's time, it is most likely the inscription would have been in Saxon characters, as not only the money both of Scotland and England, but of Germany, in that age, bears a character either Saxon, or greatly resembling it.

Whatever ardour one feels for anything that bears the genuine marks of antiquity, it is certainly a debt he owes to those who have the same taste, to contribute anything in his power

[1] The passage may be found, vol. i. p. 95, of the edition in quarto. Edinburgh, 1774: "Pocket-watches were brought there from Germany, an. 1577." Home, or Lord Kaimes, however, was too celebrated or too artful a writer to produce proofs of his historical assertions.—B.

that may prevent impositions, to which antiquaries are abundantly subject, through the low humour or avarice of others; or that may tend to confirm a fact by proper comparison and minute investigation of circumstances. Besides, this is of greater moment than settling the genuineness of a coin, or many other things of the same nature, because it involves in it the date of a very important discovery. It doth not merely refer to the history of an individual, or even of one nation, but to the history of man. It respects the progress of the arts; and an anachronism here is of considerable importance, because, being established upon a supposed fact, it becomes a precedent for writers in future ages.

[The time and place at which watches were first made similar to those now in use, are not positively determined. The first step towards its accomplishment must have consisted in making a mainspring the source of motion instead of a weight[1]. The invention of the fusee speedily followed the mainspring, and without it the former would be useless, in consequence of its tension varying according to the size of its coil. In the time of Elizabeth a watch was a very different kind of instrument to one of the present day. As regards size, it closely resembled one of our common dessert-plates. Before Dr. Hooke's improvement, the performance of watches was so very irregular that they were considered as serving only to give the time for a few hours, and this in rather a random kind of way. The invention by Dr. Hooke of a spiral spring applied to the arbor of the balance, by which means effects were produced on its vibrations similar to the action of gravity on the pendulum of a clock, was perhaps of more importance than any improvement which has been subsequently made. Watches were common in France before 1544, as in that year the corporation of master clockmakers in Paris had a statute enacted to ensure to themselves the exclusive privilege of making and causing to be made clocks and watches, large or small, within the precincts of that city. The anchor-escapement was invented by Clement, a London clockmaker, in 1680. Previously to 1790, two kinds of watches were made, the vertical and the horizontal. The former was first used in clocks, then in watches. The horizontal was invented in 1724, by George

[1] This was first used early in the sixteenth century.

Graham, F.R.S. (an apprentice of the renowned Tompion), to whom we are indebted for two of the most valuable improvements in clocks which have ever been made, viz. the dead-beat, or Graham escapement[1], as it is called, and the mercurial compensation pendulum. The best proof that can be adduced of the importance of these inventions is, that they still continue to be employed in all their early simplicity, in the construction of the best astronomical clocks of the present day. Graham's horizontal escapement is still extensively employed in the Swiss and Geneva watches, but in the better sort of those of English manufacture, it has been superseded by the duplex, and recently by the lever, which is nothing more than the application of Graham's dead-beat escapement to the watch, though patents have been taken out by various persons who have claimed the invention. The most remarkable inventions of this period were those of Harrison, consisting of his gridiron pendulum, the going fusee, the compensation curb, and the remontoir escapement. In 1736, he appears to have completed his longitude watch, and received from the Royal Society their gold medal; he ultimately received the government reward of £20,000, together with other sums from the Board of Longitude and the Honourable East India Company. Notwithstanding his application of the compensation curb to the watch, it was still a subject of inquiry, and by many persons it was thought that the expansion and contraction of the metal, of which the spring is composed, was the source of variation in the equality of its motion under changes of temperature; but the consideration that the change of rate in the clock, with a seconds pendulum, in passing from the winter to the summer temperature, amounted only to about twenty seconds, while that of the watch exceeded six minutes and a half under similar circumstances, led careful observers to infer that some other cause must be assigned for the anomaly, and the loss of elasticity of the balance-spring by heat began to be suspected, as appears by the following passage in the Prize Essay of Daniel Bernoulli, read before the French Academy:—"I must not omit (said this celebrated

[1] A very detailed and learned pamphlet has just been written on this beautiful escapement by Benjamin L. Vulliamy, F.R.A.S., clock-maker to the Queen, entitled, 'On the Construction and Theory of the Dead-Beat Escapement of Clocks.'

geometrician) a circumstance which may be prejudicial to balance watches; it is, that experimental philosophers pretend to have remarked that certain changes of elastic force uniformly follow changes of temperature. If that be the case, the spring can never uniformly govern the balance." That which Bernoulli only conjectured, was in 1773 established as a matter of certainty, and the amount in loss of time due to each of the three conjointly operating causes determined by Berthoud to be,—loss by expansion of the balance, 62 seconds; loss by elongation of the balance-spring, 19 seconds; and loss by the diminution of the spring's elastic force by heat, 312 seconds, by an increase of 60° of heat of Fahrenheit's scale. We have previously observed that Harrison's compensation curb was inefficient, as besides other defects, it interfered too much with the isochronism of the balance-spring, as the inventor himself was candid enough to confess that the balance, balance-spring, and compensation curb, were not contemporaneously affected by changes of temperature, since small pieces of metal were sooner affected than large, and those in motion before those at rest. Whence he was led to conclude, that if the provision for heat and cold could properly reside in the balance itself, as was the case with his gridiron pendulum clocks, the time-piece might be made much more perfect. This ingenuous observation is the more to Harrison's credit, as it was certainly his interest to conceal such a suggestion, being at that time a candidate for the government reward. The complexity of Harrison's timekeeper and the high price, £400, demanded by Kendall to make them after that model, still left the timekeeper to be discovered that would come within the means of purchase of private individuals: for admirably as Harrison had succeeded in the construction of those which had procured him his reward, and great as were the talents of his assistant Larcum Kendall, yet for practical purposes, there needed an instrument of greater simplicity, and to John Arnold we are indebted for its invention.

Arnold is also celebrated for the manufacture of the smallest repeating-watch ever known: it was made for his majesty George III., to whom it was presented on his birthday, the 4th of June 1764. Although less than six-tenths of an inch in diameter, it was perfect in all its parts, repeated the hours,

quarters and half-quarters, and contained the first ruby cylinder ever made. Indeed so novel was the construction of this little specimen of mechanical skill, that he was forced not only to form the design and execute the work himself, but also to manufacture the greater part of the tools employed in its construction. It is minutely described in Rees's Cyclopædia, and also in the Sporting Magazine of that time, in which latter work it is correctly stated to be of the size of a silver twopence, and its weight that of a sixpence. The King was so much pleased with this rare specimen of mechanical skill, that he presented Mr. Arnold with 500 guineas; and the Emperor of Russia afterwards offered Mr. Arnold 1000 guineas for a duplicate of it, which he declined.

Arnold's model, though destined to perform the same office as Harrison's, was entirely different in its construction, and was as simple as his predecessor's was complex. By progressive stages of improvement, it was brought by the inventor himself to so high a point of perfection, that it continues to be the model followed in the construction of the best chronometers of the present day. The instruments upon which Arnold experimented are now in the possession of his successor, Mr. C. Frodsham, and show the gradual progress of advancement made in the escapement, &c., until he arrived at that beautiful, yet simple, detached escapement, which is still followed, and known under the name of the Arnold escapement. He was the first watchmaker who introduced jewelling into watches and clocks, and in 1771 he applied ruby pallets to the two clocks of the Royal Society by Graham and Smeaton, and likewise to the transit clock by Graham at the Royal Observatory, Greenwich. In 1776 Arnold achieved what was unquestionably his greatest work, viz. the invention of the cylindrical spring and compensation balance, and their application in the chronometer, which is the name that Arnold then first employed to designate his timekeepers. This ingenious and valuable discovery introduced a new æra in chronometry. Each part of the machine under the new arrangement performed unchecked the office assigned to it. The escapement was completely detached, except at the moment of discharge and giving impulse; the balance-spring, no longer interfered with in corrections for temperature (as formerly) by the com-

pensating curb, became a free agent and the generator of motion, in which state only it is capable of being perfectly isochronized; the balance, by its expansion and contraction, varied its inertia according to the varied tension of the balance-spring by its increased or diminished elastic force in changes of temperature, while the office of the main-spring was reduced to that of a simple maintaining power. This beautiful discovery, together with the law of isochronism and other important improvements in the modification of the compensation balance, procured for him and his son John Roger Arnold the reward from government of the sum of £3000. The accuracy with which *chronometers* keep time is truly astonishing: in 1830 two chronometers constructed by Mr. Charles Frodsham were submitted for public trial at the Royal Observatory, Greenwich, for twelve months, and were observed daily. One of them made an extreme variation of 86-hundredth parts of a second, and the other of 57-hundredths only; but even this degree of accuracy, surprising as it is, is surpassed by the performance of his best *astronomical* clocks. It is therefore highly honourable to the English artists, that by their ingenuity and skill they have accomplished the great object which had occupied the attention of the learned of Europe for nearly 300 years, namely, the means of discovering the longitude at sea. It is not a little singular that Sir Isaac Newton suggested the discovery of the longitude by the aid of an accurate timekeeper.

If we go back to the period of Philip III. of Spain, we shall then see the interest and importance attached to this great discovery. As early as 1598, this monarch offered a reward of 100,000 crowns to any person who should discover the means of finding the longitude of a ship at sea; but what was the opinion then entertained of the nature of the task to be accomplished by means of the balance-watches then in use, may be gathered from an expression of Morin, who wrote about the year 1630, and who in speaking to the Cardinal Richelieu of the difficulty of constructing an instrument which should keep time to the requisite degree of accuracy for that purpose, is reported to have said, "Id verò an ipsi dæmoni nescio, homini autem suscipere scio esse stultissimum[1]."

[1] "I know not what such an undertaking would be even to the devil himself, but to man it would, undoubtedly, be the height of folly."

We have not said much on the beautiful discovery of the law of isochronism, of the balance-spring, on which the higher adjustment of clocks and watches so entirely depend, as an elaborate essay on this subject by Charles Frodsham, F.R.A.S., is in the hands of the publisher, and will shortly be circulated.

Some very ingenious contrivances have within the last few years been effected in the application of the electric fluid as a source of motive power to clocks and chronometers, and they offer peculiar advantages in the great simplicity of the apparatus in which wheels are dispensed with, hence friction is reduced to a minimum. Their invention is a subject of dispute between Professor Wheatstone and Mr. Alexander Bain [1]. We shall briefly describe Mr. Bain's clock. His source of electricity is obtained by fixing galvanic plates in moist earth. The clock consists of a pendulum, the bob of which vibrates between the poles of two permanent magnets, the opposite poles of which face one another. A small platinum-ball is affixed to the upper part of a small brass stem, which is free for lateral motion, being fastened below to a light spindle carried by the upper part of the pendulum-rod. A wire coated with silk is attached to the lower end of the suspension-spring of the pendulum. It is led down the back of the rod (which is composed of wood) and then coiled longitudinally in many convolutions around the edge of the bob in a groove. It is then taken up the back of the rod and terminates in the bearings of the spindle. The pendulum is suspended from a metal bracket fixed to the back of the case, and to which one of the poles of the battery is attached. Two pins are fixed horizontally, parallel with the platinum-ball, leaving space for its lateral motions, and at such a distance that the ball alternately comes into contact with each pin, when the pendulum has reached the opposite extremity of its arc. The other pole of the battery is placed in contact with the metal bracket which supports one of the pins. As long as the platinum-ball rests on the pin projecting from the pin-bracket to which the second pole of the battery is attached, a constant current of electricity is established and passes through the earth, the plates and the wires. But when the pendulum is set in motion by being

[1] The details of this dispute may be found in the "Applications of the Electric Fluid to the Useful Arts," by Mr. Alexander Bain. Lond. 1843. Professor Wheatstone's clock, &c. is described in the Phil. Trans. for 1841.

drawn on one side, the point of support of the rod carrying the platinum-ball is thus moved to the same side, hence the centre of gravity of the platinum-ball being removed beyond its base, it falls upon the opposite pin. This motion of the ball lets on and cuts off the flow of electricity, at or near the ends of the vibrations of the pendulum, so that the convoluted wire of the bob is alternately attracted and repelled by the magnets at the proper points of its vibrations, and thus a continual motion is kept up. Mr. Bain has also contrived arrangements by which a great number of clocks may be worked simultaneously or in rotation; as also by which ordinary clocks may be made to keep time. The latter are effected by transmitting a current of electricity once in every four hours from a regulating clock. As the details connected with these valuable contrivances can hardly be followed without figures, we must rest satisfied with referring the reader to Mr. Bain's work, before cited.]

QUARANTINE.

Of all the means by which in modern times the infection of that dangerous malady, the plague, has been so much guarded against, that according to general opinion, unless the Deity render all precaution useless, it can never again become common in Europe, the most excellent and the most effectual is, without doubt, the establishment of quarantine [1]. Had not history been more employed in transmitting to posterity the

[1] [This opinion is not generally admitted by the most experienced medical men in this country. It is a disputed point whether the plague is *even* contagious; and the mass of evidence is in favour of its being so occasionally, but that the plague is usually not propagated in this manner. The disappearance of this pest from our own and most other countries of Europe is undoubtedly owing to the much greater attention paid to drainage, ventilation, and the prevention of the accumulation of filth in the streets, &c. When the peculiar atmospheric conditions upon which its diffusion depends are present, quarantine has proved insufficient to prevent its propagation.]

crimes of princes, and particularly the greatest of them, destructive wars, than in recording the introduction of such institutions as contribute to the convenience, peace, health and happiness of mankind, the origin of this beneficial regulation would be less obscure than it is at present. At any rate, I have never yet been so fortunate as to obtain a satisfactory account of it; but though I am well-aware that I am neither acquainted with all the sources from which it is to be drawn, nor have examined all those which are known to me, I will venture to lay before my readers what information I have been able to collect on the subject, assuring them at the same time, that it will afford me great pleasure if my attempt should induce others fond of historical research to enlarge it.

The opinion that the plague was brought to Europe from the East, is, as far as I am able to judge, so fully confirmed, that it cannot be any longer doubted; though it is certainly true, that every nation endeavours to trace the origin of infectious disorders to other people. The Turks think that the plague came to them from Egypt; the inhabitants of that country imagine that they received it from Ethiopia; and perhaps the Ethiopians do not believe that this dreadful scourge originated among them [1]. As the plague however has always been conveyed to us from the East, and has first, and most frequently, broken out in those parts of Europe which approach nearest to the Levant, both in their physical and political situation, those I mean which border on Turkey, and carry on with it the most extensive trade, we may with the more probability conjecture that these countries first established quarantine, the most powerful means of preventing that evil. If further search be made in regard to this idea, we shall be inclined to ascribe that service to the Venetians, a people who, when the plague began to be less common, not only carried on the

[1] The oldest plague of which we find any account in history, that so fully described by Thucydides, book ii., was expressly said to have come from Egypt. Evagrius in his Histor. Ecclesiast. iv. 29, and Procopius De Bello Persico, ii. 22, affirm also that the dreadful plague in the time of the emperor Justinian was likewise brought from Egypt. It is worthy of remark, that on both these occasions, the plague was traced even still further than Egypt; for Thucydides and the writers above-quoted say that the infection first broke out in Ethiopia, and spread thence into Egypt and other countries.

greatest trade in the Levant, but had the misfortune to become always nearer neighbours to the victorious Turks. It is also probable that the Hungarians and Transylvanians soon followed their example in this approved precaution, as the Turks continued to approach them; and this agrees perfectly with everything I have read in history.

In the first centuries of the Christian æra, it does not seem to have been known that infection could be communicated by clothing and other things used by infected persons. The Christians all considered the plague as a divine punishment, or predestinated event, which it was as impossible to avoid as an earthquake; and the physicians ascribed the spreading of it to corrupted air, which could not be purified by human art. The Christians therefore gave themselves up, like the Turks at present, to an inactive and obstinate resignation in the will of God, and hoped by fasting and prayer to hasten the end of their misfortune.

But after the plague in the fourteenth century, which continued longer than any other, and extended over the greater part of Europe, the survivors found that it was possible to guard against or prevent infection; and governments then began to order establishments of all kinds to be formed against it. The oldest of which mention has yet been found in history, are those in Lombardy and Milan of the years 1374, 1383 and 1399 [1].

In the first-mentioned year the Visconte Bernabo made regulations, the object of which was to guard against the spreading of the plague by intercourse and mixing with those who were infected; and with that view it was ordered, that those afflicted with this disease should be removed from the city, and allowed either to die or to recover in the open air, Those who acted otherwise were to suffer capital punishment, and their property was to be confiscated. But twenty-five years after it was strictly commanded that the clothes and things used by those who had the plague should be purified with great care: and in 1383 it was forbidden under severe punishment to suffer any infected person to enter the country. These means, however imperfect, must have been attended

[1] They may be found in Muratori Scriptores Rerum Italic. tom. xvi. p. 560, and xviii. p. 82, thence copied into Chenot, p. 147. See also Boccacio, Decamer. Amst. 1679, p. 2.

with utility, because they were again employed during a new danger of the same kind in the fifteenth century.

Brownrigg, an Englishman, who wrote a book on the means of preventing the plague, says, that quarantine was first established by the Venetians in the year 1484[1], but like his learned countryman Mead, who assigns the same year, without adducing any proofs[2]. I imagined that I should find some more certain information respecting this point in Le Bret's History of the Republic of Venice; but as that historian does not mention, as the title professes, the original sources from which he derived his materials, his work is less worthy of credit. He tells us however that the grand council in 1348, chose three prudent persons, whom they ordered to investigate the best means for preserving health, and to lay the result of their inquiry before the council. The plague which broke out afterwards in 1478, rendered it necessary that some permanent means should be thought of, and on that account a peculiar magistracy consisting of three noblemen, with the title of *sopra la sanità*, was instituted in 1485. As these were not able to stop the progress of the disease, the painful office was imposed upon them, in 1504, of imprisoning people against whom complaints might be lodged, and even of putting them to death; and in 1585 it was declared, that from the sentence of these judges there should be no appeal. Their principal business was to inspect the lazarettos erected in certain places at some distance from the city, and in which it was required that all persons and merchandize coming from suspected parts should continue a stated time fixed by the laws. The captain of every ship was obliged also to show there the bill of health which he had brought along with him.

As Le Bret produces no proof that quarantine was established by the Venetians so early as he says, I cannot help suspecting that he is mistaken respecting the year (1348), and conjecture that it ought to be 1448, or perhaps 1484. I have not been able however to resolve my doubt; for, in ex-

["The Venetians seem to have been the first who established quarantine in their dominions about the year 1484, soon after the Turks became their neighbours in Europe; the constant intercourse which they maintained with those powerful neighbours, either in war or by commerce, rendering it necessary for them to take this and other precautions against the introduction of this contagion into their country."]

[2] De Peste, in Mead's Opera Medica.

amining different Italian writers, I find that various years are given [1]. The institution of the council of health (*sopra la sanità*) is mentioned by Bembo; but I cannot discover from him to what year he alludes [2]. His countryman Lancellotti, who undoubtedly must have understood him well, makes it to be 1491 [3]. Caspar Contarenus, who died in 1542, in the sixtieth year of his age, mentions no particular period, and only says that the institution had been formed not long before his time [4]. The islands on which the pest-houses were erected, were called *il Lazaretto vecchio* and *il Lazaretto nuovo*. In the elegant description of Venice, ornamented with abundance of plates, below mentioned, it is remarked that the pest-house on the former island was built in 1423, and that on the latter in 1468 [5]. The same account is given in the newest and best Topography of Venice [6].

The Venetians are entitled to the merit of having improved the establishments formed to prevent infection; and that their example was followed in other countries is generally admitted. But the year in which quarantine was first ordered by them to be performed is uncertain. Muratori [7], following Lorenzo Candio, gives the year 1484, and Howard [8] says that the college of health was instituted in 1448.

Brownrigg affirms that letters of health, in which he confides more than in quarantine, were first written in 1665 by the consuls of the different commercial nations, but they are much older, for Zegata [9] asserts that they were first established in 1527, when the plague again made its appearance in Europe.

This much is certain, that all these means against infection, which, though far from being perfect, have secured Europe from this misfortune, were not invented or proposed by physi-

[1] Everything said by Le Bret on this subject may be found equally full in D. C. Tentori, Saggio sulla Storia Civile, &c., della Republica di Venezia. Ven. 1786, 8vo, t. vi. p. 391. As Sandi in his Principi di Storia Civile della Republica di Venezia, 9 vols. 4to, 1755—1769, gives the same account, lib. viii. cap. 8. art. 4, they must have both got their information from the same source. [2] Historia Vinitiana. Vinegia, 1552, 4to, lib. i. p. 10.

[3] L'Hoggidi, overo il mondo non peggiore, ne più calamitoso del passato. Ven. 1627, 8vo, p. 610. [4] De Republica Venetorum, lib. iv.

[5] Thesaurus Antiquitatum Italiæ, v. 2, p. 241.

[6] Topografia Veneta, overo Descrizione della Stato Veneto. Venezia, 1786, 8vo, iv. p. 263. [7] Lib. i. cap. 11, p. 65.

[8] Account of the principal Lazarettos, Lond. 1789, 4to, p. 12.

[9] Cronica di Verona, in Verona, 1747, 4to, iii. p. 93.

cians, but ordered by the police, contrary to their theory. The latter seem to have known, at an early period, the most dangerous causes of infection, and to have formed at a very great expense precautionary means, the observance of which was enforced under pain of the severest punishment.

Why the space of forty days was chosen as a proof I do not know. It arose no doubt from the doctrine of the physicians in regard to the critical days of many diseases. The fortieth day seems to have been considered as the last or extreme of all the critical days; on which subject many physicians appear to have entertained various astrological conceits [1]. On the Turkish frontiers this period was reduced under the emperor Joseph II. to twenty days [2].

[With respect to the quarantine establishments in this country, M^c^ Culloch observes that they are exceedingly defective. Even in the Thames there is not a lazaretto where a ship from a suspected place may discharge her cargo and refit; so that she is detained, frequently at an enormous expense, during the whole period of quarantine, while if she have perishable goods on board, they may be very materially injured. The complaints as to the oppressiveness of quarantine regulations are almost wholly occasioned by the want of proper facilities for its performance. Were these afforded, the burdens it imposes would be rendered comparatively light.

The existing quarantine regulations are embodied in the act 6 George IV. c. 78, and the different orders in council issued under its authority. These orders specify what vessels are liable to perform quarantine, the places at which it is to be performed, and the various formalities and regulations to be complied with.]

[1] See G. W. Wedelii exercitatio de quadragesima medica, in his Centuria Exercitationum Medico-philologicarum. Jenæ, 1701, 4to, decas iv. p. 16. Wedel mentions various diseases in which Hippocrates determines the fortieth day to be critical. Compare Rieger in Hippocratis Aphoris. Hag. Com. 1767, 8vo, i. p. 221.

[2] Martini Lange Rudimenta Doctrinæ de Peste. Offenbachii 1791, 8vo. See Gottingische Anzeigen von gelehrt. Sachen, 1791, p. 1799.

PAPER-HANGINGS.

THREE kinds of paper-hangings have for some time past been much used on account of their beautiful appearance and their moderate price. The first and plainest is that which has on it figures printed or drawn either with one or more colours. The second sort contains figures covered with some woolly stuff pasted over them; and the third, instead of woolly stuff, is ornamented with a substance that has the glittering brightness of gold and silver. It appears that the idea of covering walls with parti-coloured paper might have readily occurred, but the fear of such hangings being liable to speedy decay may have prevented the experiment from being made. In my opinion the simplest kind was invented after the more ingenious, that is to say, when the woolly or velvet kind was already in use [1]. The preparation of them has a great affinity to the printing of cotton. Wooden blocks of the like kind are employed for both; plates of copper are also used; and sometimes they are painted after patterns. Artists possess the talent of giving them such a resemblance to striped and flowered silks and cottons, that one is apt to be deceived by them on the first view. Among the most elegant hangings of this kind, may be reckoned those which imitate so exactly every variety of marble, porphyry, and other species of stones, that when the walls of an apartment are neatly covered with them, the best connoisseur may not without close examination be able to discover the deception. That the resemblance may be still greater, a hall may be divided by an architect into different compartments by pillars, so as to have the appearance of a grand piece of regular architecture. Whether M. Breitkopf at Leipsic was the inventor of this kind of hangings, I do not know, but it is certain that he brought it to great perfection.

[1] The simplest or worst articles are not always the oldest or the first. The deterioration of a commodity is often the continuation of an invention, which, when once begun, is by industry practised in every form, in order that new gain may be acquired from each variation. The earliest printers, for example, had not the art of printing with such slight ink and on such bad paper as ours commonly employ; and Aldus, perhaps, were he now alive, would be astonished at the cheap mode of printing some of our most useful and popular books.

The second kind, or, as it is called, velvet-paper (now called flock-paper), is first printed like the former, but the figures are afterwards wholly, or in part, covered with a kind of glue, over which is strewed some woolly substance, reduced almost to dust, so that by these means they acquire the appearance of velvet or plush. The ground and the rest of the figures are left plain; but the whole process is so complex that it is impossible to convey a proper idea of it by a short description. The shearings of fine white cloth, which the artist procures from a cloth manufactory, and dyes to suit his work, are employed for this purpose. If they are not fine enough, he renders them more delicate by making them pass through a close hair-sieve. This, as well as the third kind, was formerly made much more than at present upon canvas; and, in my opinion, the earliest attempts towards this art were tried, not upon paper, but on linen cloth. The paper procured at first for these experiments was probably too weak; and it was not till a later period that means were found out to strengthen and stiffen it by size and paste.

The invention of velvet-paper is by several French writers[1] ascribed to the English; and, if they are not mistaken, it was first made known in the reign of Charles I. On the 1st of May 1634, an artist, named Jerome Lanyer, received a patent for this art, in which it is said that he had found out a method of affixing wool, silk and other materials of various colours upon linen cloth, silk, cotton, leather and different substances with oil, size and cements, so that they could be employed for hangings as well as for other purposes[2]. The inventor wished

[1] Origny, in Dictionnaire des Origines, v. p. 332. Journal Œconomique, 1755, Mars, p. 86. Savary, Dictionnaire de Commerce, iv. p. 903.

[2] I shall here insert the words of the patent: "To all those to whom these presents shall come, greeting. Whereas our trusty and well-beloved subject and servant Jerome Lanyard hath informed us, that he by his endeavours hath found out an art and mystery by affixing of wool, silk and other materials of divers colours upon linen cloth, silk, cotton, leather and other substances, with oil, size and other cements, to make them useful and serviceable for hangings and other occasions, which he calleth Londrindiana, and that the said art is of his own invention, not formerly used by any other within this realm, &c."—Rymeri Fœdera, tom. xix. London, 1732, fol. p. 554. The following observations may serve to illustrate all works of this nature in general. Painting, according to the most common technical meaning, may be divided into three kinds. In the first the colours or pigments are mixed with a viscous or glutinous fluid to bind them, and

to give to this new article the name of Londrindiana, which appears however not to have continued in use. It is worthy of remark, that this artist first made attempts to affix silk upon some ground, but that method as far as I know was not brought to perfection; that he employed for the ground, linen and cotton cloth, or leather; and that no mention is made of his having used paper, though he seems not to have confined himself entirely to leather or cloth.

Tierce, a Frenchman, has however disputed this invention with the English; for he asserts that one of his countrymen at Rouen, named François, made such kinds of printed paper-hangings so early as the year 1620 and 1630, and supports his assertion by the patterns and wooden blocks which are still preserved, with the above-mentioned years inscribed on them[1]. He is also of opinion, that some Frenchmen, who fled to England when persecuted for their religion, carried this art along with them. The inventor's son followed this

make them adhere to the body which is to be painted. Gums, glue, varnish, &c. may be used for this purpose. Vegetable colours will not admit of such additions, because they contain gum in their natural composition. Another kind consists in previously washing over the parts that are to be painted with some viscous substance, and then laying on the colours as the figures may require. Size or cement (I use the word in the most extensive sense) is of such a nature that either in drying or glazing it becomes hard, and binds the colours. To this method belongs not only gilding, imitating bronze and making velvet-paper-hangings, but also painting on glass and in enamel. By the third method the colours are applied to the ground without any binding substance: they are therefore more liable to decay, as is the case in painting with crayons; but they will however adhere better when the pigments consist of very fine particles like ceruse, or black-lead. It would be a great acquisition if a substance could be found out to bind the colours used in this art without injuring them, or to fix the crayons. The third kind of painting is not with colours, but with different bodies ready coloured, which are joined together in pieces according to a copy, either by cement or plaster, as in mosaic, or by working them into each other, as in weaving and sewing, which is painting with the needle. . . . . Are not the works of art almost like those of nature, each connected together as a chain? Do not the boundaries of one art approach those of another? Do they not even touch each other? Those who do not perceive this approximation are like people unacquainted with botany, who cannot remark the natural order of plants. But if a connoisseur observe a gap in the chain of artificial works, we are to suppose that some links are still wanting, the discovery of which may become a merit to more ingenious ages.

[1] Journal Œconomique, 1756, Fevrier, p. 92.

business to a great extent for more than fifty years at Rouen, and died in 1748. Some of his workmen went privately to the Netherlands and Germany, where they sold their art; and the French, therefore, with great confidence maintain, without knowing our artists and their works, that foreigners in this branch of manufacture are still far behind them. In most works of the kind my countrymen indeed are only imitators, not through want of talents to invent or to improve, but because our great people, for whom they must labour, consider nothing as fashionable or beautiful, except what has been first made by the French or the English.

I shall here observe, that Nemeitz ascribes the invention of wax-cloth-hangings, with wool chopped and beat very fine (these are his own words), to a Frenchman named Audran, who in the beginning of the last century was an excellent painter in arabesque and grotesque figures, and inspector of the palace of Luxemburg at Paris, in which he had a manufactory for hangings of that kind [1]. What particular service he rendered to the art of making paper-hangings, I have not however been able to learn. Equally uncertain and defective is the information of Von Heinecken [2], that one Eccard invented the art of imprinting on paper-hangings gold and silver figures, and carried on a manufactory for such works.

In regard to the time when these hangings began to be made in Germany, I can only say that the oldest information I know respecting them is to be found in a work [3] by Andrew Glorez von Mahren, printed for the first time in 1670. It shows that the art was then very imperfect as well as little known, and that it was practised only by women upon linen for making various small articles [4].

[1] Both his brothers, John and Benedict Audran, were celebrated engravers.

[2] Nachrichten von Künstlern und Künstsachen. Leipzig, 1768, 8vo, ii. p. 56. The author, giving an account of his travels through the Netherlands, says, "Before I leave the Hague I must not omit to mention M. Eccard's particular invention for making paper-hangings. He prints some which appear as if worked through with gold and silver. They are fabricated with much taste, and are not dear."

[3] Haus-und Land-bibliothek, iii. p. 90.

[4] The author says, "I shall give an account of a beautiful art, by which one may cover chairs, screens and other articles of the like kind, with a substance of various colours made of wool, cut or chopped very fine, and

One of the most ingenious new improvements in the art of manufacturing these hangings, consists in bestrewing them here and there with a glittering metallic dust or sand, by which they acquire a resemblance to rich gold and silver brocade. From the above-quoted work it appears that artists began very early to cover some parts of paper-hangings with silver-dross or gold-foil; but as real gold was too dear to be used for that purpose, and as imitations of it soon decayed, this method seems not to have been long continued. Instead of these, Nuremberg metallic dust as well as silver-coloured foil are employed. Metallic dust is the invention of an artist at Nuremberg, named John Hautsch, who constructed also a carriage which could be moved by the person who sat in it. He was born in the year 1595, and died in 1670. His deseendants have continued to the present time the preparation of the metallic dust, which is exported in large quantities from Nuremberg, and is used in shell-work, lackered-ware, and for various other purposes. It is prepared by sifting the filings of different metals, washing them in a strong lye, and then placing them on a plate of iron or copper over a strong fire, where they are continually stirred till their colour is altered. Those of tin acquire by this process every shade of gold-colour, with a metallic lustre; those of copper the different shades of red and flame-colour; those of iron and steel become of a blue or violet; and those of tin and bismuth appear of a white or bluish-white colour. The dust, tinged in this manner, is afterwards put through a flatting-mill, which consists of two rollers of the hardest steel, like those used by gold and silver wire-drawers, but for the greater convenience a funnel is placed over them [1]. I have in my possession samples of all the above kinds, which have an exceedingly beautiful appearance. This

cleaned by being made to pass through a hair-sieve. . . . . I remember that two Swabian women travelled about through some countries, and taught people this art, by which means they gained a good deal of money." Of the author I have been able to procure no information. His book is a compilation selected without any taste, and according to the ideas of the seventeenth century, from different writers, almost always without mentioning the sources from which the articles are taken; but it deserves a place in public libraries, because it contains here and there some things which may help to illustrate the history of agriculture and the arts.

[1] Kunkels Glasmacher-Kunst. Nurnb. 1743, 4to, p. 368. J. J. Marxens Neu vermehrte Materialkammer.

metallic dust is affixed so strongly to paper by means of a cement, that it is almost impossible to detach it without tearing the paper, as is the case with the paper-hangings procured from Aachen. In French, such paper is called *papier avec paillettes*. The lustre of it is so durable that it continues unaltered even on the walls of sitting-apartments. The metallic dust however has a considerable weight, which may undoubtedly injure the paper.

This inconvenience may have induced artists to employ, instead of metallic dust, that silver-coloured mica, which has been long used in the like manner. So early as the seventeenth century the miners at Reichenstein in Silesia collected and sold for that purpose various kinds of mica, even the black, which acquires a gold-colour by being exposed to a strong heat [1]. The nuns of Reichenstein ornamented with it the images which they made, as the nuns in France and other catholic countries ornamented their *agni Dei*, by strewing over them a shining kind of talc [2]. The silver-coloured mica however has not such a bright metallic lustre as metallic dust, but it nevertheless has a pleasing effect when strewed upon a white painted ground, and its light thin spangles or scales retain their brightness and adhere to the paper as long as it lasts. At present I am acquainted with no printed information respecting the method of laying on metallic dust and mica, nor do I know where artists procure the latter, which in many countries is indeed not scarce. I shall here observe, that I once saw at Petersburg a kind of Chinese paper, which appeared all over to have a silver-coloured lustre without being covered with any metallic substance, and which was exceedingly soft and pliable. It bore a great resemblance to paper which has been rubbed over with dry acid of borax. I conjecture that its surface was covered with a soft kind of talc, pounded extremely fine; but as I have none of it in my possession at present, I can give no further account of it.

[The manufacture of this important and elegant substitute for the ancient "hangings" of tapestry has undergone a gradual succession of improvements, and has now reached a high state of beauty and perfection. The patterns on these papers are sometimes produced by stencil plates, but more

[1] Volkmann, Silesia Subterranea. Leipzig, 1720, 4to, p. 52. [2] Pomet.

commonly by blocks, each colour being laid on by a separate block cut in wood or metal upon a plain or tinted ground. The patterns are sometimes printed in varnish or size, and gilt or copper-leaf applied; or bisulphuret of tin is dusted over so as to adhere to the pattern; and in what are called *flock-papers*, dyed wools mixed into powder are similarly applied. Powdered steatite or French chalk is used to produce the peculiar gloss known under the name of *satin*. Striped papers are sometimes made by passing the paper rapidly under a trough, which has parallel slits in its bottom through which the colour is delivered; and a number of other very ingenious and beautiful contrivances have lately been applied in this important branch of art. The invention of the paper-machine, by which any length of paper may be obtained, effected a great change in paper-hangings, which could formerly only be printed upon separate sheets, and were much more inconvenient to print as well as to apply to the walls [1].]

KERMES. COCHINEAL.

Though a variety of information respecting the history of cochineal and kermes may be found scattered in the works of different authors, I shall venture to lay before the public what I have gathered on the subject; as I flatter myself with the hope of being able to rectify some errors of my predecessors, as well as to supply deficiencies which they have left; and as it will undoubtedly be agreeable to many readers to see collected in one point of view whatever is most important, with the addition of a few explanatory observations and notes.

Cochineal and kermes, as they appear in commerce, are small grains, shaped almost like those small dried grapes without stones, which are called currants. They are sometimes of a deep and sometimes of a fainter reddish-brown, or violet-brown colour, are often covered with a gray dust or

[1] Brande's Dictionary of Science, &c.

mouldiness[1], appear full of wrinkles, as succulent bodies generally do when dried, and for the most part are a little more raised on the one side than on the other. When these grains are chewed, they have a somewhat bitterish and astringent taste, and communicate to the spittle a brownish-red colour. They are employed in medicine, but their principal use is in dyeing.

It is now well-known that they belong to that genus of insects called *Coccus*, and that they are principally the dried impregnated females. Numerous species of these insects have been described by entomologists[2], who have most frequently named them from the plants on which they occur; for the present object, however, it will be sufficient to take notice only of three kinds.

The first is the real American cochineal, or that which at present is most used, but which at the same time is the dearest. By Linnæus it is called *Coccus Cacti*. The second kind is found chiefly on a species of oak, the *Quercus Ilex*, in the Levant, Spain, France, and other southern countries, and is therefore called *Coccus Ilicis*, *Coccus arborum*, and often also kermes. The third comprehends that saleable cochineal found on the roots of several perennial plants, which is known commonly under the appellation of Polish or German cochineal; though it is not certain whether those insects produced upon the perennial knawel (*Scleranthus*), bears-breech (*Uva-ursi*) and other plants, be the same species. They are often distinguished also by the name of *Coccus radicum*.

That the second species has been mentioned by the ancient Hebrew, Greek, Latin and Arabian writers cannot be denied; and those who know that our information respecting the nature of this commodity, which is perhaps even yet imperfect, has been in modern times procured after much labour and research, will not be surprised to find their accounts mingled with many falsehoods and contradictions. The ancients must have been under more doubt and in greater ignorance on this subject, the less they were acquainted with the propagation of these insects; but we should be too precipitate were we to reject entirely everything they have said that may deviate

[1] [The powder spread out by the female insect just before laying the eggs.]

[2] [Stephens in his Catalogue of British Insects enumerates no less than thirty species as inhabitants of these islands.]

from the truth; and I think it would be no difficult task to produce writers of the seventeenth and of the eighteenth century, whose information on this point is as dubious and incorrect as that to be found in the writings of the ancients.

All the ancient Greek[1] and Latin writers agree that kermes, called by the latter *coccum*, perhaps also *coccus*, and often *granum*, were found upon a low shrubby tree, with prickly leaves, which produced acorns, and belonged to the genus of the oak; and there is no reason to doubt that they mean *Coccus Ilicis*, and that low evergreen oak, with the prickly leaves of the holly (*aquifolium*), which is called at present in botany *Quercus Ilex*[2]. This assertion appears more entitled to credit, as the ancients assign for the native country of this tree places where it is still indigenous and produces kermes.

According to the account of Dioscorides, kermes were collected in Galatia, Armenia, Asia, Cilicia and Spain. Most commentators suppose that there must be here some error, as that author first mentions Galatia and Armenia, and then Asia in general. Some, therefore, understand by the latter, the city of Asia in Lydia; others have altered or rejected the word altogether; and Serapion, in his Arabic translation, seems to have read Syria. Professor Tychsen, however, assured me that *Asia proconsularis* is here meant, to which Cilicia did not belong; and in this particular sense the word is often used by writers contemporary with Dioscorides. Of this difficulty Salmasius takes no notice.

We are informed by Pliny[3] that kermes were procured from Asia and Africa; from Attica, Galatia, Cilicia, and also from Lusitania and Sardinia; but those produced in the last-mentioned place were of the least value. Pausanias says that they were to be found in Phocis. As the *coccus* is mentioned like-

[1] By Dioscorides they are called *κόκκος βαφική*. Dioscorides, iv. 48, p. 260. Respecting the tree, Pausanias, lib. x. p. 890, seems to raise some difficulty, as he compares it to the *σχῖνος*, lentiscus, or, as others read the word, *σχοῖνος*. But it has been remarked long ago, that the reading ought to be *πρῖνος*, ilex; and this alteration is supported by some manuscripts.

[2] [Kirby and Spence and Stephens state that the *Coccus Ilicis* is found upon the *Quercus coccifera*. Moreover Beckmann's description of the "low evergreen oak" does not apply to *Q. Ilex*, but does to *coccifera*; *Ilex* grows sixty feet high, *coccifera* only ten; in the other respects detailed by him they agree.]

[3] Plin. Hist. Nat. lib. ix. cap. 41; lib. xvi. cap. 8; lib. xxii. cap. 2; lib. xxiv. cap. 4.

wise by Moses and other Hebrew writers, kermes must have been met with at that period in some of the remote countries of the East[1]. Bochart has quoted passages from the manuscript works of Arabian authors, which undoubtedly allude also to kermes; and I shall class among these, without any hesitation, the account of Ctesias, which has been copied by Photius, Ælian, and the poet Phile, though in more than one circumstance it deviates from the truth. It has already been considered by Tyson and Delaval as alluding to kermes, or rather the American cochineal, which Tyson, however, seems to confound with the genus of insects *Coccinella*, in English called the lady-bird[2].

That the kermes-oak still grows and produces kermes[3] in the Levant, Greece, Palestine, Persia and India, is sufficiently proved by the testimony of modern travellers. Bellon and Tournefort saw kermes collected in the island of Crete or Candia[4]; the former saw them also between Jerusalem and Damascus[5]; and he informs us that the greater part of them was sent to Venice. That they are indigenous in Persia, is expressly affirmed by Chardin. The kermes of Spain are so well known that it is not necessary to bring proofs of their being a production of that country. Dioscorides says that the Spanish kermes were bad[6]; and we are expressly told by Garidel, that they are still of less value than the French.

With the real nature of kermes the ancients were not acquainted. By the greater part they were considered as the

[1] Bochart. Hierozoicon, vol. ii. lib. iv. cap. 27, p. 624.

[2] Tyson's Anatomy of a Pigmy, 1751, 4to.—Delaval's Experimental Inquiry into the Cause of the Changes of Colours in Opake Bodies, 1777, 4to.

[3] The insect is not natural to the tree, but adventitious. As all rose-bushes have not tree-lice, nor all houses bugs; so all *ilices*, or oaks, have not kermes.

[4] Bellonii Itin. i. 17.—Tournefort, Voy. du Levant, i. p. 19.

[5] Bellon. ii. 88.—Roger, Voyage de la Terre Sainte, i. 2.—Voyages de Monconys, i. p. 179.—Brown's Travels in Africa, &c.

[6] In opposition to this account some have asserted that Spanish kermes are praised in Petronius, cap. 119; but the passage varies so much, in different editions, that no certain conclusion can be drawn from it. See the excellent edition of Mich. Hadrianides. Amstelod. 1669, 8vo, p. 419. If we even read, with Hardouin and others,

Hesperium coccum laudabat miles,

the soldier might mention kermes among those productions of Spain of which he was fond, though he did not consider it as the best. Hardouin says, "Loquitur de minio Hispanico;" but that was a colour for painting.

proper fruit of the tree; and although they remarked the insects, it was a common opinion that they were produced from putrefaction without propagation; and on this account they did not perceive their real origin. They imagined that the insects were the effects of corruption; and Pliny speaks as if he conceived that certain species were liable to this fault more than others. They were therefore named *scolecion*, and less valued. But in another passage he calls kermes, not improperly, a scurf or scab of the tree, *scabies fruticis*. Dioscorides says that the kermes appeared on the tree like lentils, a comparison with which Matthiolus is highly displeased; but it cannot be altogether unnatural, as many of the moderns, who never read the writings of the Greeks, compare them also to lentils or peas. The account, that a kind of kermes in Sicily, like small snails, was collected by the women with their mouths, seems to be attended with more difficulty. The comparison of snails, which may not be altogether inconsistent, I shall admit; but the gathering with the mouth is too much contrary to common sense not to be disputed. Commentators, therefore, have proposed various emendations, which seem to be drawn from the different readings; but the common one alluded to must be very old, as it has been adopted by Serapion in his translation[1]. Marcellus and Cornarius are of opinion that a word must be inserted, expressive of the time when the kermes were gathered; and that instead of "with the mouth," ought to be read "in summer[2]." For my part, I think a word signifying some instrument employed by the women in collecting them would be more proper; for the Grecian women, according to Bellon's account, use still for that purpose a small instrument shaped like a sickle. In France[3] and other countries, the women suffer the nails of their fingers to grow, in order that they may assist them in their labour[4]. However this may be, both Dioscorides and

[1] Cap. 311, p. 210. [2] These writers propose to read ἐν τῷ θέρει instead of τῷ στόματι; but the variation here is too great to be admitted.

[2] Garidel, p. 254.

[3] Having mentioned the above passage to Professor Tychsen, he suggested an emendation which, in my opinion, is preferable to any I have hitherto seen: "We must read," said he, "τῷ στονυχι, which transcribers may have readily mistaken and changed into the word στόματι, with which, perhaps, they were better acquainted. Στόνυξ signified not only the extremity of the nail but also any kind of instrument, and even weapons, in

Galen ascribe to kermes an astringent, bitter taste; but I shall leave to the examination of physicians the medicinal qualities for which they have extolled them. I shall remark only, as a technologist, that kermes was used formerly in dyeing purple to give what is called the ground; but our dyers employ it to communicate a scarlet colour, which, without doubt, excels the purple of the ancients.

The first-mentioned use of kermes in dyeing seems to have been continued through every century. In the middle ages, as they are called, we meet with kermes under the name of *vermiculus* or *vermiculum*; and on that account cloth dyed with them was called *vermiculata*. Hence the French word *vermeil*, and its derivative *vermilion*, as is well-known, had their extraction; the latter of which originally signified the red dye of kermes, but it is now used for any red paint, and also for finely pounded cinnabar. In France and Spain, at present, kermes, as soon as they are gathered, are besprinkled with vinegar and dried in the sun; but it appears that in the middle ages they were not dried sufficiently, and that they were put into leather bottles to prevent them from making their escape[1]. In preparing the liquid dye, dyers used

which last sense it occurs more than once in Lycophron." See Hesychius. Much more forced and improbable is the amendment proposed by Salmasius, which may be found in his Annotations on Solinus.

[1] The following passage, highly worthy of notice, taken from Gervasii Tilberiensis Otia Imperialia ad Ottonem IV. Imperatorem, iii. 55; a work which the author, a very learned man for his time, wrote in the year 1211, will serve to illustrate what I have said above: "De vermiculo. In regno Arelatensi (kingdom of Arles, which formerly belonged to the dukes of Burgundy) et confinio maritimo est arbor cujus sarcina pretium facit duodecim nummorum Wighorniensium. Ejus fructus in flore facit pretium quinquaginta librarum. Ejus cortex ad onus vestis pretium habet quinque solidorum. Vermiculus hic est, quo tinguntur pretiosissimi regum panni, sive serici, ut examiti, sive lanei, ut scharlata. Et est mirandum, quod nulla vestis linea colorem vermiculatum recipit, sed sola vestis quæ ex vivo animanteque vel quovis animato decerpitur." [The author here is undoubtedly right, as animal substances take a dye more readily than vegetable.] "Vermiculus autem ex arbore, ad modum ilicis et quantitatem dumi pungitiva folia habente, prodit ad pedem, nodulum faciens mollem ad formam ciceris" (the same comparison as that of Dioscorides), "aquosum, et, cum exterius colorem habeat nebulæ et roris coagulati, interius rubet; et cum ungue magisterialiter decerpitur, ne, tenui rupta pellicula, humor inclusus effluat, postquam exsiccatur et corio includitur.—Cum enim tempus solstitii æstivi advenerit, ex se ipso vermiculos generat, et nisi coriis subtiliter consutis includerentur, omnes fugerent ut in nihilum eva-

Egyptian alum, the only kind then to be had, and also urine[1]. This dye seems to have been known in Germany so early as the twelfth century; for among the productions of the country which Henry the Lion sent as a present to the Greek emperor we find *scarlata*[2].

nescerent. Hinc est, quod vermiculus nominatur propter dissolutionem quam in vermes facile facit, ex natura roris Maialis, a quo generatur; unde et illo tantum mense colligitur. Arbor autem vermiculum generans vulgo Analis nuncupatur."—This book may be found in Leibnitii Scriptor. Rerum Brunsvic. 1.

[1] Muratori has published, in the second part of Antiquitat. Italic. Medii Ævi, p. 379, a treatise which appears to have been written in the ninth century, or in the time of Charlemagne, and which contains a great many receipts respecting dyeing and other arts. Among these is the receipt then commonly used for dyeing red, *Compositio vermiculi*. It is much to be regretted that the manuscript was so illegible that there are whole passages entirely destitute of sense, and that many words occur of which no one has given, or perhaps ever will be able to give, an explanation. We find, however, that the kermes were boiled with urine in a linen bag (*in linteolo raro*): *addis lurinam expumatam*. The other ingredients I confess I do not understand. What is *luzarim*, *lulacim*, *quianus*, *coccaris*? Many of these words seem to signify not simple but compounded pigments. Lulacim, by p. 378, appears to have been the expressed juice of some plant boiled with alum. "Coccarin nascitur in folio cedrin non tritæ." Besides the word *vermiculum*, the word *coccum* also occurs: "Coccum delabas in urina." In the last sentence we ought to read *coctum*.

[2] See Barth. ad Guil. Britonis Philippidos libr. xii. Arnoldus Lubecensis, at the end of Helmoldi Chronicon Slavorum, lib. iii. cap. 4: "Præmiserat autem dux munera multa et optima juxta morem terræ nostræ, equos pulcherrimos sellatos et vestitos, loricas, gladios, vestes de scharlatto et vestes lineas tenuissimas." See Fischer's Geschichte des Teutschen Handels, Hanover, 1758, 8vo, i. p. 490. But can "munera juxta morem terræ nostræ" be with propriety translated "the productions of the country?" With all due respect to the extensive reading and great learning of Professor Fischer, I must warn the reader against some errors which occur in his book, and against his too bold assertions. From what he says, p. 448, one would suppose that he compared the kermes to our acorns; but the fruit only of the kermes-tree, as being a species of oak, has the figure of an acorn. In p. 493, he ventures to criticise Professor J. H. Schulze, who, in Dissertat. de Granorum Kermes Coccionellæ Convenientia, Viribus, et Usu, Halæ, 1743, adopts the opinion of a Dutchman (not an Englishman) De Ruuscher, which has been completely justified, that cochineal is an insect. According to Professor Fischer, both the insect and the acorn are cochineal. He talks of plantations of the kermes-tree among the ancients, and seems to believe that the Celts brought kermes along with them to Galatia, from their original country, in the same manner as the Europeans carried with them to America the corn of Europe. Kermes, however, are insects which cannot be transplanted, and I do not find any proof that there were ever

Our ancestors, in all probability, procured their kermes from the southern part of France, or rather from Spain. The Arabians, who from the earliest periods had been acquainted with this production in Africa, found it in Spain, and employed it there for dycing, and as an article of commerce; and on this account, as appears, the Arabic name *kermes*, or *alkermes*, became so common[1]. Salmasius thinks that the Arabs borrowed this word from the Latins, and that it is formed from *vermes*[2]; but even if we allow that it is not an original Arabic word, it is perhaps more probable that it is of Celtic extraction, as is the opinion of Astruc[3]. *Guer* or *quer* signified in the Celtic language a green (evergreen) oak; and in Lower Languedoc, uncultivated land on which the kermes-oak grows is still called *garrigues*. From this *guer* or *quer* Astruc is inclined to derive also the Latin word *quercus*, the etymology of which is nowhere else to be found. This conjecture is of the more importance, as *mes* in some parts signifies the fruit of the oak; so that *guermes* or kermes would be the acorns, *les glands du chesne*. Although kermes are not acorns, we cannot reject this appellation as improbable. Having requested the opinion of Professor Tychsen, as being well-acquainted with the Arabic language, on this subject, he readily complied with my desire, and I have given it in the note below,

plantations of them. [This assertion is far from correct. The true cochineal insect has been introduced from Mexico into Java, Spain, and recently into Algiers. The Journal de Pharmacie for Feb. 1844, contains a long account, by M. Simounet, of the success of the cochineal plantations in Algiers.] People collected kermes in the places where they happened to find them. The comparison of cochineal with the lady-cow, or lady-bird, as it is called, p. 493, is altogether improper, as that insect is the *Coccinella*, which has no affinity to cochineal. His proposal to place the *Coccinellæ*, or lady-birds, on the kermes-oak, or on the *Scleranthus* (perennial knawell), is totally impracticable; and even were they to remain there for eternity, they would never become cochineal or kermes.

[1] Matthiolus, in his Annotations on Dioscorides, p. 725, says that the monks who wrote a Commentary on Mesues assert that the kermes of the Arabians, the *Coccus radicum*, is not the *Coccus arborum*; but he refutes this idea upon the grounds that the Arabians themselves say everything of their kermes that is related of them by Dioscorides. I am almost induced to conjecture that the monks made this assertion in order to render more agreeable that tribute which was paid to them, in some countries, under the name of St. John's blood.

[2] Salmasius in Solinum, p. 854.

[3] Histoire Naturelle de Languedoc. Par. 1737, 4to, p. 472.

in his own words[1]. It deserves to be remarked, that *carmesin*, *carmin*, *cramoisi* of the French, and *charmesi*, *chermesino* of the Italians, and other like words, hence derive their origin.

[1] "The word *kermes*, *karmes*, and, with the article, *al kermes*, is at present in the East the common name of the animal which produces the dye, as well as of the dye itself. Both words have by the Arabs and the commerce of the Levant been introduced into the European languages. *Kermes*, Span. *al charmes*, *al quermes*, or more properly *alkermes*, *alkarmes*. Ital. *cremesino*, &c.

"To what language the word originally belongs cannot with certainty be determined. There are grounds for conjecturing several derivations from the Arabic, for example, *karasa*, *extremis digitis tenuit*, which would not ill-agree with στόνυξ; and *karmis* signifies *imbecillus*; but this word may be derived from the small insect, as well as the insect from it. As all these derivations, however, are attended with grammatical difficulties, and as the Arabians, according to their own account, got the dye and the word from Armenia, it appears rather to be a foreign appellation which they received with the thing signified, when they overran Upper Asia. Jbn Beithar in Bochart, Hierozoicon, ii. p. 625, calls kermes an Armenian dye; and the Arabian lexicographers, from whom Giggeus and Castellus made extracts, explain the kindred word *karmasal*, *coccineus*, *vermiculatus*, as an Armenian word.

"This dye however was undoubtedly known to the Hebrews, the Phœnicians, and the Egyptians, long before the epoch of the Arabians in the East. Among the Hebrews the dye occurs, though not clearly, under other names, *tola schani*, or simply *tola*, in their oldest writer, Moses. *Tola* is properly the worm, and according to the analogy of *kermes*, worm-dye, scarlet. The additional word *schani* signifies either double-dyed, or, according to another derivation, bright, deep red dye. For both significations sufficient grounds and old authorities might be quoted; but the former is the most usual, and on account of its analogy with δίβαφον, seems to be the most probable.

"But was the *coccus* known so early? Is not *tola*, the worm-dye, perhaps the same with purple, because the ancients made no distinction between *vermis* and snail? I believe not. For purple the Orientals have a particular name, *argaman*, *argevan*, which is accurately distinguished from *tola*, and is often added to it as something distinct. All the ancients therefore translate the Hebrew word *tola* by κόκκος, kermes, *zehori* and *zehorito* (deep red, bright dye), which words they never put for *argaman*. As the Phœnicians traded at so early a period with Spain and other countries, where the kermes are indigenous, it may be readily comprehended how that dye was known in Palestine about and before the time of Moses.

"It must have been known also in Egypt about the same epoch; for when Moses, in the wilderness, required scarlet to ornament the tabernacle, it could have been procured only from that country. Whether kermes be indigenous in Egypt, I do not know. On the word καλάϊνον, quoted by Bochart from Hesychius as Egyptian, the abbreviation of which, *laia*, in the Ethiopic language signifies scarlet, I lay no great stress, because it cannot be proved,—

The coccus found on the roots of some plants, as far as I know, has not been mentioned by the ancients. That these insects however were collected in Germany in the twelfth century, was first proved, as I think, by J. L. Frisch[1]. We are told that in this, and at least in the following century, several monasteries caused their vassals to collect this *coccus*, and bring to them by

1st, that the word is originally Egyptian, as it occurs several times in the Greek writers and in various significations; and 2ndly, that it signifies scarlet dye, because the ancients explain it sometimes by purple, sometimes by sea-colour. See Bochart, l. c. p. 730. If the word be Egyptian, it signifies rather red dye in general than defines purple colour. At any rate, there is in Coptic for the latter a peculiar word, *scadschi*, or *sanhadschi*. The latter is explained by Kircher in Prodrom. Copt. p. 337, 'mercator purpuræ, vermiculus coccineus, purpura,' which is altogether vague and contradictory. The Arabic lexicographer, whom he ought to have translated, gives a meaning which expresses only *purple ware*.

"If one might venture a supposition respecting the language of a people whose history is almost bare conjecture, I would ask if the Coptic *dholi* was the name of scarlet in Egypt. The lexicographers explain it by a worm, a moth; but in those passages of the translation of the Bible which I have compared another word is always used, when allusion is made to worms which gnaw or destroy. Was *dholi* the name of the worm that yields a dye? As *dholi* sounds almost like the Hebræo-Phœnician *tola*, we might farther conjecture that the Egyptians received both the name and the thing signified from the Phœnicians. But this is mere opinion. The following conclusions seem to be the natural result of the above observations:—

"1st. Scarlet, or the kermes-dye, was known in the East in the earliest ages, before Moses, and was a discovery of the Phœnicians in Palestine, but certainly not of the small wandering Hebrew tribes.

"2nd. *Tola* was the ancient Phœnician name used by the Hebrews, and even by the Syrians; for it is employed by the Syrian translator, Isaiah, chap. i. v. 18. Among the Jews, after their captivity, the Aramæan word *zehori* was more common.

"3rd. This dye was known also to the Egyptians in the time of Moses; for the Israelites must have carried it along with them from Egypt.

"4th. The Arabs received the name kermes, with the dye, from Armenia and Persia, where it was indigenous, and had been long known; and that name banished the old name in the East, as the name scarlet has in the West. For the first part of this assertion we must believe the Arabs.

"5th. Kermes were perhaps not known in Arabia; at least they were not indigenous, as the Arabs appear to have had no name for them.

"6th. Kermes signifies always *red dye*; and when pronounced short, it becomes *deep red*. I consider it, therefore, as a mere error of the translation when, in Avicenna, iii. Fen. 21, 13, *kermesiah* is translated *purpureitas*. It ought to be *coccineum*."

[1] Beschreibung von Allerley Insecten. Berl. 1736, 4to, vol. v. p. 10.

way of tribute[1], and that those who could not deliver the production in kind were obliged to pay, in its stead, a certain sum of money. The measure by which it was delivered was called *coppus*, in German *Kopf*, which word signified formerly not only a globular drinking-vessel, but also a measure both for dry and liquid things. It is still retained in the latter sense in Zurich, Aachen, Regensburg, Austria, and several other places[2]. As the *coccus* was gathered at midsummer (St. John's day), it was called St. John's blood; probably because the clergy wished by that appellation to make this revenue appear as a matter of religion; and that name is still continued among the country people. As the monks and nuns carried on at that time various trades, particularly that of weaving, they could employ the St. John's blood to very good purpose[3].

At later periods I find mention of the *coccus* only in the works of naturalists, such as those of Cornarius[4], Scaliger[5], and others; but how long the use of it, and the collecting of it for religious houses, continued, I cannot determine; perhaps longest in Poland. From that country, even at present (1792), a considerable quantity of it is sent every year to Venice;

[1] The ancient Spaniards, according to Pliny's account, were obliged to pay tribute in kermes to the Romans; and we are told by Bellon, that the Turks exacted a tribute of the like kind from the modern Greeks. It appears, therefore, that the monks imitated the example of the Romans.

[2] See Krunitz's Encyclopedie, xliv. p. 2.

[3] In Leibnitii Collectanea Etymologica, Hanoveræ, 1717, 8vo, p. 467, there is a catalogue of the effects and revenues of the church at Prüm, where a monastery of Benedictines was established as early as the eighth century. This catalogue, which was drawn up in the year 1222, says, "Solvit uuusquisque pro vermiculo denarios sex." But as allusion is made here to people who lived near Metz in Lorraine, it may be conjectured that we are to understand not *Coccus radicum*, but *Coccus arborum*, which they might have procured from thence. For this doubt, however, there is no room in Descriptio Censuum, Proventuum, ac Fructuum ex Prædiis Monasterii S. Emmerammi, in the year 1301, to be found in Pezii Thesaurus Anecdotorum Novissimus, i. p. 69. We are there told, "Singuli dant sex denarios pro vermiculo;" and p. 69 and 74, "singuli dant vasculum vermiculi;" p. 76, "reddunt vermiculi coppos duo." The people of whom these passages speak belonged to the monastery of St. Emmeran, at Regensburg, and were settled in Bavaria. Papon relates in Histoire Générale de Provence, ii. p. 356, that the archbishop of Arles, in the middle of the twelfth century, sold to the Jews the kermes collected at St. Chamas and other parts of his diocese.

[4] In Dioscoridem, iv. 39.

[5] De subtilitate; exercit. 325, § 13.

and I am inclined to believe that some of it is collected still in the county of Mark, and other parts of Germany. The following, as far as I can find, are the reasons why this indigenous production has lost its value. First, the root-kermes contain less colouring matter than the kermes of France and Spain. Secondly, the collecting of the former is more laborious as well as more tedious; and after they ceased to be paid *in natura* to the monasteries, they became too dear to stop the sale of those of France and Spain. But when the American cochineal, which is undoubtedly a far superior pigment, was in latter times made an article of commerce, and was sent to Europe in large quantities for dyeing, as it could be procured at all times, and in abundance, at a price which, if not low, was at least moderate, considering its excellent quality, from Mexico, where labour was cheaper[1], and where it was cultivated in plantations formed on purpose, the French and Spanish kermes were entirely forgotten, as appears by a French ordinance of 1671 respecting dye-stuffs: and this was the case much more with the German, which, in all probability, will never turn to great account, though some have entertained a contrary opinion.

Mexico, or New Spain, the original country of the cochineal, which word appears to be the diminutive of *coccus*[2], was discovered by the Spaniards in 1518 and the years following. Who first remarked this profitable production, and made it known in Europe, I have not been able to discover. Some assert that the native Mexicans, before they had the misfortune of

[1] The price of cochineal has in latter times fallen. In the year 1728 it cost fifty-eight schellings Flemish per pound; but in May 1786 it cost only twenty-seven and a half. [In 1814 the price of the best cochineal in this country was as high as 36*s*., 39*s*., but it has since gone on regularly declining till it has sunk to from 4*s*. to 6*s*. per pound.] Sifted cochineal is dearer than unsifted. It is often adulterated in Spain, but oftener in Holland, with the wild cochineal, as it is called. Some years ago an Englishman adulterated this article by mixing it with red wax; but the fraud required too laborious preparation, and was attended with too little profit to be long continued. [In France it is frequently adulterated with talc and white lead with a view of increasing its weight; and in London with sulphate of baryta or heavy spar and bone or ivory black].

[2] There is reason to think that the Spaniards gave as names to several American articles the diminutives of like Spanish or European productions. Thus *sarsaparilla* signifies prickly vine-stock; *platina* little silver. Is the cause of this to be referred to the Spanish *grandezza*?

being visited by the Christians, were acquainted with cochineal, which they employed in painting their houses and dyeing their clothing[1]; but others maintain the contrary[2]. The Spaniards, who had long used kermes in their own country, could not fail soon to observe the superiority of the American; and I find by Herrera, that the king in the year 1523 desired to be informed by Cortez, whether what he had been told was true, that kermes were to be found in abundance in Mexico, and if they could, as was supposed, be sent with advantage to Spain. He requested him, should this information be true, to pay attention to it, and to cause them to be collected with diligence. This commodity must soon after have begun to be an object of commerce; for Guicciardini, who died in 1589, mentions cochineal among the articles procured then by the merchants of Antwerp from Spain[3]. The plant on which the animal lives, belongs to the genus *Cactus*, and in Mexico is called *nopal* or *tuna*, though several plants of the same kind seem to be comprehended under the latter name. One species is the *Opuntia*, which has become indigenous in Spain, Portugal, and Italy, and which is not scarce in our green-houses. A second species is the *cochinillifera*. Oviedo[4] described and gave figures of two kinds of *tuna*; but of the cochineal he makes no mention. He speaks however of an excellent dye which the Americans prepared from the fruit, and formed into small cakes; but he afterwards acknowledges that he had received no authentic account on this subject. I nevertheless suspect that these cakes were made of cochineal; for Hernandez says that such were made in his time.

With the first cochineal, a true account of the manner in which it was procured must have reached Europe, and become publicly known. Acosta in 1590, and Herrera in 1601, as well as Hernandez and others, gave so true and complete a description of it, that the Europeans could entertain no doubt respecting its origin. The information of these authors, however, was either overlooked or considered as false, and disputes

[1] Raynal, Histoire des Indes. Gen. 1780, 4 vols. ii. p. 77.

[2] Algemeine Geschichte der Länder und Völker von Amerika, Halle 1753, 2 vols. 4to, ii. p. 7. [3] See Anderson's Hist. Commerce, iv. p. 73. It is possible however that Guicciardini may have meant Spanish kermes.

[4] Histoire Naturelle et Générale des Indes. Paris, 1556, fol. p. 122, 130. [Figures of the *Opuntia cochinillifera* and of the cochineal insects, will be found in Pereira's Materia Medica, vol. ii. p. 1850.]

arose whether cochineal was insects or worms, or the berries or seeds of certain plants. The Spanish name *grana*, confounded with *granum*, may have given rise to this contest; but there is not, perhaps, in all natural history a point which can be so fully cleared up as this can by the most undoubted testimony. A Dutchman, named Melchior de Ruusscher, affirmed in a society, from oral information he had obtained in Spain, that cochineal consisted of small animals. Another person, whose name he has not made known, maintained the contrary with so much heat and violence, that the dispute at length ended in a bet. Ruusscher charged a Spaniard, one of his friends, who was going to Mexico, to procure for him in that country authentic proofs of what he had asserted. These proofs, legally confirmed in October 1725, by the court of justice in the city of Antiquera, in the valley of Oaxaca, arrived at Amsterdam in the autumn of the year 1726. I have been informed that Ruusscher upon this got possession of the sum betted, which amounted to the whole property of the loser; but that, after keeping it a certain time, he again returned it, deducting only the expenses he had been at in procuring the evidence, and in causing it to be published. It formed a small octavo volume, with the following title, printed in red letters: The History of Cochineal, proved by authentic documents[1]. These proofs sent from New Spain are written in Dutch, French, and Spanish.

It may be readily supposed, that the high esteem in which this production was held would soon induce people to endeavour to convey these insects to other countries in order to breed them. This the Spaniards did every thing in their power to prevent; and notwithstanding the severity of the means which they employed, attempts were made for that purpose. When Rolander, a scholar of Linnæus, was in America, he sent to Upsal, at the request of that celebrated naturalist, a plant, with the insects upon it. The plant arrived in the year 1756, when Linnæus was engaged with his pupils. The gardener, who was not acquainted with the nature of it, cleared it from what he thought vermin, and planted it; so that

[1] The title in the original is, Natuerlyke Historie van de Couchenille, &c. Amst. 1729, 8vo. This work is scarce. A German translation of it may be found in (C. Mylius) Physikalischen Belustigungen. Berlin, 1751, 8vo, i. p. 43.

Linnæus, when he returned from his class, did not find a single insect alive. This circumstance, which he has mentioned in his Systema Naturæ, I was told by himself. I am however of opinion, that this was not the real cochineal, but the other kind spoken of by Sylvester; as the former, according to the latest information, can scarcely be procured even with more labour and expense than Rolander could bestow, and would hardly stand such a long voyage to the northern regions. The spurious kind were sent from Jamaica to England, on the *Opuntia ficus Indica*, which was planted by Miller[1], but the insects did not live above three or four months. Thiery, a young French naturalist, brought the real cochineal to St. Domingo in the year 1777, at so much hazard that he deserves a place in the martyrology of the naturalist; but after his death, which soon followed, the insects perished through the avarice or negligence of his successors; and in that island there are none now to be found but the spurious kind[2].

I am inclined to believe that the art of employing kermes to dye a beautiful red colour was discovered in the East at a very early period; that it was soon so much improved as to excel even the Tyrian purple; and that it contributed to cause the proper purple to be at length abandoned. From the costly red dyes extolled so much by the Hebrew writers, and which, according to the opinion of learned commentators, were made from kermes, I shall not venture to adduce any proofs, as I am not acquainted with the Oriental languages to examine their accounts with accuracy; but I have found a passage in Vopiscus[3], which seems to render my conjecture very probable. That author informs us, that the king of Persia sent to the emperor Aurelian, besides other articles of great value, some woollen cloth, which was of a much costlier and brighter purple colour than any that had been ever seen in the Roman empire, and in comparison of which all the other purple cloth worn by the emperor and the ladies of the court appeared dull and faded. In my opinion, this cloth, which was of a beautiful purple red colour, was not dyed with the liquor of the murex, but with kermes. This idea was indeed not likely to occur to the Romans, who were acquainted only with the purple of the

[1] Miller's Gardener's Dictionary.

[2] Traité de la culture du nopal et de l'éducation de la cochenille. Au Cap-Francois 1787, 8vo.

[3] In Vita Aureliani, cap. 29.

murex, and who had less experience in the arts in general than in that of robbing and plundering, or who at any rate in that respect were inferior to the Orientals. The Roman emperors caused this supposed purple to be sought for in India by the most experienced dyers, who, not being able to find it, returned with a vague report that the admired Persian purple was produced by the plant *Sandix*. I am well aware, that some commentators have supposed that the *Sandix* was our madder[1]. Hesychius, however, says, very confidently, that the *sandix* is not a plant, but a kind of shrubby tree which yields a dye like the *coccus*[2]. The Roman dyers, perhaps, prejudiced in favour of the murex, made that only the object of their search; and their labour proving fruitless, they might have heard something of kermes, or the kermes-oak, which they did not fully understand. Our dyers, even at present, believe many false accounts respecting the dye-stuffs which they use daily.

In later times, when it was known that the beautiful Oriental kermes-dye was not properly purple, it was no longer called by that name, but was considered as a new dye, and acquired a new appellation. Cloth dyed with it was called *scarlata*, *squarlata*, *scarleta*, *scarlatina*, *scharlatica*. That these words have an affinity to our scarlet, every one allows, but it may be difficult to discover their origin. Pezronius[3] affirms that they are of Celtic extraction, and have the same signification as *Galaticus rubor*. Astruc, as I have already shown, derives kermes from the same language, which, however, like the

[1] Those who are desirous of further information respecting the *sandix*, may consult Salmasius on Solinus, p. 810, and the editor of the Cyneget of Gratius Faliscus, x. 86. p. 46.

[2] Some have considered sandix as a mineral. Minerals however can be used for painting but not for dyeing. It may be replied that the Romans themselves dyed with kermes at this period, and that they must have easily procured it. But they understood the art of dyeing with it so badly that they employed it only for giving the ground of their purple, and on that account it must have appeared improbable to them that the people in India could produce by it a more beautiful colour than their purple was. From the like ignorance in modern times, indigo was decried, because people imagined that a complete colour could not be communicated by it; and this false conclusion retarded many improvements in the art of dyeing. It is very likely that the Greeks and the Romans were unacquainted with the effect produced upon kermes by acids, which the Persians and Indians used.

[3] Antiquit. Celt. p. 69, 70

Egyptian history, is often employed to explain what people cannot otherwise explain, because so little is known of both that much contradiction is not to be apprehended. Others wish to make scarlet from the *quisquilium*, *cusculium*, or *scolecium* of Pliny. To some the word appears to be composed of the first half of kermes and lack, with the addition of only an S, and every one is left at liberty to determine at pleasure, whether lack is to be understood as the Arabic for red, or the German word *lacken* cloth. In the first case it signifies the same as *vermiculare rubrum*; in the latter *pannus vermicularis*. Stiler [1] says *scarlach* is entirely German, and compounded of *schor* the fire, and *lacken* cloth, so that its real signification is fire-cloth, fire-coloured cloth. Reiske, on the other hand, asserts, that the word is originally the Arabic *scharal*, which means the kermes-dye [2]. Which of these conjectures is most agreeable to truth, cannot with certainty be concluded; but that the word is older than Dillon affirms it to be, on the authority of a Spaniard, can be proved. Dillon says that it was first used by Roderick, archbishop of Toledo, who finished his history of Spain in 1243 [3]. Vossius [4] has quoted several writers who use *escarletum* or *scarletum*. The oldest is Cæsarius, who lived about the year 1227. Matthew Paris, who wrote about the year 1245, used the word in referring to the year 1134. But I find that the emperor Henry III. in the middle of the eleventh century, conferred upon the count of Cleves the burg-graviate of Nimeguen, on condition of his delivering to him yearly three pieces of scarlet cloth made of English wool [5]. The word may

[1] Spaten (Stiler) der Teutschen Sprache Stammbaum, 1691, 4to, p. 1062.

[2] In his annotations on Constantini Libri de Ceremoniis Aulæ Byzantinæ, ii. p. 137. Reiske also on this occasion gives the derivation from *Charlatan*, a mountebank, juggler, *circumforaneus*, *agyrta*, because such people formerly on account of their red clothes were called *scarlatati* or *scarlatani*. Other conjectures respecting this word may be found in Menage, Dictionnaire Etymologique. See in the same work also, p. 498, the word *écarlate*. In ancient French writers the highest degree of any colour in its perfection is called *écarlate*, and we therefore meet with *écarlate blanche*, *écarlate verte*. Braun de Vestitu Sacerd. Hebræor. Amstelod. 1701, 4to, lib. i. cap. 15, p. 229, says, "*Salacka*, Tyrian red, from *sar*, Tyrus." He controverts the opinion of Gronovius that *scarlatum* is derived from *Galaticum*.

[3] Dillon's Travels through Spain, 1780, p. 21. Rod. Toletanus De Rebus Hispan. lib. vii. 1.

[4] G. J. Vossius De Vitiis Sermonis.

[5] Pontani Historia Gelrica, 1639, fol. p. 83: "Tres pannos scarlitinos Anglicanos." The year seems to have been 1050. In Lunig's Codex Diplom. Germaniæ, ii. p. 1739, may be seen a document of the year 1172, in

be often found in the twelfth century. It occurs in Petrus Mauritius [1], who died in 1157, and also in the writings of Arnold, who, in 1175, was the first abbot of Lubeck.

Of the preparation and goodness of the ancient scarlet we certainly know nothing: but as we find in many old pieces of tapestry of the eleventh century, and perhaps earlier, a red which has continued remarkably beautiful even to the present time, it cannot at any rate be denied that our ancestors extolled their scarlet not without reason. We may however venture to assert, that the scarlet prepared at present is far superior, owing principally to the effects of a solution of tin. This invention may be reckoned among the most important improvements of the art of dyeing, and deserves a particular relation.

The tincture of cochineal alone yields a purple colour, not very pleasant, which may be heightened to the most beautiful scarlet by a solution of tin in aqua regia, or muriatic acid [2]. M. Ruhlenkamp at Bremen, one of the most learned dyers of Germany, and who has studied with great care every new improvement of his art, gave me the history of this scarlet dye, as I have already related in my Introduction to Technology [3]. The well-known Cornelius Drebbel, who was born at Alkmaar, and died at London in 1634, having placed in his window an extract of cochineal, made with boiling water, for the purpose of filling a thermometer, some aqua regia dropped into it from a phial, broken by accident, which stood above it, and converted the purple dye into a most beautiful dark red. After some conjectures and experiments, he discovered that the tin by which the window-frame was divided into squares had been dissolved by the aqua-regia, and was the cause of this change. He communicated his observation to Kuffelar, an ingenious dyer at Leyden, who was afterwards his son-in-law [4]. The latter brought the discovery to perfection, and employed it some years alone in his dye-house, which gave rise to the

which the emperor Frederick I. confers on the count of Gueldres the heritable jurisdiction of Nimeguen, on condition, "*ut* ipse et ejus successores imperatori de eodem telonio singulis annis tres pannos scarlacos bene rubeos Anglicenses ardentis coloris—assignare deberet."

[1] In Statutis Cluniacensibus, cap. 18. [2] See Porner's Anleitung zur Farbekunst. Leipzig, 1785, 8vo, p. 16. [3] Page 113.

[4] Monconys mentions in his Travels, p. 408, Dr. Keiffer, a son-in-law of Drebbel, who was a good chemist.

name of Kuffelar's-colour [1]. Becher calls him Kuffler. Kunkel, in a passage which I cannot again find, makes his name Kuster, and says that he was a German. In the course of a little time the secret became known to an anabaptist called Gulich, and also to another person of the name of Van der Vecht, who taught it to the brothers Gobelins in France. Giles Gobelin, a dyer at Paris, in the time of Francis I. had found out an improvement of the then usual scarlet dye; and as he had remarked that the water of the rivulet Bievre, in the suburbs of St. Marceau, was excellent for his art, he erected on it a large dye-house, which, out of ridicule, was called *Folie-Gobelins* [2], Gobelin's-Folly. About this period, a Flemish painter, whom some name Peter Koek, and others Kloek, and who had travelled a long time in the East, established, and continued to his death in 1550, a manufactory for dyeing scarlet cloth by an improved method [3]. Through the means of Colbert, one of the Gobelins learned the process used for preparing the German scarlet dye from one Gluck, whom some consider as the above-mentioned Gulich, and others as Kloek; and the Parisian scarlet dye soon rose into so great repute, that the populace imagined that Gobelin had acquired his art from the devil [4]. It is well known that Louis XIV. by the advice of Colbert, purchased Gobelin's building from his successors in the year 1667, and transformed it into a palace, to which he gave the name of *Hôtel Royal des Gobelins*, and which he assigned for the use of first-rate artists, particularly painters, jewellers, weavers of tapestry, and others. After that time the rivulet was no longer called Bievre, but Gobelins. About the year 1643, a Fleming, named Kepler, established the first dye-house for scarlet in England, at the village of Bow, not far from London; and on that account the colour was called at first, by the English, the *Bow-dye* [5]. In the year 1667, another Fleming, named Brewer, invited to England by king Charles II. with the promise of a large salary, brought this art there to great perfection [6].

[1] In Borrichii Dissertat. ii. p. 104: Color Kufflerianus.

[2] Rabelais, xi. 22. Menage, Diction. Etymol. i. p. 682.

[3] Francheville, in Dissertat. sur l'Art de la Teinture des Anciens et Modernes, in Histoire de l'Académ. de Berlin, 1767, p. 67. In this dissertation, however, there is neither certainty nor proof.

[4] Suite de Teinturier parfait. Paris, 1716.

[5] Anderson's History of Commerce.

[6] Cary's Bemerkungen über Grossbritanniens Handel; übersetzt von Wichmann. Leipzig, 1788, i. p. 372. Boyle remarks in his Experimenta

All these accounts, however, and the names of the persons, are extremely dubious.

[Mr. Ward states in his Mexico in 1827, vol. i. p. 84, that the plantations of the Nopal (*Opuntia cochinillifera*), on which the cochineal insects feed, are confined to the district La Misteca in the state of Oaxaca, in Mexico. The animals are domesticated and reared with the greatest care. When the females have become fecundated and enlarged, the harvest commences. The insects are brushed off with a squirrel's tail, and killed by immersing them in hot water, and afterwards drying them in the sun, or by the heat of a stove. Three harvests are made annually; the first being the best, since the impregnated females alone are taken; in the second the young females are also collected; and in the third both old and young ones, and skins are collected indiscriminately. Before the rainy season commences, branches of the nopal plant loaded with young insects are cut off and preserved in the houses to prevent the animals being destroyed by the weather. It is stated in a letter from Mr. Faber to Dr. Pereira (Chemical Gazette for January 15th, 1845), that the more extensive cultivators never kill the insect by immersion, but only by the baskets being placed in heated rooms or stoves.

Three kinds of cochineal are now met with in the English market: the black, silver, and foxy. Silver cochineal is the impregnated female insect, just before laying eggs; black cochineal is the female after laying and hatching the eggs. That technically known in London as "foxy" cochineal is composed of the insects of silver cochineal which have been killed by boiling water. They are thus burst, and acquire a peculiar reddish colour, very different from the fine transparent red which forms the finest black. It is said that on the average one pound of cochineal contains 70,000 dried insects. The quantity exported from and consumed in England in 1844, amounted to no less than 1,569,120 lbs.!]

de Coloribus, Coloniæ, 1680, 4to, that a bright scarlet colour was never produced except when tin vessels were used. It appears, therefore, that he had observed the good effects of a solution of tin.

WRITING-PENS.

As long as people wrote upon tables covered with wax, they were obliged to use a style or bodkin made of bone, metal, or some other hard substance; but when they began to write with coloured liquids, they employed a reed, and afterwards quills or feathers. This is well-known, and has been proved by various authors [1]. There are two circumstances however in regard to this subject, which require some further research; and which I shall endeavour to illustrate by such information as I have been able to collect. With what kind of reeds did people write? When, and where were feathers first employed and for that purpose?

It is rather astonishing that we are ignorant of what kind of reeds the ancients used for writing, though they have mentioned the places where they grew wild, and where, it is highly probable, they grow still. Besides, we have reason to suppose that the same reeds are used even at present by all the Oriental nations; for it is well known, that among the people of the East old manners and instruments are not easily banished by new modes and new inventions. Most authors who have treated on the history of writing have contented themselves with informing their readers that a reed was employed; but the genus of plants called by the ancients *Calamus* and *Arundo*, is more numerous in species than the genus of grasses, to which their corn belonged; and it might perhaps be as difficult to determine with accuracy what kind of reed they employed for writing, as to distinguish the species of grain called *far*, *alica*, and *avena*.

The most beautiful reeds of this kind grew formerly in Egypt [2]; near Cnidus, a city and district in the province of Caria, in Asia Minor [3]; and likewise in Armenia and Italy [4]. Those which grew in the last-mentioned country, seem to

[1] See Fabricii Bibliotheca Antiquaria, p. 959. Reimmanni Idea Systematis Antiquitatis Litterariæ, 1718, 8vo, p. 169. Astle's Origin and Progress of Writing, 4to.

[2] Plin. lib. xvi. cap. 35. Martial, lib. xiv. epigram. 38.

[3] Plin. lib. c. Catullus, carm. xxxvi. 13, mentions Cnidus arundinosa. Ausonius, epist. iv. 75, calls the reeds Cnidii nodi.

[4] Plin. lib. xvi. cap. 36.

have been considered by Pliny as too soft and spongy: but his words are so obscure that little can be gathered from them; and though the above places have been explored in later times by many experienced botanists, they have not supplied us with much certain information respecting this species of reed. It is however particularly mentioned by the old botanists, who have represented it as a stem, such as I have seen in collections; but as they give no characters sufficiently precise, Linnæus was not able to assign any place in his system to the *Arundo scriptoria* of Bauhin [1].

Chardin speaks of the reeds which grow in the marshes of Persia, and which are sold and much sought after in the Levant, particularly for writing. He has even described them; but his account has been of no service to enlarge our botanical knowledge [2]. Tournefort, who saw them collected in the neighbourhood of Teflis, the capital of Georgia, though his description of them is far from complete, has taught us more than any of his predecessors. We learn from his account, that this reed has small leaves, that it rises only to the height of a man, and that it is not hollow, but filled with a soft spongy substance. He has characterized it, therefore, in the following manner in his System of Botany: Arundo orientalis, tenuifolia, caule pleno, ex qua Turcæ calamos parant [3]. The same words are

[1] Bauhini Pinax Plantar. p. 17: *Arundo scriptoria atro-rubens.* Hist. Plant. ii. p. 487. Theatrum Botan. p. 273.

[2] "Their writing-pens are made of reeds or small hard canes of the size of the largest swan-quills, which they cut and slit in the same manner as we do ours; but they give them a much longer nib. These canes or reeds are collected towards Daurac, along the Persian Gulf, in a large fen supplied with water by the river Hellé, a place of Arabia formed by an arm of the Tigris, and another of the Euphrates united. They are cut in March, and, when gathered, are tied up in bundles and laid for six months under a dunghill, where they harden and assume a beautiful polish and lively colour, which is a mixture of yellow and black. None of these reeds are collected in any other place. As they make the best writing-pens, they are transported throughout the whole East. Some of them grow in India, but they are softer and of a paler yellow colour."—Voyages de Chardin, vol. v. p. 49.

[3] "It is a kind of cane which grows no higher than a man. The stem is only three or four lines in thickness, and solid from one knot to another, that is to say filled with a white pith. The leaves, which are a foot and a half in length, and eight or nine lines in breadth, enclose the knots of the stem in a sheath; but the rest is smooth, of a bright yellowish-green colour, and bent in the form of a half-tube, with a white bottom. The panicle

applied to it by Miller; but he observes that no plants of it had ever been introduced into England. That the best writing-reeds are procured from the southern provinces of Persia is confirmed by Dapper and Hanway. The former says that the reeds are sown and planted near the Persian Gulf in the place mentioned by Chardin, and he gives the same description as that traveller of the manner in which they are prepared.

The circumstance expressly mentioned by Tournefort, that these writing-reeds are not entirely hollow, seems to agree perfectly with the account given by Dioscorides[1]. It is probable that the pith dries and becomes shrunk, especially after the preparation described by Chardin, so that the reed can be easily freed from it in the same manner as the marrowy substance in writing-quills is removed from them when prepared. Something of the like kind seems to be meant by Pliny, who, in my opinion, says that the pith dried up within the reed, which was hollow at the lower end, but at the upper end woody and destitute of pith. What follows refers to the flowers, which were employed instead of feathers for beds, and also for caulking ships. I conjectured that Forskal had given an accurate description of this reed; but when I consulted that author, I did not find what I expected. He only confirms that a great many reeds of different kinds grow near the Nile, which serve to make hedges, thatch, and wattled-walls, and which are used for various other purposes[2].

These reeds were split and formed to a point like our quills, but certainly it was not possible to make so clean and fine

or bunch of flowers was not as yet fully blown, but it was whitish, silky, and like that of other reeds. The inhabitants of the country cut the stems of these reeds to write with, but the strokes they form are very coarse, and do not approach the beauty of those which we make with our pens."—Voyage du Levant, vol. ii. p. 136.

[1] Lib. i. cap. 114. Rauwolf says in his Travels, vol. i. p. 93, "In the shops were to be sold small reeds, hollow within and smooth without, and of a brownish-red colour, which are used by the Turks, Moors, and other Eastern people, for writing." It appears that Rauwolf did not see these reeds growing, but prepared and freed from the pith. We are told by Winkelmann, in his second Letter on the Antiquities of Herculaneum, p. 46, that for want of quills he often cut into writing-pens those reeds which grow in the neighbourhood of Naples.

[2] Flora Ægyptiaco-Arabica. Havniæ, 1775, 4to, p. 47, 61.

strokes, and to write so long[1] and so conveniently with them as one can with quills. The use of them, however, was not entirely abandoned when people began to write with quills, which in every country can be procured from an animal extremely useful in many other respects. Had the ancients been acquainted with the art of employing goose-quills for this purpose, they would undoubtedly have dedicated to Minerva, not the owl, but the goose.

A passage in Clemens of Alexandria, who died in the beginning of the third century, might on the first view induce one to conjecture that the Egyptian priests even wrote with quills. This author, after describing a procession of these priests, says the sacred writer had in his hand a book with writing-instruments, and on his head feathers[2]. But it is impossible to guess what might be the intention of these feathers or wings on the head, among a people who were so fond of symbols. Besides, Clemens tells us expressly, that one of the writing-instruments was a reed with which the priests used to write.

Some assert from a passage of Juvenal[3], that quills were used for writing in the time of that poet; but what he says is only a metaphorical expression, such as has been employed by Horace[4] and various ancient writers. Others have endeavoured to prove the antiquity of writing-quills from the figure of the goddess Egeria, who is represented with a book before her, and a feather in her right hand; but the period when this Egeria was formed is not known, and it is probable that the feather was added by some modern artist[5]. No drawings in manuscripts, where the authors appear with quills, are of great antiquity. Among these is the portrait of Aristotle, in a manuscript in the library of Vienna, which, as expressly mentioned at the end, was drawn at Rome in the year 1457; and we have great reason to think that the artist delineated the

[1] Those who wish to see instances of learned men who wrote a great deal and a long time with one pen, may consult J. H. Ackeri Historia Pennarum, Altenburgi, 1726. The author has collected every thing he ever read respecting the pens of celebrated men.

[2] Clementis Alex. Opera. Coloniæ, 1688, fol. p. 633. The best account of these sacred writers may be found in the Prolegomena, p. 91, of Jablonski's Pantheon Ægypt.

[3] Sat. iv. 149.

[4] Od. iii. 29, 53.

[5] Gronovii Thesaurus Antiq. Græc. ii. n. 28.

figure for ornamenting his work, not after an ancient painting, but from his own imagination[1].

If credit can be given to the anonymous author of the history of Constantius, extracts from which have been made known by Adrian de Valois, the use of quills for writing is as old as the fifth century. We are informed by this author, who lived in the above century, that Theodoric, king of the Ostrogoths, was so illiterate and stupid, that during the ten years of his reign he was not able to learn to write four letters at the bottom of his edicts. For this reason the four letters were cut for him in a plate of gold, and the plate being laid upon paper, he then traced out the letters with a quill[2]. This account is, at any rate, not improbable; for history supplies us with more instances of such men not destined for the throne by nature, but raised to it either by hereditary right or by accident, who had neither abilities nor inclination for those studies which it requires. The western empire was governed, almost about the time of Theodoric, by the emperor Justin, who also could not write, and who used in the like manner a piece of wood, having letters cut in it, but with this difference, that, in tracing them out, he caused his hand to be guided by one of his secretaries[3].

The oldest certain account however known at present respecting writing-quills, is a passage of Isidore, who died in the year 636, and who, among the instruments employed for writing, mentions reeds and feathers[4]. Another proof of quills being used in the same century, is a small poem on a writing-pen, to be found in the works of Althelmus, called sometimes also Aldhelmus, Adelhemus, and Adelmus. This writer, descended of a noble family, was the first Saxon who wrote Latin, and who made the art of Latin poetry known to his country-

[1] Lambec. lib. vii. p. 76.—Montfaucon, Palæograph. Græca, lib. i. cap. 3, p. 21.

[2] Amm. Marcellini Hist. ed. Valesii, Par. 1681, fol. p. 699. The letters might have been raised on the plate, or deeply engraven in it, so that Theodoric only followed with his pen an impression of them made upon the paper.

[3] It is uncertain whether the characters were followed with a style, a reed, or a quill; for γραφὶς (the word used) is the general appellation. "There have been princes, also, acquainted with writing, but so lazy that they kept a servant who could imitate their hand to subscribe for them." Of this we have an instance in the emperor Carinus, respecting whom Vopiscus says, "Fastidium subscribendi tantum habuit, ut quendam ad subscribendum poneret qui bene suam imitaretur manum."

[4] Origines, lib. vi. 13, p. 132.

men, and inspired them with a taste for compositions of that kind. He died in the year 709[1].

In the eighth century writing-pens are mentioned by Alcuin, who at that period, in the time of Charlemagne, was of service in extending literary knowledge. He composed poetical inscriptions for every part of a monastery, among which there is one even for a privy [2], and another for a writing-study. Speaking of the latter, he says that no one ought to talk in it, lest the pen of the transcriber should commit a mistake [3].

After the above period proofs occur which place the matter beyond all doubt. Mabillon saw a manuscript of the gospels, which had been written in the ninth century under the reign of Louis I., in which the evangelists were represented with quills in their hands. The same author mentions a like figure of the eleventh century [4]. In the twelfth century, Peter de Clugny, who by scholastic writers is called *Venerabilis*, and who died in 1157, wrote to a friend, exhorting him to assume the pen instead of the plough, and to transcribe, instead of tilling land [5]. In short, writing-quills are often called *calami* by ancient and modern authors who wrote good Latin; and it is probable that this word is employed by older writers than Isidore to signify writing-pens, where, for want of other proofs, we understand reeds.

The poet Heerkens[6] has asserted, that the use of quills for

[1] His writings may be found in Maxima Bibliotheca Patrum. Lugduni, 1677, fol. tom. xiii. In p. 27, is the following poem on a pen:—

De Penna Scriptoria.

Me pridem genuit candens onocrotalus albam
Gutture qui patulo sorbet in gurgite lymphas.
Pergo ad albentes directo tramite campos,
Candentique viæ vestigia cærula linquo,
Lucida nigratis fuscans anfractibus arva.
Nec satis est unum per campos pandere callem;
Semita quin potius milleno tramite tendit,
Quæ non errantes ad cœli culmina vexit.

The author does not speak here of a goose-quill, but of a pelican's, which at any rate may be as good as that of a swan. [2] Ad latrinium (latrinam).

[3] Alcuini Opera, cura Frobenii, Ratisbonæ, 1777, 2 vols. fol. ii. p. 211.

[4] De Re Diplomatica, Par. 1709, fol. in Suppl. p. 51.

[5] Petr. Venerabil. lib. i. ep. 20, ad Gislebertum. C. G. Schwarz, who quotes the passage in Exercit. de Varia Supellectili Rei Librariæ Veterum, Altorfii, 1725, 4to, § 8, ascribes them falsely to the venerable Bede, who died about the year 735.

[6] Ger. Nic. Heerkens Aves Frisicæ, Rot. 1788, 8vo, p. 106.

writing is much older, and that the Romans became acquainted with them during their residence in the Netherlands, where they could not easily procure Egyptian reeds, and where, according to the account of Pliny [1], they paid so much attention to the catching of geese. That writer, however, says that this was done on account of the flesh of these animals, which they esteemed much when roasted, and of the softness of their feathers, on which they were fond of sleeping. Heerkens himself remarks, that Pliny, had he known the use of quills for writing, would not have passed it over in silence, when he gives so circumstantial an account of writing-reeds. He is of opinion also, that, as the Dutch terms of art which allude to writing, such as *schryfpen*, &c., are of Latin extraction, the Dutch must have acquired them as well as the things signified from the Romans. This however seems to afford very little support to his assertion. Of more importance is the observation that in an old and beautiful manuscript of Virgil, in the Medicean library, which was written soon after the time of Honorius, the thickness of the strokes, and the gradual fineness of the hair-strokes of the letters give us reason to conjecture that they must have been written by some instrument equally elastic as a quill, as it is not probable that such strokes could be made with a stiff reed [2]. It is also certain that the letters of the greater part of ancient manuscripts, particularly those found at Herculaneum, are written in a much stiffer and more uniform manner. But little confidence is to be placed in this observation; for we do not know but the ancient artists may have been acquainted with some method of giving elasticity to their reeds, and may have employed them in such a manner as to produce beautiful writing.

Notwithstanding the great advantage which quills have over reeds for writing, the latter however seem to have continued long in use even with the former. This conclusion I do not form, because *calamus* and *arundo* are to be found in the works of late writers; for many authors may have employed these old Latin words to express quills, like Cassiodorus, who in the sixth century, when exhorting the monks to transcribe theological works, used both these terms indiscriminately [3]; but I

[1] Hist. Nat. lib. x. cap. 22.

[2] This manuscript was correctly printed by P. F. Fogginius, in quarto, in 1741. A specimen of the writing is given, p. 15. See also Virgilius Heynii, in Elenchus Codicum, p. 41.

[3] Divin. Lection. cap. xxx. p. m. 477, 478.

found my assertion on the testimony of diplomatists, and particularly on the undoubted mention made of writing-reeds in the sixteenth century.

Men of letters, well-versed in diplomatics, assure us, from comparing manuscripts, that writing-reeds were used along with quills in the eighth century, at least in France, and that the latter first began to be common in the ninth. The papal acts, and those of synods, must however have been written with reeds much later[1]. In convents they were retained for texts and initials, while, for small writing, quills were everywhere employed.

I can allow little credit to a conjecture supported merely by a similarity of the strokes in writing, because it is probable that people at first would endeavour to write in as strong and coarse a manner with quills, as had been before done with reeds, in order that the writing might not seem much different from what was usual; and with quills one can produce writing both coarse and fine. M. Meiners, however, referred me to a passage in a letter of Reuchlin, which removes all doubt on the subject. When this worthy man, to whom posterity is so much indebted, was obliged to fly by the cruelty of his enemies, famine and the plague, and to leave behind him all his property, he was supplied with the most common necessaries by Pirkheimer[2]. Among other articles the latter sent to him, in the year 1520, writing materials, good paper, penknives, and, instead of peacocks-feathers which he had requested, the best swan-quills. That nothing might be wanting, he added also proper reeds, of so excellent a sort, that Reuchlin considered them to be Egyptian or Cnidian[3].

These reeds at that period must have been scarce and in great request, as it appears by some letters of Erasmus to Reuchlin, for my knowledge of which I am under obligations to M. Meiners, that the former received three reeds from the latter, and expressed a wish that Reuchlin, when he procured more, would send some of them to a learned man in England, who was a common friend to both[4].

Whatever may have been the cause, about the year 1433

[1] Nouveau Traité de Diplomatique, i. p. 537. [2] Reuchlin's life may be found in Meiners' Lebensbeschreibungen Berühmter Männer. Zurich. 1795, 8vo, vol. i. [3] Pirkheimeri Opera, Franc. 1610, fol. p. 259.
[4] Illustrium Virorum Epistolæ ad Jo. Reuchlin.: Hagenoæ, 1519, 4to, p. 144.

writing-quills were so scarce at Venice, that it was with great difficulty men of letters could procure them. We learn at any rate, that the well-known Ambrosius Traversarius, a monk of Camaldule, sent from Venice to his brother, in the above year, a bunch of quills, together with a letter, in which he said, "They are not the best, but such as I received in a present. Show the whole bunch to our friend Nicholas, that he may select a quill; for these articles are indeed scarcer in this city than at Florence[1]." This Ambrosius complains likewise, that at the same period he had hardly any more ink, and requested that a small vessel filled with it might be sent to him[2]. Other learned men complain also of the want of good ink, which they either would not or did not know how to make. Those even who deal in it seldom know of what ingredients it is principally composed.

[The softness of quill pens and the constant trouble required to mend them naturally led to the search for some substitute. Metals have supplied this, and the manufacture of metallic pens now gives occupation to an immense number of persons. Steel and other metallic pens have long been made occasionally[3], but were not extensively used on account of their stiffness; this was remedied by Mr. Perry, who, in 1830, introduced the use of apertures between the shoulder and the point. Numerous other improvements have been made, the metals have all had a trial, and pens can now be obtained of almost every form and quality. Perhaps the most perfect and durable, although the most expensive, are those in which the pen is made of gold, with a nib of osmium and iridium. The total quantity of steel annually employed in the manufacture of pens has been estimated at 120 tons, from which upwards of 200,000,000 pens are produced. One Birmingham manufacturer employed in 1838, 300 persons in making steel pens. They are also extensively manufactured in London and Sheffield. When first introduced, steel pens were eight shillings a gross; they afterwards fell to four shillings a gross, and now they are procured at Birmingham for fourpence a gross[4]!]

[1] Ambrosii Traversarii Epistolæ, ed. L. Mehus. Florentiæ, 1759, 2 vols. fol. ii. p. 566. [2] Ibid. p. 580. [3] [The publisher has in his possession an extremely well-made metallic pen (brass) at least fifty years old, and with it a style for writing by means of smoked paper, both in a morocco pocket-book, which formerly belonged to Horace Walpole, and was sold at the Strawberry Hill sale.]

[4] Waterston's Cyclopædia of Commerce, 1846.

WIRE-DRAWING.

It is highly probable that in early periods metals were beat with a hammer to thin plates or leaves, which were afterwards divided into small slips by means of a pair of scissors, or some other instrument; and that these slips were by a hammer and file then rounded, so as to form threads or wire. This conjecture seems to be confirmed by the oldest information respecting work of this kind. When the sacerdotal dress of Aaron was prepared, the gold was beaten and cut to threads, so that it could be interwoven in cloth[1]. We are told also that Vulcan, desirous to expose Mars and Venus, while engaged in their illicit amour, repaired to his forge, and formed on his anvil, with hammers and files, a net so fine that it could be perceived by no one, not even by the gods themselves, for it was as delicate as a spider's web[2]. These fine threads therefore were at that time first beat upon the anvil, and afterwards rounded by a file, but were not drawn out like our wire. I do not remember to have found a single passage in ancient authors where mention is made of metal prepared by being wire-drawn. The *æs ductile* of Pliny was so called because it was malleable, and could be beat into thin leaves; and he says "tenuatur in laminas[3]." In my opinion, works made with threads of metal occur too seldom in the writings of the ancients, to allow us to suppose that they were acquainted with that easy and cheap method of forming these threads by wire-drawing. Wire-work is rarely mentioned, and wherever it is spoken of, it appears to have been prepared on the anvil.

Such threads of the dearest and most malleable metal, gold, seem to have been early employed for ornamenting different articles of dress, but certainly not in so ingenious and beautiful a manner as in modern times. It is probable that slips of gold were sewed upon clothes, and particularly on the seams, as is still practised with lace; and perhaps gold stars and other figures cut from thin plates of gold were applied to dresses in the same manner, as is the case at present with spangles, and perhaps they were only affixed to them with

[1] Exodus, chap. xxxix. ver. 3.—Braun, De Vestitu Sacerdotum Hebræorum, p. 173.
[2] Homer, Odyss. lib. viii. 273, 278.—Ovid. Metamorph. lib. iv. 174.
[3] Lib. xxxiv. cap. 8.

paste. People however soon began to weave or knit dresses entirely of gold threads, without the addition of any other materials; at least such seems to be the account given by Pliny[1]. Of this kind was the mantle taken from the statue of Jupiter by the tyrant Dionysius[2], and the tunic of Heliogabalus mentioned by Lampridius[3]. These consisted of real *drap d'or*, but the moderns give that name to cloth, the threads of which are silk wound round with silver wire flattened and gilded.

The invention of interweaving such massy gold threads in cloth is by Pliny ascribed to king Attalus; but I consider it to be much older, though I have found no certain proofs to support this opinion. I conjecture that the cloth of Attalus, so much extolled on account of its magnificence, was embroidered with the needle; for in the passage where embroidery is mentioned by Pliny for the first time, he speaks of its being invented by the Phrygians; he then mentions the cloth of Attalus; and immediately after the Babylonian, which, as is proved by several expressions in ancient authors, was certainly embroidered with the needle[4]. If I am not mistaken, Attalus first caused woollen cloth to be embroidered (not interwoven) with threads of gold; and the doubt that Pliny assigns too late a period to the interweaving cloth with threads of gold is entirely removed. It appears that in the third century gold was interwoven with linen, that linen was embroi-

[1] Lib. xxxiii. cap. 4.—Aldrovandus relates, in his Museum Metallicum, that the grave of the wife of the emperor Honorius was discovered at Rome about the year 1544, and that thirty-six pounds of gold were procured from the mouldered dress which contained the body.

[2] Cicero de Nat. Deor. iii. 34, 83.—Valer. Max. i. 1. exter. § 3.

[3] Lamprid. Vita Heliogab. cap. 23.

[4] Plin. lib. viii. cap. 48. That the cloth of Attalus was embroidered with the needle is proved by a passage of Silius Italicus, lib. xiv. 661. We find by Martial, lib. xiii. ep. 28, that the Babylonian cloth was also ornamented with embroidery; and the same author, lib. xiv. ep. 50, extols the weaving of Alexandria, as being not inferior to the Babylonian embroidery with the needle. In opposition to which might be quoted a passage of Tertullian De Habitu Mulierum, where he makes use of the word *insuere* to the Phrygian work, and of *intexere* to the Babylonian. By these expressions it would appear that he wished to define accurately the difference of the Phrygian and Babylonian cloth, and to show that the former was embroidered and the latter wove. But Tertullian often plays with words. *Intexere* is the same as *insuere*. In Pliny, book xxxv. ch. 9, a name embroidered with gold threads is called "aureis litteris in palleis intextum nomen."

dered with gold threads, or that gold threads were sewed upon linen, which the emperor Alexander Severus considered as folly; because by these means the linen was rendered stiff, cumbersome and inconvenient[1].

It was not till a much later period that silver began to be formed into threads by a like process, and to be interwoven in cloth. Salmasius and Goguet have already remarked that no mention of silver stuffs is to be found in the works of the ancients; for the passages which might be quoted from Homer speak only, without doubt, of white garments[2]. Pliny certainly would not have omitted this manner of preparing silver, had it been usual in his time; especially as he treats so expressly of that metal, and its being employed for ornaments, and speaks of gold threads and embroidering with gold. Vopiscus, however, seems to afford us an indubitable proof that silver thread was not known in the time of the emperor Aurelian[3]. This author informs us that the emperor was desirous of entirely abolishing the use of gold for gilding and weaving, because, though there was more gold than silver, the former had become scarcer, as a great deal of it was lost by being applied to the above purposes, whereas every thing that was silver continued so[4]; but it has been fully proved by Salmasius that silver threads were interwoven in cloth in the time of the last Greek emperors[5].

The period when attempts were first made to draw into threads metal cut or beat into small slips, by forcing them through holes in a steel plate placed perpendicularly on a table, I cannot determine. In the time of Charlemagne this process was not known in Italy; for however unintelligible may be the directions given in Muratori[6], "de fila aurea facere, de petalis auri et argenti," we learn from them that these articles were formed only by the hammer. It is extremely probable

[1] Lamprid. Vita Alexand. Severi, c. 40.

[2] Odyss. lib. v. 230; x. 23, 24.

[3] Vita Aureliani, cap. 46.

[4] A doubt however arises respecting this proof. It is possible that the author here speaks of gilt silver; for, as the ancients were not acquainted with the art of separating these metals, their gold was entirely lost when they melted the silver. I remember no passage in ancient authors where mention is made of weaving or embroidering with threads of silver gilt.

[5] Salmas. ad Vopisc. p. 394; et ad Tertull. de Pallio, p. 208. Such cloth at those periods was called *συρματινὸν*, *συρματηρὸν*, drap d'argent.

[6] Antiquitat. Ital. Medii Ævi, ii. p. 374.

that the first experiments in wire-drawing were made upon the most ductile metals, and that the drawing of brass and iron to wire is of later date. It is likewise certain that the metal was at first drawn by the hand of the workman; in the same manner as wire is drawn by our pin-makers when they are desirous of rendering it finer. They wind it off from one cylinder upon another, by which means it is forced through the holes of the drawing-iron; and this process agrees perfectly with the description of Vanuccio [1] and Garzoni [2], as well as with the figures in the German translation of the latter.

As long as the work was performed by the hammer, the artists at Nuremberg were called wire-smiths; but after the invention of the drawing-iron they were called wire-drawers and wire-millers. Both these appellations occur in the history of Augsburg so early as the year 1351; and in that of Nuremberg in 1360 [3]; so that, according to the best information I have been able to obtain, I must class the invention of the drawing-iron, or proper wire-drawing, among those of the fourteenth century.

At first threads exceedingly massy were employed for weaving and embroidering. Among the ruins of Herculaneum were found massy gold tassels, the threads of which were wound neither round silk nor any other materials [4]. It would be of some importance if one could determine the period when flatted metal wire began to be spun round linen or silk thread, by which improvement various articles of dress and ornament are rendered more beautiful as well as cheaper. The spinning-mill, by which this labour is performed at present, is so ingeniously contrived that the name of the inventor deserves to be made immortal [5].

It appears that the wire first spun about thread was round; and the invention of previously making the wire flat is, in my opinion, a new epoch in the history of this art. Three times as much silk can be covered by flatted as by round wire; so

[1] Pyrotechnia, lib. ix. [2] La Piazza Universale, Ven. 1610, 4to.

[3] Von Murr, in Journal zur Kunstgeschichte, v. p. 78. To this author we are indebted for much important information respecting the present subject. [4] Bjornstahls Briefe, i. p. 269.

[5] See a description of it in Sprengel's Handwerken und Künsten, iii. p. 64; or in the tenth volume of the plates belonging to the Encyclopédie, under the article Tireur et fileur d'or.

that tassels and other articles become cheap in proportion. Besides, the brightness of the metal is heightened in an uncommon degree; and the article becomes much more beautiful[1]. The wire is flatted at present by means of a flatting-mill, which consists of two steel cylinders, put in motion by a handle, and as the wire passes through between them it is compressed and rendered flat. These cylinders were at first procured from the Milanese, and afterwards from Schwarzenbruck in Saxony; but since the death of the artists in those parts who were acquainted with the secret of making them, they have generally been ordered from Neufchatel. A pair of them cost two hundred dollars. The whole art, however, seems to consist in giving a proper hardness to the steel and in polishing them. In the earliest ages wire was flatted with a hammer on the anvil; and the broad slips were cut into small threads by women with a pair of scissors. The process is thus described by Vannuccio and Garzoni, without mentioning the flatting-mill which is now used for brass work, coining money, and various other purposes.

Before I proceed to the newest inventions I shall add the following observations. Of the wire-work of the ancients we have very few remains, and these are to be found upon cast statues, on which one cannot expect any fine wire spun or entwisted round other substances, even supposing that they had such. In the museum at Portici, which contains a variety of articles discovered at Herculaneum, there are three metal heads, with locks in imitation of hair. One of them has fifty locks made of wire as thick as a quill, bent into the form of a curl. On the other the locks are flat like small slips of paper which have been rolled together with the fingers, and afterwards disentangled[2]. A Venus, a span in height, has on the arms and legs golden bracelets[3] (*armillæ et periscelides*), which are formed of wire twisted round them. Grignon found in the ruins of a Roman city in Champagne a piece of gold thread which was a line in thickness[4]. Among the insignia of the German empire is the sword of St. Maurice, the handle of

[1] Bericht von Gold- und Silber-dratziehen; von Lejisugo. Lubeck, 1744, 8vo, p. 199.

[2] Winkelmann, von den Herculan. Entdeckungen. [3] Ibid. p. 38.

[4] Second Bulletin des Fouilles d'une Ville Romaine, par Grignon. Paris, 1775, 8vo, p. 111.

which is wood bound round with strong silver wire [1]. The ancients, however, must have been acquainted at an early period with the art of making gold-wire of considerable fineness, as they used it in weaving and for embroidery. When surgeons were desirous to fasten a loose tooth or to implant one of ivory in the room of one that had dropped out, they bound it to the next one by a piece of fine gold wire [2].

The greatest improvement ever made in this art was undoubtedly the invention of the large drawing-machine, which is driven by water, and in which the axle-tree, by means of a lever, moves a pair of pincers, that open as they fall against the drawing-plate; lay old of the wire, which is guided through a hole of the plate; shut as they are drawn back; and in that manner pull the wire along with them [3]. What a pity that neither the inventor nor the time when this machine was invented is known! It is, however, more than probable that it was first constructed at Nuremberg by a person named Rudolf, who kept it long a secret; and by these means acquired a considerable fortune. Conrade Celtes, who wrote about the year 1491, is the only author known at present who confirms this information; and he tells us that the son of the inventor, seduced by avaricious people, discovered to them the whole secret of the machinery; which so incensed the father that he would have put him to death, had he not saved himself by flight [4]. Von Murr, however, has not been able to find any proofs of this circumstance; and amongst the names of wire-drawers, which he met with in the records of Nuremberg, it appears that there must have been no Rudolf, else he would

[1] Von Murr, Beschreibung von Nürnberg, 1778, 8vo, p. 229.

[2] Some explain the following words in the twelve tables of the Roman laws, "Cui auro dentes vincti sunt," as alluding to this circumstance. Funccius however does not admit of this explanation, because he does not believe it possible to bind a tooth in that manner. It has, nevertheless, been sufficiently confirmed both by ancient and modern physicians. Celsus, de Medicina, lib. vii. cap. 12.

[3] A description of this excellent machine may be found in Sprengel's Handwerken, iv. p. 208; Cancrinus Beschreibnng der vorzüglichsten Bergwerke, Frankf. 1767, 4to, p. 128; in the tenth volume of the plates to the Encyclopédie, under the article Tireur et fileur d'or; and other works. Von Murr quotes a very ingenious description of it by the well-known poet Eobanus Hessus, who died in 1540.

[4] This account may be found vol. i. p. 197 of the Urbis Norimbergæ Descriptio, Hagenoæ, 1518, fol. cap. 5.

certainly have mentioned it. Doppelmayer [1], from mere conjecture, places Rudolf's invention in the year 1400; but Von Murr makes it older, because he found in the year 1360 the name Schockenzier, which signifies a person who works at wire-drawing.

This art, it appears, was brought to the greatest perfection at Nuremberg. Several improvements were from time to time found out by different persons, who turned them to their advantage, and who received exclusive patents for using them, sometimes from the emperor, and sometimes from the council, and which gave occasion to many tedious law-suits. We have, however, reason to believe that the finer kinds of work, particularly in gold and silver, were carried on with great success above all, in France and Italy; and that many improvements were brought from these countries to Germany. I have not materials sufficient to enable me to give a complete account of the progress of the art of wire-drawing at Nuremberg; but it affords me pleasure that I can communicate some important information on this subject, which was published [2] by Dr. F. C. G. Hirsching of Erlangen, taken from original papers, respecting the wire-drawing manufactory at Nuremberg [3], and which I shall here insert.

In the year 1570, a Frenchman named Anthony Fournier, first brought to Nuremberg the art of drawing wire exceedingly fine, and made considerable improvement in the apparatus used for that purpose. In 1592 Frederick Hagelsheimer, called also Held, a citizen of Nuremberg, began to prepare, with much benefit to himself, fine gold and silver wire, such as could be used for spinning round silk and for weaving, and which before that period had been manufactured only in Italy and France. Held removed his manufactory from France to Nuremberg, and received from the magistrates an exclusive patent, by which no other person was allowed to make or to imitate the fine works which he manufactured, for the term of fifteen years. On account of the large capital and great labour which was required to establish this manufactory, his patent was by the same magistrates continued in 1607 for fifteen years more.

[1] Nachricht von Nürnbergischen Künstlern, p. 281.
[2] In the Journal des Freyherrn von Bibra.
[3] Journal von und für Teutschland, 1788, achtes Stück, p. 102.

As this patent comprehended only fine work, and the city of Nuremberg, and as works of copper gilt with silver or gold were of great importance, he obtained on the 19th of March, 1608, from the emperor Rodolphus II., an extension of his patent, in which these works were included, and by which power was granted to him to seize, in any part of the empire, as well as in Nuremberg, imitations of his manufactures made by others, or such of his workmen as might be enticed from his service. A prolongation of his patent for fifteen years was again granted to him at the same time.

After the death of the emperor Rodolphus, his patent was in everything renewed, on the 29th of September, 1612, by the emperor Matthias, and extended to the term of fifteen years more. On the 16th of June, 1621, the Nuremberg patent expired; and the same year the family of Held, with consent of the magistrates of that city, entered into an agreement, in regard to wages and other regulations, with the master wire-drawers and piece-workers [1], which was confirmed in another patent granted to Held on the 28th of September, 1621, by the emperor Ferdinand II., agreeably to the tenor of the two patents before-mentioned, and which was still continued for fifteen years longer. On the 26th of September, 1622, this patent, by advice of the imperial council, and without any opposition, was converted into a fief to the heirs male of the family of Held [2], renewable at the expiration of the term specified in the patent.

It appears that in the fifteenth century, there were flatting-mills in several other places as well as at Nuremberg. In the town-books of Augsburg there occurs, under the year 1351, the name of a person called Chunr. Tratmuller de Tratmul, who certainly seems to have been a wire-drawer. In 1545, Andrew Schulz brought to that city the art of wire-drawing gold and silver, which he had learned in Italy. Before this period that art was little known in Germany; and Von Stetten mentions an imperial police ordinance of the year 1548, in which gold fringes are reckoned among those wares for

[1] Piece-workers were such masters as were obliged to work privately by the piece; because, according to the imperial patent, no one except Held or those whom he permitted durst carry on this business. For this permission it was necessary to pay a certain sum of money.

[2] The family at this period consisted of Frederick Held and his three sons Bartholomew, Frederick, and Paul.

which large sums were at that time sent out of the empire. Schulz obtained a patent from the council, but his attempt proved unsuccessful. The business, however, was undertaken afterwards in Augsburg by others, and in particular by an opulent mercantile family named Hopfer, who bestowed great pains to establish it on a permanent footing. For this purpose they invited from Venice, Gabriel Marteningi and his son Vincent, who were excellent workmen and had great experience in the art. George Geyer, who learned under them, was the first person who introduced the flatting of wire at Augsburg; and he and his son endeavoured for a long time to monopolize the employment of wire-drawing, and to prevent other people from engaging in it near them. In the year 1698, M. P. Ulstatt, John George Geyer, Joseph Matti and Moriz Zech obtained a new patent, and out of gratitude for this favour they caused a medal to be struck, which deserves to be reckoned among the most beautiful works of Philip Henry Muller, the artist who cut the die.

In the year 1447 there was a flatting-mill at Breslau [1]; and another, together with a burnishing-mill was constructed at Zwickau [2] in 1506. All the wire in England was manufactured by the hand till 1565, when the art of drawing it with mills was introduced by foreigners [3]. Before that period the English wire was bad; and the greater part of the iron-wire used in the kingdom, as well as the instruments employed by the wool-combers, was brought from other countries. According to some accounts, however, this art was carried to England at a much later period; for we are told that the first wire-making was established at Esher by Jacob Momma and Daniel Demetrius [4]. Anderson himself says that a Dutchman constructed at Sheen, near Richmond, in 1663, the first flatting-mill ever seen in England.

Iron-wire in France is called *fil d'Archal*; and the artists there have an idea, which is not improbable, that this appellation took its rise from one Richard Archal, who either invented or first established the art of drawing iron-wire in that country. The expression *fil de Richard* is therefore used also

[1] Von Breslau, Documentirte Geschichte, ii. 2, p. 409.
[2] Chronica Cygnæa, durch Tob. Schmidten, Zwickau, 1656, ii. p. 254.
[3] Anderson's Hist. Commerce. iv. p. 101.
[4] Husbandry and Trade improved, by J. Houghton, 1727, 8vo, ii. p. 188.

among the French wire-drawers [1]. Of this Archal, however, we know as little as of the Nuremberg Rudolf; and Menage will not admit the above derivation. He is of opinion that *fil d'Archal* is compounded of the Latin words *filum* and *aurichalcum* [2].

To conclude this article, I shall add a few observations respecting filigrane works and spangles. The first name signifies a kind of work of which one can scarcely form a proper idea from a description. Fine gold and silver wire, often curled or twisted in a serpentine form, and sometimes plaited, are worked through each other and soldered together so as to form festoons, flowers and various ornaments; and in many places also they are frequently melted together by the blowpipe into little balls, by which means the threads are so entwisted as to have a most beautiful and pleasant effect. This work was employed formerly much more than at present in making small articles, which served rather for show than for use; such as needle-cases, caskets to hold jewels, small boxes. particularly shrines, decorations for the images of saints and other church furniture. Work of this kind is called *filagrame*, *filigrane*, *ouvrage de filigrane*; and it may be readily perceived that these words are compounded of *filum* and *granum*. We are told in the Encyclopédie that the Latins called this work "opus filatim elaboratum," but this is to be understood as alluding to the latest Latin writers; for *filatim* occurs only once in Lucretius, who applies it to woollen thread.

This art, however, is of great antiquity, and appears to have been brought to Europe from the East. Grignon informs us that he found some remains of such work in the ruins of the Roman city before-mentioned [3]. Among church furniture we meet with filigrane works of the middle ages. There was lately preserved in an abbey at Paris, a cross ornamented with filigrane work, which was made by St. Eloy, who died in 665; and the greater part of the works of that saint are decorated

[1] Dictionnaire de Commerce, par Savary, ii. p. 599.—Dictionnaire des Origines, par D'Origny, ii. p. 285.

[2] Dictionnaire Etymologique, i. p. 593. The author quotes the following passage from a French bible printed at Paris in 1544: "Ne ayes pas merveilles, si tu lis en aucuns lieux à la fois, que ces choses estoient d'airain, et à la fois arcal; car airain et arcal est un mesme metal."

[3] Bulletin des Fouilles d'une Ville Romaine, i. p. 22.

in the like manner[1]. In the collection of relics at Hanover is still to be seen a cross embellished with this kind of work, which is said to be as old as the eleventh or twelfth century[2]. The Turks, Armenians and Indians make at present masterpieces of this sort, and with tools exceedingly coarse and imperfect. Marsden extols the ingenuity of the Malays on the same account[3]; and articles of the like nature, manufactured at Deccan, are, we are told, remarkably pretty, and cost ten times the price of the metal employed in forming them[4]. This art is now neglected in Europe, and little esteemed. Augsburg, however, a few years ago had a female artist, Maria Euphros. Reinhard, celebrated for works of this kind, who died in 1779. In 1765 she ornamented with filigrane work some silver basons, which were sent to Russia for the use of the church, and which gained her great honour[5].

Spangles, *paillettes*, are small, thin, round leaves of metal, pierced in the middle, which are sewed on as ornaments; and though they are well-known, it might be difficult for those who never saw them manufactured, or read an account of the manner in which they are prepared, to conceive how they are made. The wire is first twisted round a rod into the form of a screw; it is then cut into single spiral rings, like those used by pin-makers in forming heads to their pins; and these rings being placed upon a smooth anvil are flattened by a smart stroke of the hammer, so that a small hole remains in the middle, and the ends of the wire which lie over each other are closely united. I remember to have seen on old saddle-cloths and horse-furniture large plates of this kind; but the small spangles seem to be of later invention. According to Lejisugo[6], whose real name I do not know, they were first made in the French gold and silver manufactories, and imitated in Germany, for the first time, in the beginning of the seventeenth century. The method of preparing them was long kept a secret.

[1] Menage, Dictionnaire Etymologique, i. p. 593.
[2] Jungii Disquisit. de Reliquiis, &c. Hanov. 1783, 4to.
[3] History of Sumatra. London, 1783, 4to, p. 145.
[4] Kindersley Briefe von der Insel Teneriffa und Ostindien. Leipzig, 1777, 8vo. The jesuit Thomans praises the negroes of Monomotapa on the same account. See his Reise und Lebensbeschreibung. Augsburg, 1788, 8vo.
[5] Von Stetten, Kunstgeschichte, i. p. 489, and ii. p. 287.
[6] Bericht von Dratziehen, p. 192.

BUCK-WHEAT.

Grasses alone, and of these the seeds only of those which are so abundant in an eatable farinaceous substance that they deserve to be cultivated as food to man, are properly corn. Notwithstanding this definition, buck-wheat, which belongs to a kind of plants that grow wild in Europe, knot-grass, water-pepper, &c., because it is sown and employed like corn, is commonly reckoned to be corn also. Our wheat and oats, however, were not produced from indigenous grasses, as has been the opinion of some learned naturalists, who, nevertheless, were not botanists; nor has buck-wheat been produced from the above-mentioned wild plants[1]. Both these assertions can be proved by the strongest botanical evidence; and the latter is supported by historical testimony, which cannot be adduced in regard to the proper species of corn, as they were used before the commencement of our history.

Two centuries ago, when botanists studied the ancients, and believed that they had been acquainted with and given names to all plants, some of them maintained that buck-wheat was their *ocimum*: others have considered it as the *erysimum* of Theophrastus; and some as the *panicum* or *sesamum*. All these opinions, however, are certainly false. It is indeed difficult to determine what plant the *ocimum* of the ancients was; but it may be easily proved that it was not buck-wheat, as Bock or Tragus[2] has confidently asserted. The *ocimum*, or a species of that name, for it seems to have been applied to several vegetable productions, was a sweet-smelling plant, called also, at least by later writers, *basilicum*; one kind of *ocimum* had a thick, woody root[3], and others possessed a strong

[1] It cannot however be denied that some indigenous grasses might be brought by culture, perhaps, to produce mealy seeds that could be used as food. It is at any rate certain that some grasses, for example, the slender-spiked cock's-foot panic-grass, *Panicum sanguinale*, which we have rooted out from many of our gardens, was once cultivated as corn, and is still sown in some places, but has been abandoned for more beneficial kinds.

[2] "If the learned would lay aside disputing, and give place to truth, they would be convinced, both by the sight and the taste, that this plant (buck-wheat) is the *ocimum* of the ancients."—Kreuterbuch, Augsburg, 1546, fol. p. 248.

[3] Theophrast. l. vii. c. 3.

medicinal virtue[1]. The ancient writers on agriculture give it a place between the garden flowers and the odoriferous herbs[2]; but none of these descriptions can be applied to our buck-wheat, which is both insipid and destitute of smell. Two unintelligible passages of an ancient writer on husbandry make *ocimum* to have been a plant used for fodder, or rather a kind of green fodder or meslin composed of various plants mixed together[3]. The *erysimum* of Theophrastus produced seeds which had a very hot acrid taste[4]; and he doubts whether it was eaten by cattle[5]. Pliny says expressly that it ought to be classed rather among medicinal plants than those of the corn-kind[6]; though Theophrastus has mentioned it more than once among the latter.

It is not worth the trouble to enter into an examination of more opinions of the like kind, as several respectable writers, who lived in the beginning of the sixteenth century, consider buck-wheat to be a plant first introduced into Europe in their time, though they are not all agreed in determining its native country. John Bruyerinus, or as he was properly called, La Bruyère-Champier, physician to Francis I., king of France, who in the year 1530 wrote his book, often printed, De Re Cibaria[7], says that buck-wheat had been first brought to Europe a little before that time from Greece and Asia. That well-known botanist Ruellius[8], who wrote in 1536, and Conrade Heresbach[9], who died in 1576, give the same account. The latter calls the northern part of Asia the original country of this plant, or

[1] Dioscor. l. ii. c. 171. [2] Geopon. l. ix. c. 28.

[3] Varro, lib. i. cap. 31. That a kind of meslin is here to be understood, has been supposed by Stephanus, in his Prædium Rusticum, p. 493; and Matthiolus is of the same opinion. See Matthioli Opera, p. 408. Buck-wheat may have been employed green as fodder; and it is indeed often sown for that use; but there are many other plants which can be employed for the like purpose. [4] Dioscorid. l. ii. c. 188. [5] Theophrast. p. 941.

[6] Plin. lib. xviii. cap. 10. He says in the same place, and also p. 291, that the *erysimum* was by the Latins called also *irio*; and hence it is that Ruellius and other old botanists give that name to buck-wheat.

[7] The first edition was published in octavo, at Lyons, in 1560. Two editions I have now before me; the first is called Dipnosophia seu Sitologia, Francofurti, 1606, 8vo. The other Joan. Bruyerini Cibus Medicus, Norimbergæ, 1659, 8vo. The author was a grandson of Symphorien Champier, whose works are mentioned in Haller's Biblioth. Botan. i. p. 246.

[8] De Natura Stirpium, Basiliæ, 1543, fol. p. 324.

[9] Rei Rusticæ Libri Quatuor. Spiræ Nemetum, 1595, 8vo, p. 120. He calls it triticum faginum, *φαγόπυρον*, or nigrum triticum, buck-wheat.

that from which it had a little before been brought to Germany. A nobleman of Brittany, whose book, Les Contes d'Eutrapel[1], was printed after his death in 1587, remarks occasionally, that at the time when he wrote, buck-wheat had been introduced into France about sixty years, and that it had become the common food of the poor. Martin Schook[2] wrote in 1661, that buck-wheat had been known in Flanders scarcely a hundred years. The old botanists, Lobelius, the brothers Bauhin, Matthiolus, and others, all assert that this grain was new in Europe[3]. I shall here remark, that Crescentio, who lived in the thirteenth century, and described all the then known species of corn, makes no mention of buck-wheat. It undoubtedly acquired this name from the likeness which its seeds have to the fruit of the beech-tree[4]; and in my opinion another name, that of *Heidenkorn* (heath-corn), by which it is known in Germany, has been given it because it thrives best in poor sandy soil where there is abundance of heath. From the epithets *Turcicum* and *Saracenicum*, its native country cannot be determined, for maize is called Turkish wheat, though it originally came from America. I consider also as improbable the conjecture of the learned Frisch[5], that from the word *Heide* (a heathen), an expression little known in Upper Germany, has arisen the appellation of *ethnicum*[6], and thence *Saracenicum*, given to this plant, though the Bohemians call it *pohanka*, from *pohan*, which signifies also a heathen.

There is reason to believe that this grain must have been common in many parts of Germany in the fifteenth century. In a bible, printed in Low-German, at Halberstadt, in the year 1522, entitled Biblia Dudesch, the translator, who is not

[1] Le Grand d'Aussy quotes from this book in his Histoire de la Vie Privee des François, i. p. 106, the following words: "Sans ce grain, qui nous est venu depuis soixante ans, les pauvres gens auraient beaucoup à suffrir."

[2] M. Schookii Liber de Cervisia. Groningæ, 1661, 12mo.

[3] Lobelii Stirpium Adversaria. Antv. 1576, fol. p. 395.—Bauhini Hist. Plant. ii. p. 993.—Chabræi Stirpium Sciagraphia. Gen. 1666, fol. p. 312, and in App. p. 627.—C. Bauhini Theatr. Bot. p. 530.

[4] The beech-tree in German is called *Buche* or *Buke*, in Danish *Bög*, and in Swedish, Russian, Polish, and Bohemian, *Buk*.

[5] Wörterbuch, p. 434. This derivation may be found also in Martinii Lexicon, art. Fagopyrum.

[6] Buck-wheat is sometimes named by botanists *frumentum ethnicum* (heathen-corn), and *triticum Saracenicum*, because some have supposed that it was introduced into Europe from Africa by the Saracens.

known, but who is supposed to have been a catholic, translates a passage of Isaiah, chap. xxviii. ver. 25, which Luther translates *er säet spelz*, he soweth spelt, by the words *he seyet bockwete*, he soweth buck-wheat [1]. The name *heydenkorn* occurs in a catalogue of plants so early as the year 1552 [2]; and Jos. Maaler, or Pictorius, has in his Dictionary, printed in octavo, at Zurich in 1561, Heidenkorn, *Ocimum*. I find there also, Heydel, a plant, *Panicum*. Dasypodius [3] likewise in his Dictionary, of which I have the edition printed in 1537, says *Panicum*, Butzweyss, Heydel; and in a vocabulary of the names of plants added to it, Heydel, *Panicum*. Butz Weysz, *Panicum*. Frisch has the word Heydel-Fench, which he explains by Buck-wheat; and he remarks that in the Swiss dialect *Buch* is changed into *Butz*. Ryff or Rivius, a physician who lived in the middle of the sixteenth century, has changed *Buch* or *Book* into *Bauch*, and such errors often arise by transforming the High- into Low-German. It has, however, analogy in its favour, for the long *o* of the Low-German is in High-German often changed into *au*: for example, *look*, *lauch*; *schmooken*, *smauchen*; *ook*, *auch*; *ooge*, *auge*. But the long *o* of the Low-German becomes frequently the long *u* of the High-German; as *good*, *gut*; *buch*, *buchbaum*; *book*, *bookbaum*, &c.

That buck-wheat was cultivated in England about the year 1597, is proved by Gerard's Herbal.

A new species of this grain has been made known of late years, under the name of Siberian buck-wheat, which appears by experience to have considerable advantages over the former. It was sent from Tartary to Petersburgh by the German botanists who travelled through that country in the beginning of the last century; and it has thence been dispersed over all Europe. We are however told in the new Swedish Economical Dictionary, that it was first brought to Finland by a soldier who had been a prisoner in Tartary [4]. Linnæus received the first seeds, in 1737, from Gerber the botanist [5], and

[1] A particular description of this scarce bible may be found in J. H. a Seelen's Selecta Litteraria, Lubecæ, 1726, 8vo, p. 398, 409.

[2] This small work is entitled Vocabula Rei Nummariæ, &c. Additæ sunt Appellationes Quadrupedum, et Frugum, a Paulo Ebero et Casp. Peucero. Witebergæ, 1552, 8vo.

[3] Dictionarium Latino-Germanicum. Argentorati, 4to.

[4] Nya Swenska Economiska Dict. Stockh. 1780, 8vo, vol. ii.

[5] Abhandlungen der Schwedisch. Akad. der Wissenschaften, vi. p. 107, where is given, as far as I know, the first figure of it.

described the plant in his Hortus Cliffortianus. After this it was mentioned by Ammann [1], in 1739; but it must have been earlier known in Germany, at least in Swabia; for in 1733 it was growing in the garden of Dr. Ehrhart, at Memmingen [2]. In Siberia this plant sows itself for four or five years by the grains that drop, but at the end of that time the land becomes so full of tares that it is choked, and must be sown afresh. Even in the œconomical gardens in Germany it is propagated in the same manner; and it deserves to be remarked that it grows wild among the corn near Arheilgen, a few miles from Darmstadt, though it is cultivated nowhere in the neighbourhood. Had it been indigenous there, Ehrhart might in 1733 have raised it from German seed.

The appellation of *Saracenicum* gives me occasion to add the following remark: Ruellius [3] says, that in his time a plant had begun to be introduced into the gardens of France, but merely for ornament, called Saracen-millet, the seeds of which were brought to that country about fifteen years before. This millet, which was from five to six feet in height, was undoubtedly a *Holcus*, and perhaps the same kind as that sought after by us for cultivation a few years ago, under the name of *Holcus sorghum* [4]. This *Holcus*, however, was cultivated, at least in Italy, long before the time of Ruellius; for there is little reason to doubt that it was the *Milium indicum* which was brought from India to that country in the time of Pliny [5]. That ancient naturalist says it was a kind of millet seven feet high; that it had black seeds, and was productive almost beyond what could be believed. In the time of Herodotus it

[1] Stirpes Rariores Imperii Russici, 1739, 4to.

[2] Ehrhart's Œkonomische Pflanzen Historie, viii. p. 72.

[3] Ruellius De Natura Stirp. lib. ii. cap. 27. Some very improperly have considered this plant as Turkish wheat.

[4] Several species of this genus were cultivated in the southern districts. Their distinguishing characteristics do not however appear as yet to be fully established. Bauhin makes the proper *sorghum* to be different from the *durra* of the Arabs. Linnæus in his last writings has separated *Holcus bicolor* from *sorghum*. Forskal thus describes the *durra*: "Holcus panicula ovata; spiculis sessilibus, subvillosis; alternatim appendiculatis; flosculo uno vel duobus vacuis, sessilibus." There are kinds of it with white and reddish-yellow (*fulva*) seeds. According to his account, however, the Arabs cultivate another kind known under the name of *dochna*, though in less quantity, chiefly as food for fowls.

[5] Lib. xviii. cap. 7. *Holcus sorghum* is sold at Venice for brooms, as we are told by Ray in his Hist. Plant.

was cultivated at Babylon, but it must have been then little known to the Greeks; for that historian would not venture to mention its size and fertility, as he was afraid that his veracity might be called in question [1]. According to his account, it grew to be as large as a tree. It is worthy of remark, that this kind of millet is still cultivated at Babylon, where it was seen and admired by Rauwolf [2]. It is undoubtedly the monstrous *Holcus* mentioned by Apollonius, who considered it as one of the most remarkable productions of India [3]. It appears that it continued to be cultivated by the Italians in the middle ages; for it was described in the thirteenth century by Crescentio, who speaks of its use and the method of rearing it [4]. The seeds had some time before been brought from Italy to Germany, and we find that it is on that account called Italian millet. The old botanists named it also *Sorgsamen* and *Sorgsaat*; appellations formed from *sorghum*. The name *Morhirse*, under which it again came to us from Switzerland, in later times [5], has arisen either from the black colour of one of the kinds, or it may signify the same as *Moren-hirse* (Moorish-millet), because it is almost the only corn of the sable Africans [6]. However this may be, it can never become an object of common cultivation among us, for our summer is neither sufficiently long nor sufficiently warm, to bring it to perfection. Last summer (1787) I could with difficulty obtain a few ripe grains for seed.

[The cultivation of buck-wheat has never been very extensive in this country, as it will not bear the frosts of our springs or the severity of winter. The only counties in which it is grown to a moderate extent are Norfolk and Suffolk, where it is called *brank*. If a small patch is occasionally met with elsewhere, it is in general principally for the sake of encouraging game, particularly pheasants, which are extremely fond of it.

[1] Herodot. lib. i. cap. 193.

[2] Beschreibung der Reyss Leonhardi Rauwolfen. Frankf. 1582, 4to, ii. p. 68. The author observes that this kind of millet is mentioned also by Rhases and Serapion.

[3] Philostrat. Vita Apollon. lib. iii. cap. 2.

[4] Melica cioe saggina e conosciuta, et e di due manere, una rossa et una bianca, e trovasene una terza manera che a più bianca che l'miglio. Crescentio D'Agricoltura. In Venctia, 1542, 8vo, lib. iii. cap. 17. It appears therefore that in our dictionaries *saggina* ought not to be explained by Turkish wheat alone.

[5] Andrea, Briefe aus der Schweitz. Zurich, 1776, 4to, p. 182.

[6] Adanson, Voyage au Senegal.

The seed of the buck-wheat is said to be excellent for horses, the flowers for bees, and the plant green for soiling cows, cattle, sheep, or swine. No grain seems so eagerly eaten by poultry, or makes them lay eggs so soon or so abundantly. The flour is fine and white, but from a deficiency in gluten does not make good fermented bread; it serves well, however, for pastry and cakes, and in Germany and Holland is extensively used, especially by the farmers, dressed in a variety of ways, among others as pancakes, which if eaten hot are light and pleasant, but become very heavy as they cool. A hasty pudding made of the flour with water or milk, and eaten with butter and sugar, is considered a favourite dainty.]

SADDLES.

In early ages the rider sat on the bare back of his horse without anything under him [1]; but, in the course of time, some kind of covering, which consisted often of cloth, a mattress, a piece of leather or hide, was placed over the back of the animal. We are informed by Pliny [2], that one Pelethronius first introduced this practice; but who that person was is not certainly known. Such coverings became afterwards more costly [3]; they were made frequently in such a manner as to hang down on both sides of the horse, as may be seen by the beautiful engravings in Montfaucon [4], and were distinguished among the Greeks and Romans by various names [5]; but even

[1] J. Lipsii Poliorcet. seu de Militia Romana, lib. iii. dial. 7.

[2] Lib. vii. cap. 56. Hyginus, fab. 274.

[3] Coverings for horses made of the costly skins of animals are mentioned by Silius Italicus, lib. iv. 270, and lib. v. 148. Also by Statius. See Thebaid. lib. iv. 272. Costly coverings of another kind occur in Virgil, Æneid. lib. vii. 279; viii. 552; and Ovid. Metam. lib. vii. 33. Livy, lib. xxxi. cap. 7, comparing the luxury of the men and the women, says, "Equus tuus speciosius instructus erit, quam uxor vestita."

[4] Antiquité Expliquée, tom. ii. lib. 3. tab. 27, 28, 29, 30.

[5] Seneca, Epist. 80: "Equum empturus, solvi jubes stratum." Macrob. Saturnal. i. 11: "Stultus est, qui, empturus equum, non ipsum inspicit, sed stratum ejus et frenum." Apuleius calls these coverings for horses *fucata ephippia*. They were called also στράματα.

after they were common, it was reckoned more manly to ride without them. Varro boasts of having rode, when a young man, without a covering to his horse; and Xenophon [1] reproaches the Persians because they placed more clothes on the backs of their horses than on their beds, and gave themselves more trouble to sit easily than to ride skilfully. On this account such coverings were for a long time not used in war; and the old Germans, who considered them as disgraceful, despised the Roman cavalry who employed them [2]. The information, therefore, of Dion Cassius [3], according to whom such coverings were first allowed to the Roman cavalry by Nero, is very doubtful. This author, perhaps, alludes only to reviews, at which, it is probable, the cavalry were before obliged always to appear without them. In the time of Alexander Severus, the horses of the whole Roman cavalry had beautiful coverings [4]. Saddles, however, at that period were certainly unknown, though they afterwards obtained the old name *ephippium*, which originally signified nothing more than a covering for a horse. Xenophon says, a rider, whether placed on the bare back of the animal or on a covering, must not assume a position as if he sat upon one of those seats which people use in carriages [5].

Our saddles at present consist of a wooden frame called the saddle-tree, which has on the fore part the pommel; behind it the crupper; and at the sides the stirrups. In the inside they are stuffed like a cushion, and on the outside are covered with leather or cloth. They are made fast to the horse by means of a girth which goes round the animal's belly; and the breast-

[1] Pæd. lib. viii.

[2] Cæsar, De Bello Gallico, lib. iv. 2. An old saddle with stirrups was formerly shown to travellers at Berne in Switzerland, as the saddle of Julius Cæsar. The stirrups, however, were afterwards taken away, and in 1685 they were not to be seen. Mélanges Historiques, recueillis et commentez par Mons.——Amst. 1718, 12mo, p. 81.

[3] Lib. lxiii. 14. After writing the above, I found with satisfaction that Le Beau, in l'Académie des Inscriptions, vol. xxxix. p. 333, forms the same conjecture. Before that period, the cavalry, when reviewed, were obliged to produce their horses without any covering, that it might be more easily seen whether they were in good condition. This useful regulation was abolished by Nero, in order that the cavalry might exhibit a grander appearance. He employed his soldiers for show, as many princes do at present.

[4] Lamprid. Vita Alex. Severi, cap. 50.

[5] De Re Equestri, p. 602. Respecting the stool or chair placed in carriages for people to sit on, see Pitisci Lexic. art. Sella curulis.

leather and crupper prevent them from being moved either forwards or backwards. It is extremely probable that they were invented in the middle of the fourth century: but it is hardly possible to find any certain proof; for we have reason to believe that the ancient covering was gradually transformed into a saddle. Pancirollus [1] thinks that the first mention of a saddle is to be found in Zonaras; and many have adopted his opinion. This historian relates that Constantine the younger was killed in the year 340 when he fell from his saddle. But in this proof alone I place very little confidence; and Pancirollus seems to have founded his assertion on the Latin translation, in which the word *sella* is used. Both the Greek and Latin terms [2], it is true, were employed at later periods to signify a proper saddle; but the Greek word was used long before for the back of the horse, or the place where the rider sat; and the words of Zonaras may be so understood as if Constantine was killed after he had fallen from his horse [3].

Montfaucon [4] has given a figure of the pillar of Theodosius the Great, on which he thinks he can distinguish a saddle; and indeed, if the engraving be correct, it must be allowed that the covering of the horse on which the rider sits seems, in the fore part, to resemble the pommel, and behind the extremity of the saddle-tree of our common saddles.

The clearest proof of the antiquity of saddles is the order of the emperor Theodosius in the year 385, by which those who wished to ride post-horses were forbidden to use saddles that weighed more than sixty pounds. If a saddle was heavier, it was to be cut to pieces [5]. This passage appears certainly to allude to a proper saddle, which at that period, soon after its invention, must have been extremely heavy; and we may conclude from it also, that every traveller had one of his own.

[1] De Rebus Deperditis, lib. ii. tit. 16.

[2] Ἕδρα and sella.

[3] Zonaras, lib. xiii. cap. 5. Ἐκπέπτωε τῆς ἕδρας ὁ Κονσταντίνος. Nicetas in And. Comnenus, lib. i. Τῆς ἕδρας ἀποβάλλεται. The word ἕδρα occurs twice in Xenophon, De Re Equestri. He gives an account how the back of the horse should be shaped in order that the rider may have a fast and secure seat; τῷ ἀναβάτῃ ἀσφαλέστεραν τὴν ἕδραν; and where he speaks of currying, says that the hair on a horse's back ought to be combed down, as the animal will then be less hurt by his rider. I have taken the trouble to consult other historians who give an account of the death of Constantine, but they do not mention this circumstance.

[4] Antiq. Expliquée, vol. iv. lib. iii. cap. 75, tab. 30.

[5] Codex Theodosian. lib. viii. tit. 5, leg. 47. Codex Justin. lib. xii. tit. 51, 12.

As the saddle is here called *sella*, and as that word occurs oftener at this than at any other period, for the seat of the rider, it is probable that it is to be understood afterwards as signifying a real saddle. Besides, it cannot be denied that where it is used, many other little circumstances are found which may with great propriety be applied to our saddles.

Nazarius, in his panegyric on Constantine the Great, describing the manner in which the enemy's cavalry were destroyed, says that, when almost lifeless, they hung *sedilibus*. Lipsius is of opinion that they could have hung in this manner only by saddles; but there is reason to think that they might lay hold of the coverings of the horses, if it be certain that these were girded to the animals like our saddles. Of this, however, there is no proof; for though some have asserted that *postilena* signified a girth, that meaning has not been supported by sufficient authorities; and it is more probable that the words *postilena*, *antilena*, and also *postella* and *antella*, as well as the girth itself, which they are supposed to express, were not introduced till after the invention of saddles. The first word occurs in Plautus [1]; but it perhaps alludes to some part of the harness of draught-horses or cattle. Vegetius [2] distinguishes saddle-horses from others; and the saddle-tree seems to be mentioned by Sidonius Apollinaris [3]. In the fifth century saddles were made so extravagantly magnificent, that a prohibition was issued by the emperor Leo I. in which it was ordered that no one should ornament them with pearls or precious stones [4]. In the sixth century, the emperor Mauritius required that the saddles of the cavalry should have large coverings of fur [5]. Further information respecting saddles in later times may be seen in Du Cange, who has collected also various terms of art to which the invention of saddles gave rise, such as *sellatores*, saddlers, of which the French have made *selliers*; *sellare*, the saddle-tree; *sellare* and *insellare*, to saddle. The ignominious punishment of bearing the saddle, of which a good account may be found in Du Cange [6], had its origin in the middle ages. The conjecture of Goropius Becanus [7], that the saddle was invented by the *Salii*, and named after

[1] Casina, i. 37. See Scheffer, De Re Vehiculari. Frankf. 1671, 4to, p. 125; and Gesneri Thesaur. Ling. Lat.
[2] De Arte Veterinaria, iv. 6, 2 and 4.
[3] Lib. iii. epist. 3.
[4] Codex Justin. lib. xi. tit. 11.
[5] Maurieii Ars Militaris; edit. Schefferi, lib. i. cap. 2.
[6] See art. Sellam gestare.
[7] Lib. ii. Francicorum, p. 48.

them, is not worth refutation ; as it is perfectly clear that the denomination of *sella* arose from the likeness of a saddle to a chair; and by way of distinction Sidonius and the emperor Leo say *sella equestris* ; and Jornandes says *sella equitatoria.* Others, perhaps, will pass no better judgement on a conjecture which I shall here venture to give. I consider it as probable that the invention of saddles belongs to the Persians ; because, according to the testimony of Xenophon, they first began to render the seat of the rider more convenient and easy, by placing more covering on the backs of their horses than was usual in other countries. Besides, the horses of Persia were first made choice of in preference for saddle-horses, on account, perhaps, of their being early trained to bear a saddle, though Vegetius [1] assigns a different reason.

STIRRUPS.

Respecting the antiquity of stirrups several men of learning [2] have long ago made researches ; but as their observations are scattered through a great variety of books, some of which are now scarce, and are mingled with much falsehood, it will perhaps afford pleasure to many to find here collected and reduced into order the greater, or at least the most important, part of them. In executing this task I shall aim at more than the character of a diligent collector ; for to bring together information of this kind, to arrange it, and to make it useful, requires no less readiness of thought than the labours of those

[1] Vegetius, De Arte Veterin. iv. 6, 4to, p. 1157.

[2] The principal works in which information is to be found on this subject are the following: Hieron. Magii Miscellan. lib. ii. cap. 14.—Gruteri Lampas, ii. p. 1339.—Lipsii Poliorceticon sive de Militia Romana, Antv. 1605, lib. iii. dial. 7.—Pitisci Lexicon Antiquit. Rom. iii. p. 482.—Salmasius in Ælii Spart. Antonin. Carac. p. 163.—G. J. Vossius, De Vitiis Sermonis, Amst. 1695, fol. p. 11.—Polyd. Vergilius De Rerum Inventoribus, lib. iii. cap. 18.—Hugo De Militia Equestri, i. 4.—Licetus De Lucernis.—Menagiana, iv. p. 263.—Brown's Vulgar Errors.—Berenger's History and Art of Horsemanship, London, 1771, 4to.—Montfaucon, Antiquité Expliquée, iv. lib. 3, cap. 3, p. 77, and Supplement, iv. lib. ii. cap. 4.—Le Beau, in Mém. de l'Acad. des Inscriptions, xxxix. p. 537.

who assume the character of original thinkers, and who imagine that they render others inferior to themselves when they bestow on them the appellation of compilers.

We have here a new proof how much people may be deceived, when they suppose that objects must be of great antiquity because they tend to common convenience and because they appear even so indispensably necessary and easy to have been invented, that one can scarcely conceive how they could at any time have been wanting. I cannot, however, deprive our ancestors of the merit of ingenuity and invention; for they must undoubtedly have possessed no small share of talents and ability, to perform, without the assistance of our arts, what perhaps would be difficult even for the present age to accomplish. And who knows but there are many things still to be invented, the discovery of which may give posterity equal reason to reproach us?

Stirrups are useful in two points of view; for they not only assist one in mounting, but also in riding, as they support the legs of the rider, which otherwise would be exposed to much inconvenience. No traces of any invention for this purpose are to be found in the old Greek and Latin writers; and though means to assist people to get on horseback were devised in the course of time, neither stirrups nor any permanent support to the legs were for a long period thought of. Nothing that could perform the same service as a stirrup is to be perceived on ancient coins which exhibit the representation of persons on horseback; on statues cast or formed with the chisel, or on any remains of ancient sculpture. In the excellent equestrian statues of Trajan and Antoninus, the legs of the rider hang down without any support whatever. Had stirrups been in use when these statues were formed, the artists certainly would not have omitted them; and the case would have been the same with those writers who speak so fully of riding, and of the necessary equipage and furniture. How is it possible, that Xenophon, in the two books which he wrote expressly on horsemanship and the art of riding, where he gives rules for mounting, and where he points out means for assisting old people and infirm persons, should not have mentioned stirrups had he been acquainted with them? And how could they have been passed over by Julius Pollux, in his Lexicon, where he gives every expression that concerns riding-furniture?

Hippocrates[1] and Galen[2] speak of a disease which in their time was occasioned by long and frequent riding, because the legs hung down without any support. Suetonius[3] also relates that Germanicus, the father of Caligula, by riding often after dinner endeavoured to strengthen his ancles, which had become weak; and Magius explains this very properly by telling us, that as his legs hung down without stirrups, they would be continually moved backwards and forwards, and of course the circulation of the blood towards those parts would be increased.

Neither in the Greek nor Roman authors do we meet with any term that can be applied to stirrups, for *staffa*, *stapia*, *staphium*, *stapha*, *stapedium*, *stapeda*, and *stapes* are words formed in modern times. The last, as Vossius and others say, was invented by Franc. Philelphus, who was born in 1398 and died in 1481[4], to express properly a thing unknown to the ancients, and for which they could have no name. The other words are older, as may be seen in Du Cange, and appear to be derived from the German *stapf*, which is still retained in *Fuss-stapf*, a foot-step.

The name of one of the ear-bones, which, on account of its likeness to a stirrup, has from anatomists received the same appellation, may occur here to some of my readers; and if that expression was known to the ancients, it might invalidate my assertion. That small bone, however, was first remarked at Naples in the year 1546 by John Philip Ingrassias, a Sicilian, who called it *stapes*. To the ancient anatomists it was not known[5].

Montfaucon is of opinion that it is impossible there could be stirrups before saddles were invented, because the former, at present, are fastened to the latter. This conclusion, how-

[1] De Aëre, Locis et Aquis, sect. 3. The author here speaks in particular of the Scythians, who were always on horseback; but he afterwards extends his observations to all those much addicted to riding.

[2] Galen. De Parvæ Pilæ Exercitio, cap. 5. De Sanitate Tuenda, lib. ii. cap. 11.

[3] Vita Caligulæ, cap. 3.

[4] Fabricii Biblioth. Med. et Inf. Ætatis, vol. v. p. 845.

[5] The history of this anatomical discovery, written by Ingrassias himself, may be found in J. Douglas, Bibliographiæ Anatomicæ Specimen; Lugd. Bat. 1734, 8vo, p. 186. This discovery was claimed by a person named Columbus; but that it belongs to Ingrassias has been fully proved by Fallopius in his Observat. Anatomicæ.

ever, is not altogether just. Stirrups might have been suspended from leather straps girt round the horse. In mounting, it would only have been necessary that some one should hold fast the strap on the other side; and stirrups arranged in this manner would have supported the feet of the rider as well as ours. It is certain that mounting on horseback was formerly much easier than it has been since the invention of high saddles; and it is probable that stirrups were introduced soon after that period. The arguments which I have here adduced will receive additional force when one considers the inconvenient means which the ancients employed to assist them in getting on horseback; and which, undoubtedly, they would not have used had they been acquainted with stirrups.

The Roman manners required that young men and expert riders should be able to vault on horseback without any assistance. To accustom them to this agility there were wooden horses in the Campus Martius, on which practitioners were obliged to learn to mount and dismount, both on the right and the left side, at first unarmed, and afterwards with arms in their hands[1]. In many public places, particularly highways, stones were erected, to which a rider could lead his horse in order to mount with more facility. Such stones Gracchus caused to be set up[2]; and they were to be found at many cities, in the sixteenth century, especially near the council-houses, that they might be used by the members of the council, who at that time did not ride in coaches. A convenience of this kind was constructed at the Roman gate at Frankfort in 1502; and steps for the same purpose may be still seen in many parts of England, where they are employed principally by the ladies. If a certain ludicrous inscription be ancient, such a stone was called *suppedaneum*; but this word occurs nowhere else[3].

People of high rank and fortune kept riding-servants to as-

[1] Vegetius De Re Milit. i. 18. [2] Plutarchus, Vita C. Gracchi.

[3] This inscription may be found in Thom. Porcacchi Funerali Antichi. Venct. 1574, fol. p. 14.

"Dis pedip. saxum
Cinctæ dorsiferæ et cluniferæ,
Ut insultare et desultare commodetur,
Pub. Crassus mulæ suæ Crassæ bene ferenti
Suppedaneum hoc cum risu pos."

Here *Dis pedip.* seems to be an imitation of *Dis Manibus*; *saxum* of the usual word *sacrum*: and *bene ferenti* of *bene merenti.*

sist them in mounting, who were called *stratores*[1]. It was usual also to have portable stools, which were placed close to the horse when one wished to mount; and this gave rise to the barbarous practice of making conquered princes and generals stoop down that the victor might more easily get on horseback by stepping upon their backs as upon a stool. In this ignominious manner was the emperor Valerian treated by Sapor, king of Persia[2]. Some horses also were so instructed that they kneeled until the rider mounted[3]; and warriors had on their spears or lances a step or projection, on which they could rest the foot while they got on horseback[4]. Winkelmann has described a cut stone in the collection of Baron Stosch, on which a rider is represented in the act of mounting with one foot on the step of his spear; and it appears, by an ancient drawing, that a leather loop[5], into which the foot could be put, was fastened sometimes to the lance also.

Of those who believe that traces of stirrups are to be found among the ancients, no one has erred more than Galeotus Martius[6], who follows a wrong reading in Lucretius[7], and translates still worse the words which he adopts. Magius and others consider as authentic an inscription, in which stirrups are clearly mentioned; and because the letters D. M. (*diis manibus*), usual in Pagan inscriptions, appear at the top, he places it in the first century of the Christian æra[8]. Menage[9], however, and others have already remarked that this inscription was forged in modern times, and in all probability by Franc. Columna, who lived in the middle of the sixteenth century, and who sometimes called himself Polyphilus[10]. Gru-

[1] Lipsius De Milit. Romana, p. 410. Pitisci Lexic. Antiq. These servants were called also *ἀναβολεῖς*.

[2] Eutrop. lib. ix. cap. 6.—Victor. epit. 46.—Trebell. Pollio, Vita Valeriani.—Hofmanni Lexic. artic. Calcandi hostium corpora ritus, p. 642.

[3] Strabo, lib. iii. says that the Spaniards instructed their horses in this manner. [4] Lipsius understands in this sense what Livy says, book iv. chap. 19, of Cornelius Cossus, "Quem cum ictum equo dejecisset, confestim et ipse hasta innisus sc in pedes excepit." [5] Figures of both may be seen in Berenger, tab. 8. [6] De Promiscua Doctrina, cap. 28.

[7] Lib. v. 1296, "Et prius est repertum in equi conscendere costas." Martius reads *clostris*; and thinks that *clostra* is the Greek name for a ladder, which however is *κροσσά*.

[8] In this inscription the following words occur, "Casu desiliens, pes hæsit stapiæ, tractus interii." [9] Menagiana. Paris, 1715, vol. iv. p. 83.

[10] Fabricii Biblioth. Med. et Inf. Ætatis, i. p. 1131.

ter, therefore, reckons it among those which ought to be rejected as spurious: and of as little authority is the silver coin on which the Emperor Constantine is represented on horseback with stirrups.

Magius quotes from the letters of Jerome, who died in the year 420, the following words, "Se cum quasdam accepit literas jumentum conscensurum, jam pedem habuisse in bistapia." These words have been again quoted by several writers; and we may readily believe that the author when he wrote them alluded to a stirrup. Magius however quotes from memory, and says, "Si memoria non labat." But these words are not to be found in Jerome; and it is probable that Magius may have read them in the works of some other author.

The first certain account of stirrups, as far as I have been able to learn, is in a book by Mauritius [1] respecting the art of war, where the author says that a horseman must have at his saddle two iron *scalæ*. This work, commonly ascribed to the emperor Mauritius, is supposed to have been written in the end of the sixth century; and it is not a sufficient proof to the contrary, that mention is made in it of the Turks, Franks, and Lombards. The first were then well known; for Justin II. some time before had concluded a peace with them: the Lombards made themselves known in the middle of that century: and the Franks had been known much longer. The same words are inserted by the emperor Leo VI., in his work on tactics, which he wrote in the end of the ninth century [2] Still clearer is another passage of Mauritius [3], and of the emperor Leo [4], where it is expressly said, that the *deputati*, who were obliged to carry the wounded horsemen from the field, ought to have two stirrups on the left side of the horse, one at the fore part and the other at the hind-part of the saddle-tree, that they might each take a disabled soldier on horseback behind them. That these *scalæ* were real stirrups there seems to be no reason to doubt; and in my opinion, that word, and other expressions of the like kind to be found in later writers, may be understood in this sense, especially as concomitant circumstances appear rather to strengthen than to oppose such a conjecture.

[1] Mauricii Ars Militaris, edita a Joh. Scheffero. Upsaliæ 1664, 8vo p. 22.
[2] Leonis Tactica, edit. Meursii cap. vi. § 10. p. 57.
[3] Lib. ii. cap. 8. p. 64.
[4] Tactica, cap. xii. § 53, p. 150.

Isidore, in the seventh century, says "Scansuæ, ferrum per quod equus scanditur;" and also "Astraba, tabella, in qua pedes requiescunt[1]:" both which expressions allude to stirrups. Leo the Grammarian, in the beginning of the tenth century[2], calls them, as Mauritius does, *scalæ*. Suidas, who wrote about the same period, says *anaboleus* signifies not only a riding-servant, who assists one in mounting, but also what by the Romans was called *scala*. As the machine used for pulling off boots is named a Jack, because it performs the office of a boy, in the like manner that appellation, which at first belonged to the riding-servant, was afterwards given to stirrups, because they answered the same purpose. Suidas, as a proof of the latter meaning, quotes a passage from an anonymous writer, who says that Massias, even when an old man, could vault on horseback without the assistance of a stirrup (*anaboleus*). Lipsius thinks that the passage is to be found in Appian[3], respecting Masanissa; and in that case the first meaning of the word may be adopted. Suidas, according to every appearance, would have been in a mistake, had he given Masanissa at so early a period the Roman *scalæ*, with which he could not be acquainted. But that the passage is from Appian, and that Masanissa ought to be read instead of Massias, is only mere conjecture; at any rate Suidas could commit no mistake in saying that the Romans in his time made use of *scalæ*. Lipsius, however, was not altogether wrong in considering this quotation alone as an insufficient proof of stirrups, because with the still older and more express testimony of Mauritius he was unacquainted. Eustathius, the commentator of Homer[4], speaks in a much

[1] Both passages are quoted by Du Cange from the Gloss. Isidori. The latter word signified also the saddle-bow; for Suidas says, Ἀστράβη, τὸ ἐπὶ τῶν ἐφιππίων ξύλον ὃ κρατοῦσιν οἱ καθεζόμενοι. Lignum quod est in ephippiis, quod sessores tenent. Allusion is made to this saddle-bow by the emperor Frederic II. De Arte Venandi, ii. 71, p. 152, where he describes how a falconer should mount his horse: "Ponat pedem unum in staffa sellæ, accipiens *arcum sellæ* anteriorem cum manu sua sinistra, supra quam jam non est falco, posteriorem autem cum dextra, super quam est falco." Nicetas, however, in Manuel. Comnen. lib. ii. p. 63, gives that name to the whole saddle; for we are told that the Scythians, when about to cross a river, placed their arms on the saddle (ἀστράβην), and laying hold of the tails of their horses, swam after them.

[2] Leonis Grammatici Chronographia, printed in the Paris Collection of the Byzantine Historians, with Theophanis Chronograph. 1655, fol. p. 470.

[3] De Bellis Punicis, edit. Tollii, p. 107.

[4] Odyss. lib. i. 155.

clearer manner; but he gives us to understand that stirrups in his time, that is in the twelfth century, had not become very common. On a piece of tapestry of the eleventh century, which Montfaucon caused to be engraven [1], the saddles of all the horses appear to have stirrups. Aimonius calls them *scandilia*[2], and in the twelfth century the word *staffa* occurs very often, and without doubt in that sense[3]. In the ages of superstition, the clergy carried their boundless pride to such a length, that they caused emperors and kings to hold their stirrups when they mounted on horseback[4]. It however long continued to be thought a mark of superior dexterity to ride without stirrups, at least Phile praises Cantacuzenus on this account[5].

HORSE-SHOES.

It can be proved by incontestable evidence, that the ancient Greeks and Romans endeavoured, by means of some covering, to secure from injury the hoofs of their horses and other animals of burden; but it is equally certain that our usual shoes,

[1] Monumens de la Monarchie Françoise, i. tab. 35.

[2] Aimonius De Miraculis Sancti Benedicti, ii. 20.

[3] Fredericus II. De Venat. lib. ii. cap. 71. According to Du Cange, stirrups as well as spurs occur seldom on seals in the eleventh century. In the thirteenth they are more frequent. See P. W. Gerkens Anmerkungen über die Siegel. Stendal, 1786, 8vo, part 2. Heineccius De Sigillis, p. 205. I shall here remark that Cœlius Rhodiginus, xxi. 31, is mistaken when he says that Avicenna calls stirrups *subsellares*. Licetus, De Lucernis, p. 786, has proved that this Arabian author speaks only of a covering to secure the feet from frost.

[4] Instances of this pride have been collected by Du Cange in his annotations on Cinnamus, p. 470, and more may be found in his Dictionary, vol. vi. p. 681. When steps were not erected on the highways, a metal or wooden knob was affixed to each side of the saddle, which the rider, when about to mount, laid hold of, and then caused his servant to assist him. The servants also were often obliged to throw themselves down that their master might step upon their back. See Constantin. De Ceremoniis Aulæ Byzant. p. 242. A, 6; and p. 405, B, 3; also Reiske in his Annotations, p. 135.

[5] In Cantacuz. edit Wernsdorfii. Lipsiæ, 1768, 8vo, p. 218, who calls stirrups κλίμακες, scalæ.

which are nailed on, were invented much later[1]. We are told by Aristotle[2] and Pliny[3], that shoes were put upon camels in the time of war, and during long journeys; and the former gives them the same name as that given to the shoes, or rather socks or soles, of the common people, which were made of strong ox-leather. When the hoofs of cattle, particularly oxen, had sustained any hurt, they were furnished with shoes, made of some plant of the hemp kind[4], wove or plaited to-

[1] The principal works with which I am acquainted that contain information respecting the antiquity of horse-shoes, are the following: Pancirollus De Rebus Deperditis, ii. tit. 16, p. 274.—J. Vossius in Catulli Opera. Ultrajecti, 1691, 4to, p. 48.—Lexicon Militare, auctore Carolo de Aquino. Romæ, 1724, fol. ii. p. 307.—Gesner in his Index to Auctores Rei Rusticæ, art. Soleæ ferreæ.—Montfaucon, Antiquité Expliquée, iv. liv. 3. p. 79.—Le Beau, in Mémoires de l'Académie des Inscriptions. vol. xxxix. p. 538.—Archæologia, London, 1775, 4to, iii. p. 35 and 39.

[2] Histor. Anim. ii. 6, p. 165, edit. Scaligeri. They appear not to have been used at all times, but only when the hoofs began to be injured.

[3] Hist. Nat. lib. xi. cap. 43.

[4] A few observations respecting *spartum* may be of service to those who wish to carry their researches further. The ancients, and particularly the Greeks, understood by that appellation several species of plants which could be used and manufactured like flax or hemp, and which appear to have been often mentioned under that general name. The Greeks however understood commonly by *spartum* a shrub, the slender branches of which were woven into baskets of various kinds, and which produced young shoots that could be prepared and manufactured in the same manner as hemp; and this plant, as has already been remarked by the old botanists, is the *Spartium junceum*, or Spanish broom, which grows wild on dry land, that produces nothing else, in the Levant and in the southern parts of Europe. This broom is that described and recommended in Comment. Instituti Bononiensis, vi. p. 118, and vi. p. 349. The French translator of the papers here alluded to is much mistaken when he thinks, in Journal Econonique, 1785, Novembre, that the author speaks of the common broom (*Spartium scoparium*) that grows on our heaths. M. Broussonet, in Mémoires d'Agriculture, par la Société de Paris, 1785, p. 127, has also recommended the cultivation of the *Spart. junceum*, under the name of *genêt d'Espagne*, and enumerated the many uses to which it may be applied. The people in Lower Languedoc, especially in the neighbourhood of Lodeve, make of it table-cloths, shirts and other articles of dress. The offal or rind serves as firing. This *spartum* of the Greeks, or *Spartium junceum* of the botanists, is the species called by Pliny, book xxxix. chap. 9, *genista*, and which he improperly considers as the Spanish and African *spartum*. The latter is certainly the *Stipa* (*Macrochloa*) *tenacissima*, which grows in Spain and Africa, called there at present *sparto* or *esparto*, and which is still prepared and employed as described by Pliny, b. xix. c. 2. Baskets, mattresses, ship-cables, and other strong ropes were made of it; and when this grass had

gether [1]. These indeed were only a sort of chirurgical bandages; but such shoes were given in particular to mules, which in ancient times were employed more than at present for riding; and it appears by two instances of immoderate extravagance handed down to us by Roman writers, that people of rank caused these shoes to be made very costly. Nero, when he undertook short journeys, was drawn always by mules which had silver shoes [2]; and those of his wife Poppæa had shoes of gold [3]. The information of these authors however is not sufficient to enable us to conjecture how these shoes were made; but from a passage of Dio Cassius we have reason to think that the upper part only was formed of those noble metals, or that they were perhaps plaited out of thin slips [4].

Arrian also reckons these soles or shoes among the riding-furniture of an ass [5]. Xenophon relates that certain people of Asia were accustomed, when the snow lay deep on the ground,

been prepared like hemp, it was used for various fine works. Even at present the Spaniards make of it a kind of shoes called *alpergates*, with which they carry on a great trade to the Indies, where they are very useful on the hot, rocky and sandy soil. [Moritz Willkomm, in his Botanical Notices from Spain (Annals of Natural History for March 1845), notices among the most valuable vegetable productions of Spain, "the celebrated Esparto (*Macrochloa tenacissima*), which, growing on many of the hills situated near the sea, forms an important article of trade in South Spain, since this tough grass is used partly for the plaiting of coverings for rooms and balconies, and for making various sorts of baskets, especially panniers for mules, chairs, and the peculiar sandals which are worn all over the kingdom; and partly worked into ropes, which are in great request, and are manufactured in great quantity at Marseilles.] Whether the ancients made shoes for their cattle of the *Spartium junceum* or the *Stipa tenacissima*, I will not venture to determine. It is probable that the former was used by the Greeks, and the latter by the Romans; and it is highly worthy of being here remarked, that in modern times a kind of socks for horses were made of a species of *spartum*, as we learn from J. Leonis Africæ Descriptio, lib. iii. p. 120. The same author however says expressly, p. 96, that common shoes of iron were also used.

[1] Columella, vi. 12, 3: "Spartea munitur pes." vi. 15, 1: "Spartea calceata ungula curatur." Vegetius, i. 26, 3: "Spartea calceare curabis." See also ii. 45, 3. Galen De Alim. Facult. i. 9: Σπαρτὸς ἐξ οὗ πλέκουσι ὑποδήματα ὑποζυγίοις. Is there not some reason therefore to conclude that this practice was followed not merely in regard to cattle only that were diseased?

[2] Sueton. Vita Neronis, cap. 30.

[3] Plin. lib. xxxiii. cap. 11.—Scheffer, De Re Vehiculari, proves that we are here to understand she-mules.

[4] Dio Cassius, lxii. 28, and lxxiii. Commodus caused the hoofs of a horse to be gilt.

[5] Commentar. in Epictetum, lib. iii.

to draw socks over the feet of their horses, as they would otherwise, he adds, have sunk up to the bellies in the snow[1]. I cannot comprehend how their sinking among the snow could, by such means, have been prevented; and I am inclined rather to believe, that their feet were covered in that manner in order to save them from being wounded. The Russians, in some parts, such as Kamtschatka, employ the same method in regard to the dogs which draw their sledges, or catch seals on the ice. They are furnished with shoes which are bound round their feet, and which are so ingeniously made that their claws project through small holes[2].

The shoes of the Roman cattle must have been very ill fastened, as they were so readily lost in stiff clay[3]; and it appears that they were not used during a whole journey, but were put on either in miry places, or at times when pomp or the safety of the cattle required it; for we are informed by Suetonius, that the coachman of Vespasian once stopped on the road to put on the shoes of his mules[4].

The reason why mention of these shoes on horses occurs so seldom, undoubtedly is, because, at the time when the before-quoted authors wrote, mules and asses were more employed than horses, as has been already remarked by Scheffer and others. Artemidorus speaks of a shod horse, and makes use of the same expression employed in regard to other cattle[5]. Winkelmann has described a cut stone in the collection of Baron Stosch[6], on which is represented the figure of a man holding up one foot of a horse, while another, kneeling, is em-

[1] Xenophon De Cyri Min. Expedit. p. 228.

[2] B. F. Hermann, Beytrage zur Physik. Œkonomie der Russischen Länder. Berlin, 1786, 8vo, part i. p. 250. The same account respecting the dogs of Kamtschatka is given in Cook's last Voyage.

[3] Catullus, viii. 23. By which passage it appears that the shoe was of iron, iron wire, or plate-iron.

[4] Sueton. Vita. Vespasian seems to have suspected that his driver had been bribed to stop by the way, and that he had done so on pretence of shoeing his horses. Had the mules been shod, and had the driver only had to rectify something that related to the shoe, as our coachmen have when a nail is lost, or any other little accident has happened, Suetonius would not have said *mulas*, but *mulam*. The driver therefore stopped for the first time on the journey to put on the shoes of his cattle, as has been remarked by Gesner.

[5] Artemidori Oneirocritica. Lutetiæ, 1603, 4to, lib. iv. cap. 32.

[6] Déscription des Pierres Gravées du Baron de Stosch, 1760, p. 169.

ployed in fastening on a shoe. These are all the proofs of horses being shod among the ancients with which I am acquainted. That they were never shod in war, or at any rate, that these socks were not sufficient to defend the hoof from injury, seems evident from the testimony of various authors. When Mithridates was besieging Cyzicus, he was obliged to send his cavalry to Bithynia, because the hoofs of the horses were entirely spoiled and worn out[1]. In the Latin translation it is added that this was occasioned by the horses not having shoes; but there are no such words in the original, which seems rather to afford a strong proof that in the army of Mithridates there was nothing of the kind. The case seems to have been the same in the army of Alexander; for we are told by Diodorus Siculus, that with uninterrupted marching the hoofs of his horses were totally broken and destroyed[2]. An instance of the like kind is to be found in Cinnamus, where the cavalry were obliged to be left behind, as they had suffered considerably in the hoofs; an evil, says the historian, to which horses are often liable[3].

From what has been said I think I may venture to draw this conclusion, that the ancient Greek and Roman cavalry had not always, or in common, a covering for the hoofs of their horses, and that they were not acquainted with shoes like those used at present, which are nailed on. In the remains of ancient sculpture, among the ruins of Persepolis[4], on Trajan's pillar, those of Antoninus, Marcus Aurelius, and many others, no representation of them is to be found; and one can never suppose that the artists designedly omitted them, as they have imitated with the utmost minuteness the shoes of the soldiers, and the nails which fasten on the iron that surrounds the wheels of carriages. The objection that the artists

[1] Appian. De Bello Mithridat. edit. Tollii, p. 371.

[2] Diodor. Sicul. lib. xvii. 94, edit. Wesselingii, p. 233. Vegetius, i. 56, 28, mentions a salve, "quo ungulæ nutriantur, et medicaminis beneficio subcrescat quod itineris *attriverat* injuria."

[3] Joh. Cinnamus De Rebus Gestis Imperat. edit. Tollii, 1652, 4to, lib. iv. p. 194. Vegetius, ii. 58, recommends rest for horses after a long journey, on account of their hoofs.

[4] No traces of them are to be found in the figures given by Chardin, and by Niebuhr in the second volume of his Travels. The latter mentions this circumstance in particular, and says, p. 157, "It appears that the ancient Persians had no stirrups and no proper saddle."

have not represented the shoes then in use, and that for the same reason they might have omitted shoes such as ours though common, is of no weight; for the former were used only very seldom; they were not given to every horse, and when they were drawn over the hoof and made fast, they had an awkward appearance, which would not have been the case with iron shoes like those of the moderns A basso-relievo, it is true, may still be seen in the Mattei palace at Rome, on which is represented a hunting-match of Gallienus, and where one of the horses has a real iron shoe on one of his feet. From this circumstance Fabretti[1] infers that the use of horse-shoes is of the same antiquity as that piece of sculpture; but Winkelmann has remarked, that this foot is not ancient, and that it has been added by a modern artist[2].

I will readily allow that proofs drawn from an object not being mentioned in the writings of the ancients are of no great importance, and that they may be even very often false. I am however of opinion, whatever may be said to the contrary, that Polybius, Xenophon in his book on riding and horsemanship, Julius Pollux in his Dictionary where he mentions fully everything that relates to horse-furniture and riding-equipage, and the authors who treat on husbandry and the veterinary art, could not possibly have omitted to take notice of horse-shoes, had they been known at those periods when they wrote. Can we suppose that writers would be silent respecting the shoeing of horses, had it been practised, when they speak so circumstantially of the breeding and rearing of these animals, and prescribe remedies for the diseases and accidents to which they are liable? On account of the danger which arises from horses being badly shod, the treatment of all those disorders to which they are incident has been committed to farriers; and is it in the least probable that this part of their employment should have been entirely forgotten by Vegetius and the rest of the ancients, who studied the nature and maladies of cattle? They indeed speak seldom, and not very expressly, of the ancient shoes put on horses; but this is not to be wondered at, as they had little occasion to mention them, because they gave rise to no particular infirmity. Where they could be of utility, they have recommended them, which plainly shows that the use of them was not then common.

[1] De Columna Trajani, c. 7. [2] Pierres Gravées de Stosch, p. 169.

Gesner remarks very properly, that Lycinus, in Lucian, who was unacquainted with riding, when enumerating the many dangers to which he might be exposed by mounting on horseback, speaks only of being trod under the feet of the cavalry, without making any mention of the injury to be apprehended from iron shoes. To be sensible, however, of the full force of this argument, one must read the whole passage[1]. Many of the ancient historians also, when they speak of armies, give an account of all those persons who were most necessary in them, and of the duties which they performed; but farriers are not even mentioned. When it was necessary for the horses to have shoes, each rider put them upon his own; no persons in particular were requisite for that service; but had shoes, such as those of the moderns, been then in use, the assistance of farriers would have been indispensable.

As our horse-shoes were unknown to the ancients, they employed the utmost care to procure horses with strong hoofs[2], and for the same reason they tried every method possible to harden the hoofs and to render them more durable. Precepts for this purpose may be found in Xenophon[3], Vegetius[4], and other authors. It indeed appears wonderful to us, that the use of iron shoes should have remained so long unknown; but it was certainly a bold attempt to nail a piece of iron, for the first time, under the foot of a horse; and I firmly believe that there are many persons at present, who, had they never seen such a thing, would doubt the possibility of it if they heard it mentioned. Horse-shoes, however, are not absolutely necessary; horses in many countries are scarce, and in some they

[1] Navigium seu Vota. "Nunquam equum ullum ascendi ante hunc diem. Proinde metuo, tubicine classicum intonante, decidens ego in tumultu a tot ungulis conculcer, aut etiam equus ferocior existens, arrepto freno in medios hostes efferat me, aut denique oporteat me alligari ephippio, si manere super illud debeam, frenumque tenere."—Had stirrups been then in use, he would have been exposed also to the danger of being dragged along by the heels. When I extracted the above passage, I had no edition of Lucian at hand, but that of Basle, 1563, 12mo. It may be found there, vol. ii. p. 840.

[2] The prophet Isaiah, chap. v. ver. 28, to make the enemy appear more terrible, says, "The hoofs of their horses shall be counted like flint;" and Jeremiah, chap. xlvii. v. 3, speaks of the noise made by the horses stamping with their hoofs. See Bochart. Hierozoic. i. p. 160.

[3] De Re Equestri, cap. iv. p. m. 599.

[4] Lib. i. cap. 56, 28, 30; also lib. ii. cap. 57, 58.

are not shod even at present. This is still the case in Ethiopia, in Japan, and in Tartary[1]. In Japan, shoes, such as those of the ancients, are used. Iron shoes are less necessary in places where the ground is soft and free from stones; and it appears to me very probable, that the practice of shoeing became more common as the paving of streets was increased. There were paved highways indeed at a very early period, but they were a long time scarce, and were to be found only in opulent countries. But when roads covered with gravel were almost everywhere constructed, the hoofs of the horses would have soon been destroyed without iron shoes, and the preservatives before employed would have been of very little service.

However strong I consider these proofs, which show that the ancients did not give their horses shoes such as ours, I think it my duty to mention and examine those grounds from which men of learning and ingenuity have affirmed the contrary. Vossius lays great stress, in particular, upon a passage of Xenophon, who, as he thinks, recommends the preservation of the hoofs by means of iron. Gesner, however, has explained the words used by that author so clearly as to leave

[1] J. Ludolphi Hist. Æthiop. i. cap. 10, and his Commentarium, p. 146.—Thevenot, vol. ii. p. 113.—Voyage de Le Blanc, part ii. p. 75, 81.—Lettres Edifiantes, vol. iv. p. 143.—Tavernier, vol. i. c. 5.—Hist. Gen. des Voyages, vol. iii. p. 182.—Kæmpfer, Histoire du Japan, Amst. 1732, 3 vols. 12mo, ii. p. 297. The passage of the last author, where he mentions the articles necessary for a journey in Japan, is worthy of notice: "Shoes for the servants and for the horses. Those of the latter are made of straw, and are fastened with ropes of the same to the feet of the horses, instead of iron shoes, such as ours in Europe, which are not used in this country. As the roads are slippery and full of stones, these shoes are soon worn out, so that it is often necessary to change them. For this purpose those who have the care of the horses always carry with them a sufficient quantity, which they affix to the portmanteaus. They may however be found in all the villages, and poor children who beg on the road even offer them for sale, so that it may be said there are more farriers in this country than in any other; though, to speak properly, there are none at all."

Almost the same account is given by Dr. Thunberg, a later traveller in Japan. "Small shoes or socks of straw," says he, "are used for horses instead of iron shoes. They are fastened round the ankle with straw ropes, hinder stones from injuring the feet, and prevent the animal from stumbling. These shoes are not strong; but they cost little, and can be found every where throughout the country." Shoes of the same kind, the author informs us, are worn by the inhabitants.—Trans.

no doubt that Vossius judged too rashly. Xenophon[1] only gives directions to harden the hoofs of a horse, and to make them stronger and more durable; which is to be done, he says, by causing him to walk and to stamp with his feet in a place covered with stones. He describes the stones proper for this purpose; and that they may be retained in their position, he advises that they should be bound down with cramps of iron. The word which Vossius refers to the hoofs, alludes without doubt to the stones which were to be kept together by the above means. Xenophon, in another work, repeats the same advice[2], and says that experience will soon show how much the hoofs will be strengthened by this operation.

Vossius considers also as an argument in his favour the expressions used by Homer and other poets when they speak of iron-footed and brazen-footed horses, loud-sounding hoofs, &c., and is of opinion that such epithets could be applied only to horses that had iron shoes. But if we recollect that hard and strong hoofs were among the properties of a good horse, we shall find that these expressions are perfectly intelligible without calling in the assistance of modern horse-shoes. Xenophon employs the like comparisons free from poetical ornament, and explains them in a manner sufficiently clear. The hoofs, says he, must be so hard, that when the horse strikes the ground, they may resound like a cymbal. Eustathius, the scholiast of Aristophanes, and Hesychius, have also explained these expressions as alluding to the hardness and solidity of the hoofs. Of the same kind is the *equus sonipes* of the Roman poet[3]; and the stags and oxen with metal feet[4], mentioned in fabulous history, which undoubtedly were not shod. Epithets of the like nature were applied by the poets to persons who had a strong voice[5].

Le Beau quotes a passage of Tryphiodorus, which on the first view seems to allude to a real horse-shoe. This author, where he speaks of the construction of the Trojan horse, says that the artist did not forget the metal or iron on the hoofs[6].

[1] De Re Equestri, p. 599. [2] Hippareh, p. m. 611.

[3] Virg. Æneid. lib. iv. 135. lib. xi. 600, 638.

[4] Virg. Æneid. lib. vi. 803. Ovid. Heroid. ep. xii. 93, and Metamorph. lib. vii. 105. Apollonius, lib. iii. 228.

[5] Iliad. lib. v. 785. Stentor is there called χαλκεόφωνος. Iliad. lib. xviii. 222, Achilles is said to have had a brazen voice. Virg. Georg. lib. ii. 44: ferrea vox. [6] Tryphiod. by Merrick, Ox. 1739, v. 86, p. 14.

But supposing it true that the author here meant real shoes, this would be no proof of their being known at the time of the Trojan war, and we could only be authorised to allow them the same antiquity as the period when the poet wrote. That however is not known. According to the most probable conjectures, it was between the reign of Severus and that of Anastasius, or between the beginning of the third and the sixth century. Besides, the whole account may be understood as alluding to the ancient shoes. At any rate, it ought to be explained in this manner till it be proved by undisputed authorities that shoes, such as those of the moderns, were used in the time of the above poet.

Vossius asserts that he had in his possession a Greek manuscript on the veterinary art, in which there were some figures, where the nails under the feet of the horses could be plainly distinguished. But we are ignorant whether the manuscript or the figures still exist, nor is the antiquity of either of them known. It is probable that shoes were given to the horses by a modern transcriber, in the same manner as another put a pen into the hand of Aristotle.

In my opinion we must expect to meet with the first certain information respecting horse-shoes in much later writers than those in which it has been hitherto sought for, and supposed to have been discovered. Were it properly ascertained that the piece of iron found in the grave of Childeric was really a part of a horse-shoe, I should consider it as affording the first information on this subject, and should place the use of modern horse-shoes in the eighth century. But I do not think that the certainty of its being so is established in a manner so complete as has hitherto been believed. Those who affirm that this piece of iron had exactly the shape of a modern horse-shoe, judged only from an engraving, and did not perceive that the figure was enlarged[1]. The piece of iron itself, which seemed to have four holes on each side, was so con-

[1] The first figure may be found in Anastasis Childerici, Francorum regis, sive Thesaurus sepulchralis Tornaci Nerviorum effossus; auctore J. J. Chifletio. Antverpiæ, 1655, 4to, p. 224. Montfaucon, in Monarchie Françoise, i. p. 16, has given also an engraving of it. Childeric died in the year 481. In 1653 his grave was discovered at Tournay, and a gold ring with the royal image and name found in it afforded the strongest proof that it was really the burying-place of that monarch. In the year 1665, these antiquities were removed to the king's library at Paris.

sumed with rust, that it broke while an attempt was made to clear them; and undoubtedly it could not be so perfect as the engraving.

The account given by Pancirollus induced me to hope that I should find in Nicetas undoubted evidence of horse-shoes being used about the beginning of the thirteenth century; but that writer has deceived both himself and his readers, by confining himself to the translation. After the death of Henry Baldwin, the Latins threw down a beautiful equestrian statue of brass, which some believed to be that of Joshua. When the feet of the horse were carried away, an image was found under one of them which represented a Bulgarian, and not a Latin as had been before supposed. Such is the account of Nicetas; but Pancirollus misrepresents it entirely; for he says that the image was found under a piece of iron torn off from one of the feet of the horse, and which he considers therefore as a horse-shoe. The image, however, appears to have represented a vanquished enemy, and to have been placed in an abject posture under the feet of the statue (a piece of flattery which artists still employ), and to have been so situated that it could not be distinctly seen till the whole statue was broken to pieces. Hence perhaps arose the vengeance of the Latins against the statue, because that small figure was by some supposed to represent one of their nation[1].

As it appeared to me that the words used by ancient authors to express shoes[2] occurred less frequently in the writers of later periods, I conjectured that modern horse-shoes, in order that they should be distinguished from the ancient shoes, might have received a particular new name, under which I had never found them mentioned. In the course of my researches, therefore, I thought of the Greek word *selinaia*, the meaning of which I had before attempted to explain; and I am now fully convinced that it signifies horse-shoes, such as those used at present, as has been already remarked by others. As far as I know, that word occurs, for the first time, in the ninth century, in the works of the Emperor Leo[3]: and this antiquity of horse-shoes is in some measure confirmed by

[1] The whole account may be found at the end of the Annals, in the Paris edition by Fabrotti, 1647, fol. p. 414.

[2] The words *ὑποδήματα* and *soleæ*.

[3] Leonis Tactica, v. 4. p. 51.—In the passage where he names every

their being mentioned in the writings of Italian, English, and French authors of the same century. When Boniface marquis of Tuscany, one of the richest princes of his time, went to meet Beatrix, his bride, mother of the well-known Matilda, about the year 1038, his whole train was so magnificently decorated, that his horses were not shod with iron but with silver. The nails even were of the same metal; and when any of them dropped out they belonged to those who found them. The marquis appears to have imitated Nero; but this anecdote may be only a fiction. It is related by a contemporary writer; but, unfortunately, his account is in verse; and the author, perhaps sensible of his inability to make his subject sufficiently interesting by poetical ornaments, availed

thing belonging to the equipage of a horseman, he says, *πέδικλα σελιναῖα σιδηρὰ μετὰ καρφίων αὐτῶν*. I shall here first remark, that after *πέδικλα* there ought to be a comma, for by that word is meant the ropes with which saddled horses were fastened. Du Cange says *πεδικλοῦν* signifies *to bind*. See likewise Scheffer's Annotations on Mauricii Ars Militaris, p. 395. The translator also has improperly said, "Pedicla, id est calceos lunatos ferreos cum ipsis carphiis." Κάρφια means *nails*, as Du Cange has proved by several instances, and here *horse-shoe nails*. The word may be found for the second time in the tenth century, in the Tactica of the Emperor Constantine, where the whole passage, however, is taken from Leo without the least variation; so that we may suppose Constantine understood it in the same sense as Leo. It is used, for the third time, by the same emperor, twice in his book on the Ceremonial of his own court. In p. 265, where he speaks of the horses (*τὰ ἱππάρια*) which were to be procured for the imperial stable; these, he says, were to be provided with every thing necessary, and to have also *σελιναῖα*. In page 267 it is said further, that a certain number of pounds of iron should be given out from the imperial stores to make *σελιναῖα*, and other horse-furniture. The same word is used a fourth time by Eustathius, who wrote in the twelfth century, in his commentary on Homer, Χαλκὸν δὲ νῦν λέγει *τὰ σελιναῖα ὑπὸ τοῖς ποσὶ τῶν ἵππων, οἷς διακόπτονται εἰς πλέον τά πατούμενα*. See Iliad. lib. xi. 152. Though I do not believe that Homer had the least idea of horse-shoes, I am fully convinced that Eustathius alludes to them by that word. This commentator has explained very properly various passages of the like kind in Homer; but he seems here, as was the case sometimes with his poet himself, to have been asleep or slumbering.

When one considers that the *σελιναῖα*, or *σεληναῖα*, belonged to horse-furniture; that they were made of iron; that, as Eustathius says, they were placed under the hoofs of the horses; that the word seems to show its derivation from the moon-like form of shoes, such as those used at present; and lastly, that nails were necessary to these *σελιναῖα*; I think we may venture to conclude, without any fear of erring, that this word was employed to signify horse-shoes of the same kind as ours, and that they were known, if not earlier, at least in the ninth century.

himself of the license claimed by poets to relate something singular and uncommon [1]. However this may be, it is certain that the shoes of the horses must have been fastened on with nails, otherwise the author could not have mentioned them.

Daniel, the historian, seems to give us to understand that in the ninth century horses were not shod always, but only in the time of frost, and on other particular occasions [2]. The practice of shoeing appears to have been introduced into England by William the Conqueror. We are informed that this sovereign gave the city of Northampton as a fief to a certain person, in consideration of his paying a stated sum yearly for the shoeing of horses [3]; and it is believed that Henry de Ferres or de Ferrers, who came over with William, and whose descendants still bear in their arms six horse-shoes, received that surname because he was entrusted with the inspection of the farriers [4]. I shall here observe, that horse-shoes have been found, with other riding-furniture, in the graves of some of the old Germans and Vandals in the northern countries; but the antiquity of them cannot be ascertained [5].

FLOATING OF WOOD.

The conveying of wood in floats is an excellent invention; as countries destitute of that necessary article can be supplied by water carriage, not only with timber for building and other useful purposes, but also with fire-wood. The former is either pushed into the water in single trunks, and suffered to be carried along by the stream, or a number of planks are ranged close to each other in regular order, bound together in that manner,

[1] This life of Matilda may be found in Leibnitii Scriptores Brunsvicenses, vol. i. p. 629; but the fullest and most correct edition is in Muratori Rerum Italicarum Scriptores. Mediolani 1724, fol. vol. v. p. 353.

[2] Histoire de France, vol. i. p. 566. The author here speaks of the cavalry of Louis le Débonnaire. [3] Dugd. Bar. i. 58. ex Chron. Bromtoni, p. 974, 975, Blount's Tenures, p. 50.

[4] Brook's Discovery of Errors in the Catalogue of the Nobility, p. 198.

[5] Beckmann in Beschreibung der Mark Brandenburg, Berlin, 1751, 2 vols. fol. i. p. 401, mentions an old shoe found in a grave, the holdfasts of which did not project downwards but upwards. Arnkul in his Heidnischen Alterthümern speaks also of a horse-shoe found near Kiel.

and steered down the current as boats are, by people accustomed to such employment. The first method is that most commonly used for fire-wood. Above floats of the second kind a load of spars, deals, laths, pipe-staves, and other timber, is generally placed; and with these, floaters will trust themselves on broad and rapid rivers, whereas fire-wood is fit to be transported only on rivulets or small streams; and sometimes canals are constructed on purpose [1]. However simple the invention of floating fire-wood may be, I consider the other method as the oldest; and I confess that I do not remember to have found in ancient authors any information respecting the former. Fire-wood was, indeed, not so scarce formerly in the neighbourhood of large cities as it is at present. Men established themselves where it was abundant; and they used it freely, without thinking on the wants of posterity, till its being exhausted rendered it necessary for them to import it from distant places. It is probable that the most ancient mode of constructing vessels for the purpose of navigation gave rise to the first idea of conveying timber for building in the like manner; as the earliest ships or boats were nothing else than rafts, or a collection of beams and planks bound together, over which were placed deals. By the Greeks they were called *schediai*, and by the Latins *rates*; and it is known from the testimony of many writers, that the ancients ventured out to sea with them on piratical expeditions as well as to carry on commerce; and that after the invention of ships they were still retained for the transportation of soldiers and of heavy burthens [2].

[1] Those who are desirous of particular information respecting everything that concerns the floating of wood may read Bergius, Polizey- und Camera.-magazin, vol. iii. p. 156; Krunitz, Encylopedie, vol. xiv. p. 286; and the Forstmagazin, vol. viii. p. 1. To form an idea of the many laborious, expensive, and ingenious establishments and undertakings which are often necessary in this business, one may peruse Mémoire sur les Travaux qui ont Rapport à l'Exploitation de la Mâture dans les Pyrénées. Par M. Leroy. Londres et Paris, 1776, 4to. So early as the time of cardinal Richelieu the French began to bring from the Pyrenees timber for masts to their navy; but as the expense was very great, the attempt was abandoned, till it was resumed in the year 1758 by a private company, who entered into a contract with the minister for supplying the dock-yards with masts. After 1765 government took that business into their own hands; but it was attended with very great difficulties.

[2] Plinius, lib. vi. cap. 56.—Strabo, lib. xvi. where he calls these rafts σχεδίαι.—Festus, p. 432.—Scheffer, De Militia Navali Veterum, lib. i. cap. 3.—Pitisci Lexicon Antiq. Rom. art. Rates.

The above conjecture is confirmed by the oldest information to be found in history respecting the conveyance by water of timber for building. Solomon entered into a contract with Hiram, king of Tyre, by which the latter was to cause cedars for the use of the temple to be cut down on the western side of Mount Lebanon above Tripoli, and to be floated to Jaffa. The words at least employed by the Hebrew historian, which occur nowhere else, are understood as alluding to the conveyance of timber in floats; and this explanation is considered by Michaelis as probable. At present no streams run from Lebanon to Jerusalem; and the Jordan, the only river in Palestine that could bear floats, is at a great distance from the cedar forest. The wood, therefore, must have been brought along the coast by sea to Jaffa [1]. In this manner is the account

[1] "My servants shall bring them down from Lebanon unto the sea: and I will convey them by sea in floats unto the place that thou shalt appoint me."—I Kings, chap. v. ver. 9. "And we will cut wood out of Lebanon, as much as thou shalt need: and we will bring it to thee in floats by sea to Joppa; and thou shalt carry it up to Jerusalem."—2 Chronicles, chap. ii. v. 16. Pocock thinks that the wood was cut down near Tyre. The accounts given by travellers of Mount Lebanon, and the small remains of the ancient forests of cedar, have been collected by Busching in his Geography.

The following is the account given of these cedars by the abbé Binos, who visited them in the year 1778. "Here," says he, "I first discovered the celebrated cedars, which grow in an oval plain, about an Italian mile in circumference. The largest stand at a considerable distance from each other, as if afraid that their branches might be entangled, or to afford room for their tender shoots to spring up, and to elevate themselves also in the course of time. These trees raise their proud summits to the height of sixty, eighty, and a hundred feet. Three or four, when young, grow up sometimes together, and form at length, by uniting their sap, a tree of a monstrous thickness. The trunk then assumes generally a square form. The thickest which I saw might be about thirty feet round; and this size was occasioned by several having been united when young. Six others, which were entirely insulated, and free from shoots, were much taller, and seemed to have been indebted for their height to the undivided effects of their sap." These cedars, formerly so numerous, are now almost entirely destroyed. In the year 1575, Rauwolff found twenty-four that stood round about in a circle, and two others, the branches whereof are quite decayed with age; Bellon, in 1550, counted twenty-eight old trees; Fremenet, in 1630, counted twenty-two; La Roque, in 1688, twenty; Maundrell, in 1696, sixteen; Dr. Pococke, in 1738, fifteen; and Schulze, in 1755, counted twenty, besides some young ones; Burckhardt, in 1810, eleven or twelve; Dr. Richardson, in 1818, eight; Mr. Robinson, in 1830, seven; Lord Lindsay, in 1836, seven. Mr. Buckingham, in 1816, differs greatly from the other authorities, computing the whole number of trees at two hundred, of which he describes twenty as being very large.—TRANS.

understood by Josephus; but although he assures us that he gives the letters of both the kings as they were at that time preserved in the Jewish and Tyrian annals, it is certain that they are spurious, and that he took the whole relation from the sacred books of the Jews which are still extant, as he himself tells us in the beginning of his work[1].

An old tradition prevailed that the city Camarina, on the southern coast of Sicily, was built of the clay or mud which the river Hipparis carried along with it, and deposited in a lake of the same name. This account seems to be confirmed by a passage in Pindar, which Aristarchus quotes in explaining it[2]; and, according to Bochart, some proof is afforded also by the name Camarina, as *chamar* or *chomar* signifies sealing-clay[3]. In this tradition there is nothing improbable. In the like manner the Egyptians drew up mud from the lake Mœris[4]; and thus do the Dutch at present fish up in bag-nets the fine mud or slime which chokes up their rivers, such as the Issel, and which they employ for various uses. This explanation, however, has not been adopted by the old commentators of Pindar. Didymus[5] and others assert that the poet alludes to wood for building the city being conveyed in floats on the river Hipparis. But whatever opinion may be formed of these elucidations of the scholiasts, we have reason to conclude that the inhabitants of Camarina were much better acquainted with the floating of wood than with drawing up slime by means of bag-nets.

The Romans transported by water both timber for building and fire-wood. When they became acquainted, during their wars against the Germans, with the benefit of the common larch, they caused large quantities of it to be carried on the Po to Ravenna from the Alps, particularly the Rhætian, and to be conveyed also to Rome for their most important buildings. Vitruvius says[6] that this timber was so heavy, that, when alone, the water could not support it, and that it was necessary to

[1] Antiquit. lib. viii. These letters have been printed by Fabricius in Codex Pseudepigraphus Veteris Testamenti, i. p. 1026.

[2] Olymp. v. 29. Gesner, in explaining Pindar, translated φάος or φῶς by the word *help*, which Hebraism occurs in the New Testament, and also in Homer. The stream therefore assisted the inhabitants while under a great inconvenience. [3] Chanaan, i. 29, p. 605. [4] Herodot. lib. iii.

[5] See Pindar, ed. Welsted, 1697, fol. p. 53 and 56, a, 37.

[6] Vitruv. lib. ii. 9, p. 77.

carry it on ships or on rafts. Could it have been brought to Rome conveniently, says he, it might have been used with great advantage in building. It appears, however, that this was sometimes done; for we are told that Tiberius caused the Naumachiarian bridge, constructed by Augustus, and afterwards burnt, to be rebuilt of larch planks procured from Rhætia. Among these was a trunk one hundred and twenty feet in length, which excited the admiration of all Rome [1].

That the Romans procured fire-wood from Africa, particularly for the use of the public baths, is proved by the privileges granted on that account to the masters of ships or rafts by the emperor Valentinian [2]. Those who have read the writings of the Latin authors with attention must have remarked other testimonies; but I have found no mention in the ancients of floating timber in single planks, or of canals dug for that purpose; at least as far as I can remember. In the Latin language also there are scarcely two words that allude to what concerns the floating of timber; whereas the German contains more of that kind, perhaps, than are to be found in any other; and I am thence induced to conjecture that the Germans were the first who formed establishments for this mode of conveyance on a large scale.

The earliest information respecting the floating of wood in Saxony appears to be as old as the year 1258 [3], when the margrave Henry the Illustrious remitted by charter to the monastery of Porta, the duty collected at Camburg from the wood transported on the river Saale for the use of the monastery [4]. It is, however, uncertain whether wood really conveyed in floats, or transported in boats and lighters, be here meant. Much clearer information concerning wood floated on the Saale is contained in a letter, expedited in the year 1410 by the two brothers Frederic and William, landgraves of Thuringia, and margraves of Misnia, in which, on account of the scarcity of wood that prevailed in their territories, they so much lessened the toll usually paid on the Saale as far as

[1] Plin. lib. xvi. cap. 39, p. 33 and 34.

[2] Codex Theodos. lib. xiii. tit. 5, 10. Lex xiii. p. 78. Compare Symmachi Epist. lib. x. ep. 58. As far as I know, such ordinances occur also in the Code of Justinian.

[3] See Sammlung vermischter Nachrichten zur Sächsischen Geschichte, by G. J. Grundig and J. F. Klotzsch, vol. vi. 221.

[4] Pertuchii Chronic. Portense, p. 54.

Weissenfels, that a Rhenish florin only was demanded for floats brought on that river to Jena, and two Rhenish stivers for those carried to Weissenfels; but the proprietors of the floats were bound to be answerable for any injury occasioned to the bridge [1]. In the year 1431, Hans Munzer, an opulent citizen of Freyberg, with the assistance of the then burgomasters, put a float of wood upon the river Mulda, which runs past the city, in order that it might be conveyed thither for the use of the inhabitants and of the mines; which seems to be a proof that the floating of timber was at that period undertaken by private persons, on their own risk and at their own expenses. In 1486 the floating of wood on the Mulda by the people of Zwikaw, was opposed by the neighbouring nobility; but the rights of the city were protected by the electors. When the town of Aschersleben built its church in the year 1495, the timber used for the work was transported on the Elbe from Dresden to Acken, and thence on the Achse to the place of its destination. This is the oldest account known of floating timber on the Elbe. In the year 1521, duke George caused a large canal to be cut at the village of Plauen, which was supplied with water from the Weiseritz, and carried as far as Dresden. It appears that in 1564 there was a float-master, who was obliged to give security to the amount of four hundred florins; so that the business of floating must at that time have been of considerable importance. Floating of wood was undertaken at Annaberg in 1564, by George Oeder, one of the members of the council, and established at the expense of 4000 florins. Of the antiquity of floating in other German states I know nothing more than what is to be gathered fr m public ordinances respecting this object and forests; by which we learn that in the sixteenth century it was practised in Brandenburg, on the Elbe, Spree, and Havel; in Bavaria, and in the duchy of Brunswick [2].

As the city of Paris had consumed all the wood in its neighbourhood, and as the price of that article became enormous on account of the distance of forests and the expense of transporting it, John Rouvel, a citizen and merchant, in the year 1549, fell upon the plan of conducting wood bound together along rivers which were not navigable for large vessels. With

[1] Rudolphi Gotha Diplomatica, pars i. p. 279.

[2] See the Forest Laws in Fritschii Corp. Juris Ven. Forest.

this view, he made choice of the forests in the woody district of Morvant, which belonged to the government of Nivernois; and as several small streams and rivulets had their sources there, he endeavoured to convey into them as much water as possible[1]. That great undertaking, at first laughed at, was completed by his successor René Arnoul, in 1566. The wood was thrown into the water in single trunks, and suffered to be driven in that manner by the current to Crevant, a small town on the river Yonne; where each timber-merchant drew out his own, which he had previously marked, and, after it was dry, formed it into floats that were transported from the Yonne to the Seine, and thence to the capital. By this method large quantities of timber are conveyed thither at present from Nivernois and Burgundy, and some also from Franche-Comté. The French extol highly a beneficial establishment formed by one Sauterau, in Morvant, at his own expense, by which the transportation of timber was rendered much more speedy, and for which a small sum was allowed him from the proprietors of all the wood floated on the Yonne.

The success of this attempt soon gave rise to others. John Tournouer and Nicholas Gobelin, two timber-merchants, undertook to convey floats in the like manner on the Marne; and canals were afterwards constructed in several places for the purpose of forming a communication between different rivers. The French writers consider the transportation of large floats, *trains de bois*, like those formed at present, from the before-mentioned districts, and also from Bourbonnois, Champagne, Lorraine, Montergis, and other parts of the kingdom, as a great invention; but I am firmly of opinion that this method was known and employed in Germany at a much earlier period[2].

[Victor Hugo gives the following animated account of floating rafts. The traveller who ascends the river sees it, so to speak, coming to him, and then the sight is full of charms. At each instant he meets something which passes him; at one time, a vessel crowded with peasants, especially if it be Sunday; at another, a steam-boat; then a long, two-masted ves-

[1] Wood was conveyed in boats upon the Yonne so early as the year 1527. See Coquille in Histoire du Nivernois.

[2] Traité de la Police, par De la Marc, iii. p. 839.—Savary, Dictionnaire de Commerce, art. Bois flotté and Train.

sel, laden with merchandize, its pilot attentive and serious, its sailors busy, with women seated near the door of the cabin; here, a heavy-looking boat, dragging two or three after it; there, a little horse drawing a huge bark, as an ant drags a dead beetle. Suddenly there is a winding in the river; and formerly, on turning, an immense raft, a floating house, presented itself, the oars splashing on both sides. On the ponderous machine were cattle of all kinds, some bleating, and others bellowing, when they perceived the heifers peaceably grazing on the banks. The master came and went, looked at this, then at that, while the sailors busily performed their respective duties. A whole village seemed to live on this float,—on this prodigious construction of fir.]

The floating of wood seems, like many other useful establishments, to have been invented or first undertaken by private persons at their own risk and expense, with the consent of governments, or at least without any opposition from them; but, as soon as it was brought to be useful and profitable, to have been considered among regalia. Hence, therefore, soon arose the float-regal, which, indeed, on account of the free use granted of rivers, the many regulations requisite, and its connexion with the forest-regal, can be sufficiently justified. But when and where originated the term *jus grutiæ*, under which this regal is known by jurists?

The few authors who have turned their thoughts to this question have not been able, as far as I know, to answer it with certainty, nor even with probability. They have only repeated, without making any researches themselves, what Stypmann[1] has said on the subject; and the latter refers to a passage of Hadrian Junius, which I shall here more particularly notice. Junius, speaking of the oldest families in the Netherlands, says that the family of Wassenaer had formerly a certain supremacy over the rivers in Rhineland, so that no one, without their permission, could keep swans on them, and that the brewers paid for the use of the water a certain tax called the *gruyt-geld*, from which arose the *jus grutæ*. The origin of this word he did not know; but he conjectured that it was derived either from *gruta*, which signifies duckweed (*Lemna*), a plant that grows in the water and covers its surface during the summer, or from *grut*, an ingredient used

[1] De Jure Maritimo, p. i. c. 10. n. 100.

in making beer[1]. It is certain that in the tenth, eleventh, and thirteenth centuries *gruta*, *grutt*, or *gruit*, signified a tax which brewers were obliged to pay[2]; but the origin of the word has been sufficiently explained neither by Junius nor any other writer. I nowhere find that it was used in ancient times for a float-duty; and this meaning Junius himself has not so much as once mentioned.

The word *gruit* occurs under a quite different sense in a letter of investiture of the year 1593, by which the elector of Cologne gave as a fief to the countess of Moers, the *gruit* within the town of Berg, with all its rents, revenues, and appurtenances. "No other person was allowed to put *grudt* or any plant in beer, or to draw beer brought from other countries. On the other hand, the countess was to make good *grutt*, and to cause it to be sold at the price usual in the neighbouring parts; she was bound also to supply the elector gratis with what beer was necessary for family consumption; and if more was required than usual, on extraordinary occasions, she was to ask and receive money. If any one in the town did not deliver good *gruidt*, and should prove that he could not deliver better, as the fault was occasioned by the *gruitte*, the loss that might arise should fall upon the countess. The word *grut* or *gruitt* seems to occur here under a double meaning; as an ingredient in the beer, and as the beer itself which was made from it. Of this difficulty I have in vain endeavoured to find an explanation. *Grut*, perhaps, may signify malt. In

[1] H. Junii Batavia. Lugd. Bat. 1558, 4to, p. 327.—Hugo Grotius de Antiquitate Reipub. Batavicæ, cap. 4.—Délices de la Hollande. Amst. 1685, 12mo, p. 218: "Les Wassenaers tiennent leur origine d'une village qui est entre Leiden et la Haye, ou des droits qu'ils eurent les siecles passez sur les eaux, les estangs et les lacs de la Hollande."—Those who are fond of indulging in conjecture might form the following conclusion:—The lakes and streams belonged to the Wassenaers, who kept swans, geese and ducks upon them. When the brewers were desirous of clearing the water from the duck-weed, which in Fritsch's German Dictionary is called *Enten-grutz*, in order that it might be fitter for use, they were obliged to pay a certain sum to obtain permission; and when the practice of floating timber began, the floats disturbed the ducks, and destroyed the plant on which they fed, and the proprietors of floats were on this account obliged to pay a certain tax also. But was it customary at that period to float timber in the Netherlands?

[2] Glossarium Manuale, iii. p. 850: "Gruta, Grutt, Gruit, appellant tributum, quod pro cerevisia pensitatur."

Dutch and other kindred languages *grut* means the small refuse which is separated from anything; and to which *grusch* bran, and *grütze* groats, have an affinity. May not ground malt be understood by it? I have thought likewise of a kind of herb-beer, which was much esteemed in the sixteenth century; and that *grut* might signify a mixture of herbs used for making that beer. It is probable that this word was confined within the boundaries of the Netherlands; and thence only, perhaps, is an explanation of it to be expected.

I am, however, still unable to comprehend how the float-duty obtained the name of *jus grutiæ*; and in our kindred languages I can find no derivation of it. The German word *flosz*, from *fliessen*, to flow or glide; *flusz*, a river, occurs in them all. The Dutch say *vlot*, *vlothout*; the Swedes, *en flott*, *flotta*, to float; *flot-wed*, float-wood; and the English, *a float*, *to float*, &c.

LACE.

Fifty years ago, when a knowledge of many useful and ingenious arts formed a part of the education given to young women destined for genteel life, one who should have supposed that any reader could be ignorant of the manner in which lace is made, would only have been laughed at; but as most of our young ladies at present employ the greater part of their time in reading romances or the trifles of the day, it is probable that many who have even had an opportunity of frequenting the company of the fair sex, may never have seen the method of working lace. For this reason, I hope I shall be permitted to say a few words in explanation of an art towards the history of which I mean to offer such information as I have been able to collect.

Proper lace or point was not wove. It had neither warp nor woof, but was rather knit after the manner of nets (*filets*) or of stockings. In the latter, however, one thread only is employed, from which the whole piece or article of dress is made; whereas lace is formed of as many threads as the pat-

tern and breadth require, and in such a manner that it exhibits figures of all kinds. To weave, or, as it is called, knit lace, the pattern, stuck upon a slip of parchment, is fastened to the cushion of the knitting-box; the thread is wound upon the requisite number of spindles, which are called bobbins; and these are thrown over and under each other in various ways, so that the threads twine round pins stuck in the holes of the pattern, and by these means produce that multiplicity of eyes or openings which give to the lace the desired figures. For this operation much art is not necessary; and the invention of it is not so ingenious as that of weaving stockings. Knitting, however, is very tedious; and when the thread is fine and the pattern complex, it requires more patience than the modern refinement of manners has left to young ladies for works of this kind. Such labour, therefore, is consigned to the hands of indigent girls, who by their skill and dexterity raise the price of materials, originally of little value, higher when manufactured than has ever yet been possible by any art whatever. The price, however, becomes enormous when knit lace has been worked with the needle or embroidered: in French it is then called *points*.

The antiquity of this art I do not pretend to determine with much certainty; and I shall not be surprised if others by their observations trace it higher than I can. I remember no passage in the Greek or Latin authors that seems to allude to it; for those who ascribe works of this kind to the Romans found their opinion on the expression *opus Phrygianum*: but the art of the Phrygians[1], as far as I have hitherto been able to learn, consisted only in needle-work: and those ingenious borders sewed upon clothes and tapestry, mention of which occurs in the ancients, cannot be called lace, as they have been by Braun[2] and other writers. I am however firmly of opinion that lace worked by the needle is much older than

[1] This is proved by the vestes Phrygioniæ of Pliny mentioned before in the article on wire-drawing. Those who made such works were called *phrygiones*. In the Menæchmi of Plautus, act ii. scene 3, a young woman, desirous of sending her mantle to be embroidered, says, "Pallam illam ad phrygionem ut deferas, ut reconcinnetur, atque ut opera addantur, quæ volo." Compare Aulul. act iii. scene 5; Non. Marcellus, i. 10; and Isidor. 19, 22. The Greeks seem to have used the words κεντεῖν and κατασττίζειν as we use the word *embroider*.

[2] De Vestitu Sacerdot. Hebræorum, i. p. 212.

that made by knitting. Lace of the former kind may be found among old church furniture, and in such abundance that it could have been the work only of nuns or ladies of fortune, who had little else to employ their time, and who imagined it would form an agreeable present to their Maker; for had it been manufactured as an article of commerce, we must certainly have found more information respecting it.

We read in different authors that the art of making lace was brought from Italy, particularly from Genoa and Venice, to Germany and France; but this seems to allude only to the oldest kind, or that worked with the needle, and which was by far the dearest. At any rate, I have nowhere found an expression that can be applied to lace wove or knit. In the account given of the establishment of the lace manufacture under Colbert in 1666, no mention is made but of *points*[1].

I will venture to assert that the knitting of lace is a German invention, first known about the middle of the sixteenth century; and I shall consider as true, until it be fully contradicted, the account given us that this art was found out, before the year 1561, at St. Annaberg, by Barbara wife of Christopher Uttmann. This woman died in 1575, in the sixty-first year of her age, after she had seen sixty-four children and grandchildren; and that she was the inventress of this art is unanimously affirmed by all the annalists of that part of Saxony[2]. About that period the mines were less productive, and the making of veils, an employment followed by the families of the miners, had declined, as there was little demand for them. This new invention, therefore, was so much used that it was known in a short time among all the wives and daughters of

[1] Count de Marsan, the youngest son of count d'Harcourt, brought from Brussels to Paris his former nurse, named Du Mont, with her four daughters, and procured for her an exclusive right to establish and carry on the lace manufactory in that capital. In a little time Du Mont and her daughters collected more than two hundred women, many of whom were of good families, who produced such excellent work that it was in little or nothing inferior to that imported from other countries.—Vie de Jean-Bapt. Colbert, Cologne, 1696, 12mo, p. 154.

[2] The oldest information on this subject is to be found in Annabergæ Urbis Historia, auctore Paulo Jenisio. Dresdæ, 1605, 4to, ii. p. 33.—C. Melzer, Berglauftige Beschreibung der Stadt Schneeberg. 1684, p. 471.—Historia Schneebergensis. Schneeberg 1716, 4to, p. 882.—Tob. Schmidt, Zwickauische Chronik. Zwickau, 1656, 4to. ii. p. 384.—Lehmanns Historischer Schauplatz des Obererzgebirges. Leipzig, 1699, 4to, p. 771.

the miners; and the lace which they manufactured, on account of the low price of labour, soon became fashionable, in opposition to the Italian lace worked with the needle, and even supplanted it in commerce.

A doubt, however, has often occurred to me, which may probably occur also to some of my readers, that this Barbara Uttmann may be entitled only to the merit of having made known and introduced this employment; and that, as has often happened to those who first brought a new art to their own country, she may have been considered as the inventress, though she only learned it in a foreign land, where it had been long practised. But I conjecture that this could not have been the case, as I find no mention of the art of knitting lace, nor any of the terms that belong to it, before the middle of the sixteenth century.

[The application of machinery to the manufacture of lace dates from the early part of the present century, The original fabric, called pillow or bone-lace, which formerly gave employment to so many thousands[1] of the poorer classes, is now, especially in this country, almost entirely abandoned, in consequence of the invention of the bobbin-net machinery.

The bobbin-net trade is a branch of the cotton manufacture, the net being almost invariably formed of that material. It originated in successive improvements and alterations on the stocking-frame, by which it was adapted to the weaving of lace; though it is deserving of notice that it could have had ao existence but for Samuel Crompton's invention, the mule, which spins yarn suitable for that delicate fabric. The application of the stocking-frame to lace-making was first attempted by a frame-work knitter of Nottingham, named Hammond, nbout 1768; but it was not rendered completely successful till after improvements by John Heathcoat, also of Nottingham, for which a patent was secured in 1809. His improvements were of so important a character as to entitle him to be justly considered the inventor of the lace-frame, and the father of the bobbin-net manufacture. Means were besides discovered for making the net into various widths, instead of only one

[1] It is difficult to form an estimate of the number of persons employed in pillow-lace making during its prosperity; but in a petition from the makers in Buckingham and the neighbourhood presented to her Majesty queen Adelaide in 1830, it was stated that 120,000 persons were dependent on the trade.

broad piece as at first, and likewise to work various ornaments into it by the aid of machinery, which, in point of complex ingenuity, far surpasses that used in any other branch of human industry[1]. One of Fisher's spotting-frames, according to Dr. Ure, is as much beyond the most curious chronometer in multiplicity of mechanical device, as that is beyond a common roasting-jack. The combined effects of these improvements is, that fabrics, for which £5 were paid during the existence of Mr. Heathcoat's patent, may now be purchased for 2*s.* 6*d.* The different systems of bobbin-net machines are described in Ure's Dictionary, or his Cotton Manufacture of Great Britain. It has been found that no machines, except those upon the circular-bolt principle invented by Mr. Morley of Derby, have been found capable of working successfully by mechanical power.]

ULTRAMARINE.

Ultramarine is a very fine blue powder, almost of the colour of the corn-flower or blue-bottle, which has this uncommon property, that, when exposed to the air or a moderate heat, it neither fades nor becomes tarnished. On this account it is used in painting; but it was employed formerly for that purpose much more than at present, as smalt, a far cheaper article, was not then known. It is made of the blue parts of the lapis lazuli, by separating them as much as possible from the other coloured particles with which they are mixed, and reducing them to a fine powder. The real lapis lazuli is found in the mountains of that part of Tartary called Bucharia, which extends eastwards from the Caspian sea, and particularly at Kalab and Budukschu. It is sent thence to the East Indies, and from the East Indies to Europe. The Bucharians also carry fragments of it, weighing sometimes a pound and more, to Orenburg, though less frequently than some years ago. As large pieces of a pure and beautiful colour are scarce even in that distant country, and as they are employed for making orna-

[1] Waterston's Encyclopædia of Commerce.

ments and toys, the rough stone itself is costly; and this high price is increased in the ultramarine by its laborious preparation, though in later times the process has been rendered much easier[1].

On account of the scarcity and great value of the lapis lazuli, other stones, somewhat like it only in colour, have been substituted in its stead; and hence have arisen the many contradictions to be found in the works of different authors, particularly those of the ancients, where they speak of the properties and country of this species of stone. Many have considered the Armenian stone, which is a calcareous kind of stone tinged with copper; many the mountain blue or malachite, and many also blue sparry fluor, and blue jasper, as the lapis lazuli[2]; and ultramarine of course is not always what it

[1] The old method of preparing ultramarine may be found in De Boot, Gemmarum Histor. Lugd. Bat. 1647, 8vo, p. 279. Formerly ultramarine was improperly called a precipitate or magisterium.

[2] Besides the before-mentioned proofs of the real lapis lazuli being found in Tartary, the same thing is confirmed by Tavernier in his Travels. Paulus Venetus also seems to speak of that country when he says, "Suppeditat quoque mons alius in hac provincia (Balascia) lazulum, de quo fit azurum optimum, quale etiam in mundo non invenitur. Elicitur autem ex mineris non secus ac ferrum; præbent quoque mineræ argentum." A great many however assert that this species of stone is brought from Persia: but it is not indigenous in that country, and is carried thither from Thibet. As the Persians are remarkably fond of this paint, they endeavour to procure as much of it as possible; but Persia itself produces only the blue copper ochre, which is sometimes used there instead of ultramarine. Tavernier mentions this very particularly, and, as he dealt in precious stones, was not liable to be deceived. To rectify a prevailing mistake, I shall here insert his own words:—"In the copper mines of Persia, veins of lazur, which is much used in that country, and with which the flowers on the ceiling and roofs of apartments are painted, have also been found. Before these were discovered, the Persians had no other lazur than the real kind which comes from Tartary, and is exceedingly dear. The Persian lazur is a sort of copper ore; and when the stone is pounded and sifted, which is the process employed with the real kind, it forms a fine paint, which appears very bright and pleasant. After this discovery, the Persians durst no more purchase the Tartarian lazur; and Mahomet-Beg issued an order that painters should not use foreign but Persian lazur. This prohibition however did not long continue; for the Persian lazur could not stand the effects of the atmosphere like the real kind, but in the course of time became of a dark and dismal colour. Sometimes it was full of scales, and would not hang to the end of a soft hair brush. On this account it was soon neglected as a coloured earth, and the lazur of Tartary again introduced." This information is confirmed also by Chardin, in Voyages en Perse, iv. p. 66.

ought to be. At present, smalt of a good colour is often purchased therefore at a dear rate; and it is in greater request, as it is certain that its colour is more durable in fire than even that of the lapis lazuli. Good ultramarine must be of a beautiful dark colour, and free from sand as well as every other mixture. It must unite readily with oil; it must not become tarnished on a red-hot tile or plate of iron, and it ought to dissolve in strong acids, almost like the zeolite, without causing any effervescence. In the year 1763, an ounce of it at Paris cost four pounds sterling, and an ounce of *cendre d'outremer*, which is the refuse, two pounds. At Hamburg, Gleditsch sold fine real Oriental ultramarine for a ducat per ounce, and warranted it to stand proof by fire; but whether it would stand proof by acids also, I do not know.

From what has been said, a question arises, whether ultramarine was known to the ancient Greeks and Romans? And this gives occasion to another, whether they were acquainted with lapis lazuli? The name lapis lazuli no one indeed can expect to find among them; for it is certain that we received it from the Arabians; and the word *ultramarinum* is altogether barbarous Latin. Some centuries ago, many foreign articles, brought from beyond sea, had a name given them from that circumstance; and the ancients applied the epithet *marinum* to various productions on the like account. Hence, in the decline of the Roman language was formed *ultramarinum*, which some have endeavoured to improve by changing it into *transmarinum*, but this among the ancients never signified a colour.

Though the ancient names of precious stones have neither been examined with sufficient accuracy nor distinguished with

"In the country around Tauris," says the author, "is found lapis lazuli, but it is not so good as that of Tartary, as its colour changes, becomes dark, and afterwards fades." In page 255, he says likewise, "The lapis lazuli, called *lagsverd*, from which we have formed the word *azur*, is found in the neighbourhood, in the country of the Yousbecs, but the general magazine for it is Persia." I do not believe that this species of stone was formerly procured from Cyprus, as is asserted in many books. Copper is a production of that island, and it produces even at present mountain blue. Those also who assert that the colour of ultramarine fades in the fire, must not have been acquainted with the genuine sort. See Schriften der Schwedischen Acad. xii. p. 69. Montamy, in Abhandlung von den Farben zum Porzellan, Leipzig, 1767, 8vo, p. 121, affirms that ultramarine is not good for enamel-painting, but it is certain that it was once used for that purpose.

the greatest possible certainty, I think I can discover among them the lapis lazuli. I consider it as the sapphire of the ancients, and this opinion has been entertained by others; but I hope to render it more probable than it has hitherto appeared. In the first place, the sapphire of the Greeks and Romans was of a sky-blue colour with a violet or purplish glance; and sometimes it had a very dark or almost blackish-blue colour. Secondly, this stone was not transparent. Thirdly, it had in it a great many gold points, or golden-yellow spots, but that which had fewest was most esteemed. Fourthly, it was polished and cut; but when it was not perfectly pure, and had mixed with it harder extraneous particles, it was not fit for the hands of the lapidary. Fifthly, it appears that it was procured in such large pieces that it could be employed for inlaid or mosaic-work. Sixthly, it was often confounded with, or compared to, copper-blue, copper-ore, and earth and stones impregnated with that metal. Seventhly, such medicinal effects were ascribed to it as could be possessed only by a copper salt; and lastly, it formed veins in rocks of other kinds of stone, as we are informed by Dionysius [1].

That a stone with these properties cannot be the sapphire of our jewellers is beyond all doubt. Our real sapphire does not form veins in other fossils, but is found among sand in small crystals, shaped like diamonds; though they sometimes have rather the figure of columns. Like other precious stones, they are always transparent; they have never gold points in them; their blue colour resembles more or less that of blue velvet, and it is often very pale, and approaches seldom, or very little, to purple. Powder of sapphire appears like fine pounded glass, exhibits no traces of copper, and can in no manner produce a blue pigment, or be confounded with mountain-blue.

The question, whether the ancients were acquainted with our sapphire, and whether it may not belong to their amethysts or hyacinths, I shall not here examine. I am inclined rather to decide in the negative than the affirmative; and at any rate the proof will always remain dubious. It might perhaps be difficult also to determine whether every modern mineralogist who has spoken of the sapphire was acquainted with, and alluded to, the real stone of that name.

[1] See Plin. lib. xxxvii. cap. 9 and 10.—Isidori Orig. xvi. 9.—Theophrast. de Lapid. § 43.—Dioscorides, v. 157.—Dionys. Orb. Desc. v. 1105.—Epiphanius de xii gemmis, § 5.—Marbodeus de Lapidibus, 53, p. 46.

On the other hand, we can affirm with the greatest certainty, that the sapphire of the ancients was our lapis lazuli. The latter is of a blue colour, which inclines sometimes to violet or purple, and which is often very dark. It is altogether opake, yet its colour will admit of being compared to a sky-colour; in mentioning of which Pliny had no idea of transparency, for he compares the colour of an opake jasper to a sky-blue[1]. The lapis lazuli is interspersed with small points, which were formerly considered as gold, but which are only particles of pyrites or marcasite. It can be easily cut and formed into articles of various kinds, and at present it is often used for seals. Pliny, however, informs us that it was not fit for this purpose when it was mixed with hard foreign particles, such as quartz; and that which was of one colour was therefore much more esteemed[2]. Many cut stones of this kind, which are considered as antiques, may be found in collections. I remember to have seen several works of this sort in the excellent collection of the duke of Brunswick, which, in all probability, are Egyptian, and which are worthy of an accurate description. That lapis lazuli was used formerly for inlaid works I am well convinced, though at present I can produce no proofs. In how beautiful a manner it is employed for that purpose in Florentine works, is well known. The largest and most magnificent squares of lapis lazuli which I ever saw, are in the apartments at Zarskoe-Selo, a summer palace near Petersburg, belonging to the empress of Russia, the walls of which are covered with amber, interspersed with plates of this costly stone. I was informed that these plates were procured from Thibet. The doubt expressed by Epiphanius concerning stairs overlaid with lapis lazuli, respects only the great expense of it, and he perhaps imagined that the steps were entirely cut from the solid stone. The confounding the sapphire with the *cya-*

[1] Lib. ii. p. 782. Jaspis aërizusa—which I certainly do not, with Salmasius, consider as the turquoise. We have blue jasper still.

[2] Plin. Inutiles scalpturæ, intervenientibus crystallinis centris.—Several learned men have understood this passage as if Pliny said that the sapphire could not be cut; but they seem not to have attended properly to the author's words, and to have forgot what the ancient artists called *centra* in stones and different kinds of wood which were to be cut. This Pliny himself explains, b. xvi. c. 39. In b. xxxvii. c. 2, he reckons also "prædurum ac fragile centrum" among the faults of rock crystal, which however, when it had not this blemish, was very proper for being cut. Theophrastus uses in the same sense the word *κέντρον*.

nus, or comparing it to it, of which several instances occur, proves that the former must have had a great resemblance to copper-ore; for that the *cyanus* is a kind of mineral or mountain blue, tinged with copper, I have proved already[1]. The blue colour of lapis lazuli has always been supposed to be owing to copper; but according to the latest discoveries it originates from iron[2]. The medicinal effects which the ancients ascribed to their sapphire could be produced only from a mixture of copper, as they considered the Armenian stone, or false lapis lazuli, to be the real kind. They recommended copper ochre for an inflammation of the eyes[3]. In the last place it agrees with what Dionysius says, that the sapphire or lapis lazuli was produced in veins among other kinds of stone[4]. The sapphire also mentioned in the oldest writings of the Hebrews, appears to be no other than the sapphire of the Greeks, or our lapis lazuli; for it was said likewise to be interspersed with gold points[5].

The ancients therefore were acquainted with our lapis lazuli; but the question whether they used it as a paint, or prepared ultramarine from it, I cannot answer with sufficient certainty. It is possible that their *cæruleum* sometimes may have been real ultramarine; but properly and in general it was only copper ochre[6]. The objection that the ancients made blue glass and blue enamel, and if they had not smalt they could use no other pigment that would stand fire but ultramarine, I shall answer in the next article.

Before I proceed to the oldest information with which I am acquainted respecting ultramarine, or the blue colour made from lapis lazuli, I shall communicate what I know of the origin and antiquity of the name commonly given to this stone. That I might be able to offer something more on the subject than what has been said by Salmasius[7], I requested the opi-

[1] Aristotelis Auscultat. Mirabil. cap. 59, p. 123.

[2] Systema Mineralium, i. p. 313. [3] Dioscorides, Parabil. i. p. 10, 11.

[4] Some years ago my former colleague, H. Laxman, discovered lapis lazuli in veins of granite near Baikal in Siberia. These veins contained also along with it felspar and a milky-coloured kind of stone, perhaps zeolite, like pyrites.

[5] Braun de Vestitu Sacerdotum. ii. p. 530.—See Michaelis Supplementa ad Lexica Hebraica, num. 1775. The name sapphire is very ancient.

[6] Plin. lib. xxxiii. cap. 13.—Aristot. Auscult. Mirab. p. 123.

[7] De Homonymis Hyles Iatricæ. Trajecti ad Rhenum, 1689, fol. p. 217.

nion of Professor Tychsen, which, with his permission, I have here subjoined[1]. It is, in the first place, certain that the word is of Persian derivation, and the stone, as I have already remarked, has hitherto been brought to us from Persia. Secondly, it signifies a blue colour. It was at first also the common name in Europe for blue stones and blue colours used in painting; and it was a long time used to express mountain-blue impregnated with copper. The modern systematic mineralogists, it appears, first appropriated the corrupted Persian word to the present lazur-stone, properly so-called; and those therefore would commit an error in mineralogy who should now apply this name to the Armenian stone, mountain-blue, or any other blue mineral containing copper.

Without pretending to have discovered the first mention of the name lazuli in those writings which have been handed down to us, I shall here offer, as the oldest with which I am acquainted, that found in Leontius[2], who, where he gives directions for colouring a celestial globe, speaks of *lazurium*. If Fabricius be right, Leontius lived in the sixth century[3]. Among the receipts for painting, written in the eighth century, which Muratori[4] has made known, we find an unintelligible account how to make *lazuri*, for which *cyanus compositus*, perhaps a prepared kind of mountain-blue, was to be employed. There is also another receipt which orders blue-bottles to be pounded in a mortar. It appears therefore that this word was used in the corrupted Latin of that period to

[1] *Lazul* or *lazur* is not of Arabic, but Persian extraction. *Ladschuardi* or *lazuardi* in Persian signifies a blue colour and lapis lazuli. It ought properly to be pronounced *lazuverd*; but the Arabs in their pronunciation contract the *v* very much, so that it sounds like *u*; and one can say therefore *lazurd*. The derivative *lazurdi* or *lazuverdi* signifies *blue*.

The pronunciation *lazul*, with an *l* at the end, is agreeable to the common custom among the Arabs of confounding *l* and *r*; as instead of *zingiber* they say *zengebil*. The initial *l* is not the article, but seems to belong to the word itself, because it is not originally Arabic. It is worthy of remark, that the Spaniards call blue *azul*, which is plainly derived from the above word; and the *l* has been omitted because it was considered as the article, and thus the word was mutilated, as is often the case with foreign words among the Arabs, who say, for example, *Escandria*, instead of *al Escandria* (*Alexandria*).

[2] Leontius de Constructione Arateæ Sphæræ, in Astronomica Veterum Scripta, 1589, 8vo, p. 144.

[3] Biblioth. Græca, ii. p. 456.

[4] Antiquitat. Ital. Medii Ævi, ii. p. 372, 378.

signify a blue colour for painting. The same word, formed after the Greek manner, seems to have been used for blue by Achmet, the astrologer, who lived in the ninth century[1], and by Nonus in the tenth for a blue earth[2]. Of still more importance is a passage of Arethas, who lived in the following century, and who, in his exposition of a verse in the book of Revelation[3], says, the sapphire is that stone, of which *lazurium*, as we are told, is made[4]. This, therefore, is a strong corroboration that the sapphire of the ancients was our *lapis lazuli*, and appears to be the first certain mention of real ultramarine. The word however occurs often in the succeeding centuries for blue copper-ochre. Constantinus Africanus, a physician of the eleventh century, ascribes to lapis lazuli the same medicinal qualities as those of copper-ochre[5]; as do also Avicenna, Averroes, and Myrepsius. The first, under the letter *lam*, gives a chapter entitled *lazuard*, to which the translator has prefixed "De azulo, id est, de lapide Armenio;" and the last says expressly, that the *lapis lazuli* of the Latins is the *lazurios* of the Greeks[6]. The words *azura*, *azurum*, *azurrum*, occur often also in that century for *blue*.

The name *ultramarine*, or, as it was first called, *azurrum ultramarinum*, I have not yet found in any writer of the fifteenth century. But it appears that it must have been common about the end of that century, as it was used by Camillus Leonardus in 1502[7]. It is probable that it originated in Italy. In the first half of the sixteenth century Vanuccio Biringoccio gave directions for preparing the real ultramarine, which he distinguishes with sufficient accuracy from copper azur[8], or, as he

[1] Introductio in Astrolog. [2] De Morb. Curat. cap. 143.

[3] Chap. xxi. ver. 19. [4] The exposition of Arethas is printed with Œcumenii Comm. in Nov. Test. Paris, 1630, 2 vols. fol.

[5] De Gradibus, quos vocant Simplicium, p. 362. This passage serves further to explain and confirm what I have said respecting Aristotelis Auscultat. Mirab. cap. 59, where we are told that copper-ochre promotes the growth of the hair and of the eye-brows. The works of Constantinus were printed at Basle, 1536–39, in two folio volumes.

[6] Matth. Silvaticus says, "*Lapis lazuli* Latinis, Arabibus *Hager alzenar* sive *alzanar*;" and also, "*Lauzud.* Arab. Azurinum, lapis lazuli."

[7] Speculum Lapidum. Hamb. 1717, 8vo, p. 125.

[8] Of azur there are two sorts, one called by painters *azurro oltramarino*, and the other *azurro dell' Alemagna*. The ultramarine is that made of the stone known by the name of lapis lazuli, which is the proper matrix of gold ore. This stone, after being pounded and washed, is reduced to an impalpable

calls it, the *azurro dell' Alemagna*. At that period, however, the best method of preparing it must have been doubtful as well as little known, and on that account of no great benefit; for, in the beginning of the sixteenth century, the father of the celebrated Giambatista Pigna, an apothecary at Modena, was in possession of the secret for making the best ultramarine, by which he acquired more riches than would have arisen from a large estate[1]. It is not, therefore, altogether true that Alexius Pedemontanus, as Spielmann relates[2], was the first person who mentioned ultramarine. I am of opinion that this Alexius, or Hieronymus Ruscellai concealed under that name, who wrote in the beginning of the sixteenth century, only first published a complete account of the method of preparing it. At any rate, his receipt was long followed as the best and the most certain[3]. But on what information is

powder. It is then brought back to its lively and beautiful colour by means of a certain paste composed with gum, and is refined and freed from all moisture. This kind is that most esteemed; and according to its colour and fineness is purchased at a high price by painters; for it not only adds great beauty to paintings, but it withstands fire and water—two powers which other colours are not able to resist.—Pirotechnia, p. 38. The German azur of Biringoccio is not smalt; for he describes that colour before under the name of *zaffera*.

See also Fallopius, who in 1557 wrote his book De Metallis seu Fossilibus, chap. xxxiii. p. 338, who observes that *ultramarine* was then selling for 100 golden scudi per ounce.

[1] As young Pigna applied too closely to study, Bartholom. Ricci, in a letter still extant, advised him to be more moderate, as he was not compelled by necessity to labour so hard. "Without it," he observes, "you are possessed of an estate sufficiently ample. Farms, country and town houses, the choicest furniture, all your own: besides, you have a father who is as good as a hundred estates to you; who in preparing one blue colour, called ultramarine (to say nothing of his skill and large profits in compounding medicines), has exclusively the secret, and is thereby enabled to acquire great riches, and indeed is daily adding to his store."—Riccii Opera, vol. ii. p. 336; and Tiraboschi Bibliotheca Modenese, vol. iv. p. 134.

[2] Institut. Chemiæ, p. 45.

[3] The work of Alexius Pedemontanus De Secretis is no contemptible source from which materials may be drawn for the technological History of Inventions; and on this account it will perhaps afford pleasure to many if I here give an account of the author, according to such information as I have been able to obtain. Conrad Gesner seems not to have known anything of him, as he is not mentioned either in his Epistolæ Medicinales or his Bibliotheca. Ciaconius, in Bibliotheca Libros et Scriptores fere cunctos complectens, Parisiis, 1731, fol. p. 94, says that his real name was Hieronymus Ruscellai. The same account is given by Haller in Biblioth. Botan., &c.

that assertion founded, which we read in English and French authors [1], that the preparation of ultramarine was found out in England, and that a servant of the East India Company disclosed it, in order to be revenged for some injury which he had sustained?

[The following is the method of making ultramarine from lapis lazuli. The finest mineral is selected, heated to a dull red heat, and quenched in water; it is thus rendered friable, and is ground down into an impalpable powder. This is then mixed with a tenacious paste made of linseed oil, wax, resin, turpentine and mastic; and the mixture being kneaded in

Gobet, in Les Anciens Minéralogistes de France, Paris, 1779, 8vo, ii. p. 705, tells us that this Jerome Ruscellai died in 1565; and that his book was composed from his papers by Franc. Sansovino, who published many works not his own, and printed for the first time at Milan, in 1557. I have nowhere found a particular account of this Ruscellai; and indeed it is always laborious to search out any of that noble family, which I have already spoken in the article Lacmus. He appears to me to be none of those mentioned in Jochers Gelehrten-Lexicon. I have met with no earlier edition of his works than that of 1557: but I suspect that the first must be older. However much the book may have been sought after, it seems to me improbable that three editions should be published in Italian in the course of the first year; for, besides that of Milan, two editions printed at Venice the same year, one in quarto and another in octavo, are still extant. A French translation also was published at Antwerp, in 1557. Is it possible that an English translation could be published at London in 1558, if the original appeared for the first time only in 1557? At that period translations were not made so speedily. The Secrets of Alexis, London, 1558, is mentioned in Ames's Typographical Antiquities, p. 296. I have in my possession a French translation by Christofle Landré, Paris, 1576, 12mo, which I seldom find quoted. It has a large appendix, collected from various authors.

It is well-known that Joh. Jaeob Wecker, a physician at Colmar, translated into Latin this book of Alexius, and enlarged it with additions, under the title of De Secretis Libri xvii. The first edition, as Haller says, was printed at Basle in 1559, 8vo. Every edition seems to differ from the preceding; many things are omitted, and the new additions are for the most part of little importance. I have the edition of Basle, 1592, 8vo, in which there is a great deal not to be found in that of 1662, and which wants some things contained in the edition of 1582. The latest editions are printed from that improved by Theod. Zwinger, Basle, 1701, 8vo. The last by Zwinger, was published at Basle in 1753. Though these books on the arts, as they are called, contain many falsehoods, they are still worthy of some notice, as they may be reckoned among the first works printed on technology, and have as much induced learned men to pay attention to mechanics and the arts, as they have artists to pay attention to books and written information.

[1] See Savary, Dict. de Commerce, art. *Outremer*, which has been copied into Rolt's Dictionary of Trade, Lond. 1756, fol.

warm water gives out the blue particles, which are afterwards collected by subsidence.

Chemists are not agreed concerning the cause of the colour of ultramarine. Dr. Elsner considers it to arise from sulphuret of sodium and of iron, the former being a higher sulphuret than the latter. MM. Clement and Desormes show that the iron is not essential, either to the lapis lazuli, or to the pigment made from it.

An artificial method of making ultramarine was discovered in 1828 by M. Guimet; the process has been kept secret. Processes have also been discovered by M. Gmelin of Tübingen, M. Persoz of Strasburg, and others. M. Gmelin's process consists in fusing a mixture of two parts of sulphur and one of dry carbonate of soda in a Hessian crucible, and then sprinkling into it by degrees another mixture of silicate of soda and aluminate of soda. The crucible must be exposed to the fire for an hour after this. The ultramarine thus prepared contains a little sulphur, which can be separated by means of water.

Some valuable observations on this subject have lately been published by M. Prückner [1]. He states that the materials required in the preparation of ultramarine are alumina, sulphate of soda, sulphur, charcoal and a salt of iron, the common sulphate or green vitriol being the best. The alumina is supplied in white bole, or a very pure white clay. The sulphate of soda is reduced by charcoal and heat to the state of sulphuret, and its solution thus obtained afterwards boiled with sulphur so as to form a persulphuret (penta-sulphuret, Berz.). The solution is then mixed with the dried clay and stirred; during the mixing a solution of green vitriol is added and mixed. It is then dried and very finely powdered as rapidly as possible. It is afterwards heated in a muffle; then washed, drained and again heated in a muffle; finally it is again washed, dried and powdered.]

[1] Chemical Gazette, May 31, 1845.

COBALT, ZAFFER, SMALT.

The name cobalt is given at present to that metal and its ores, the oxides of which are largely employed in the manufactures of glass, porcelain and pottery, for the production of a blue colour. The cobalt ores are first roasted and freed from foreign mineral bodies, particularly sulphur, iron, nickel, bismuth, and arsenic, with which they are united, and then well calcined, and sold, either mixed or unmixed with fine sand, under the name of zaffer (*zaffera*); or the cobalt is melted with siliceous earth and potash to a kind of blue glass called smalt, which, when ground very fine, is known in commerce by the name of powder-blue. All these articles, because they are most durable pigments, and those which best withstand fire, and because one can produce with them every shade of blue, are employed, above all, for tinging crystal and for enamelling; for counterfeiting opake and transparent precious stones, and for painting and varnishing real porcelain and earthen and potters' ware. This colour is indispensably necessary to the painter when he is desirous of imitating the fine azure colour of many butterflies and other natural objects; and the cheaper kind is employed to give a blueish tinge to new-washed linen, which so readily changes to a disagreeable yellow.

The preparation of this new colour may be reckoned among the most beneficial inventions of modern times. It rendered of importance an useless and hurtful production; gave employment to a number of hands; assisted in bringing many arts to a degree of perfection which they could never before attain; and has drawn back to Germany a great deal of money which was formerly sent out of it for foreign articles.

Though there is no doubt that the process used in the preparation of cobalt and smalt was invented about the end of the fifteenth or the beginning of the sixteenth century, we have reason to ask whether the ancients were acquainted with cobalt, and if they employed it for colouring glass. They opened and worked mines in various parts; and it is at any rate possible that they may have found cobalt; they made many successful attempts to give different tints to glass[1]; and they

[1] See what is said under the article Artificial Rubies.

produced blue glass and blue enamel. They may have learned by an accident to make this glass, as they did to make brass; and they may have continued to make the former as long as their supply of coloured earth lasted. When the mineral failed them, they may have lost the art, in the same manner as the method of preparing Corinthian brass [1] was lost for a considerable space of time. The use of cobalt does not imply a knowledge of its metal; for the moderns made brass and smalt for whole centuries, before they learned to prepare zinc and regulus of cobalt.

It seems, however, difficult to answer this question; for one can scarcely hope to discover cobalt with any certainty among those minerals mentioned by the ancients. They could describe minerals in no other manner than according to their exterior appearance, the country where they were found, or the use to which they applied them. Now there is no species more various and more changeable in its figure and colour than cobalt ore, which on this account shows the impossibility of distinguishing minerals with sufficient accuracy by external characteristics. Besides, there are scarcely two passages of the ancients which seem to allude to it; and these, when closely examined, give us little or no information.

The meaning of the term *cadmia* is as various and uncertain as that of the word *cobalt* was two centuries ago. It signified often calamine; sometimes furnace-dross; and perhaps, in later times, also arsenic; but, as far as I know, it was never applied to cobalt till mineralogists wished in modern times to find a Latin term for it [2], and assumed that which did not belong properly to any other mineral. The well-known passage of Pliny [3], in which Lehmann thinks he can with certainty distinguish cobalt, is so singular a medley that nothing to be depended on can be gathered from it. The author, it is true, where he treats of mineral pigments, seems to speak of a blue sand which produced different shades of blue paint, according as it was pounded coarser or finer. The palest powder was called *lomentum*; and this Lehmann considers as our powder-blue. I am however fully convinced that the *cyanus* of Theophrastus, the *cæruleum* of Pliny, and the *chrysocolla* [4], were

[1] See the Annotations on Arist. Auscult. Mirab. p. 98.

[2] I am of opinion that this Latin name for cobalt was first used by Agricola.

[3] Lib. xxxiii. cap. 13. Theophrast. De Lapid. § 97

[4] Aristot. Auscult. Mirab. p. 123.

the blue copper earth often already mentioned, which may have been mixed and blended together. Besides, Pliny clearly adds to it an artificial colour, which in my opinion was made in the same manner as our lake; for he speaks of an earth, which when boiled with plants, acquired their blue colour, and which was in some measure inflammable. With these pigments walls were painted; but as many of them would not endure lime, they could be used only on those which were plastered with clay (*creta*). The expression *usus ad fenestras* has been misapplied by Lehmann, as a strong proof of his assertion; for he explains it as if Pliny had said that a blue pigment was used for painting window-frames; but glass windows were at that time unknown. I suspect Pliny meant to say only that one kind of paint could not be employed near openings which afforded a passage to the light, as it soon decayed and lost its colour. This would have been the case in particular with lake in which there was a mixture of vegetable particles.

For my part, I find in this passage as few traces of smalt as M. Gmelin; and I agree with him in opinion that the strong and unpleasant mixtures arising from cobalt would, had it been known, have induced the ancients to make particular mention of it in their writings. Would not the arsenic, which is so often combined with cobalt, have given occasion to many reports respecting the dangerous properties of these minerals? And would not arsenic and bismuth have been sooner known, had preparations of cobalt been made at so early a period? It is a circumstance of great weight also, that in the places where the ancients had mines, and where antiquities painted or tinged blue, and resembling in colour that produced by cobalt, have been dug up, cobalt has not been discovered, or has been discovered only in modern times. At present we know nothing of Egyptian, Arabian, Ethiopian, Italian, and Cyprian cobalt; and in Spain[1] this mineral was first found in the reign of Philip IV. I shall here observe, that the island of Cyprus was formerly so abundant in copper, that, in a mineralogical sense, it might be called the island of Venus; and we can therefore entertain the less doubt that the *cæruleum Cyprium* was copper-blue.

[1] Bowles, Introducion à la Historia Natural y à la Geographia Fisica de España.—Madrit, 1775 p. 399.

The principal reason, however, why Lehmann, Pauw[1], Ferber, Delaval, and others, think that the ancients used smalt, and were acquainted with cobalt, is that, as has been already said, various antiquities both of painting and enamel have been discovered, in which a blue appears that seems to give grounds for conjecturing that it was produced by cobalt. Ferber[2] speaks of blue glass squares in mosaic-work; and Delaval mentions old Egyptian glass-work of this colour[3]. It is well known also that the Chinese and people of Japan gave to their porcelain that fine blue colour, for which it is celebrated, long before the discovery of smalt in Europe. On mummies a blue is seen likewise, which, even after so many centuries, seems to have lost little or nothing of its beauty[4]. We must therefore allow that the ancients used either ultramarine or cobalt.

The first opinion seems, in regard of porcelain, to be confirmed by Duhalde[5], who speaks of a mine of *azur*, and relates that the Chinese, in modern times, use instead of it, for painting their porcelain, a blue colour brought from foreign countries. It is probable that by the former he means lapis lazuli, and by the latter smalt, which is sent in large quantities from Europe to China. The invention of ultramarine, however, appears to me too new, its effect on porcelain too uncertain, and its price too high to allow us to suppose that it has been much used. We should therefore have been almost obliged to adopt the latter opinion, had not M. Gmelin proved by chemical experiments[6] that it is not only possible to give to glass and enamel a blue colour by means of iron, but that the before-mentioned antiquities, upon which so much stress has been laid, show not the smallest traces of cobalt. He even made experiments upon blue tiles, found in a Roman tessel-

[1] Recherches Philosophiques sur les Egyptiens et les Chinois. Berlin, 1773, i. p. 345.—Delaval's Experimental Inquiry into the Cause of the Changes of Colour in Opake and Coloured Bodies. Lond. 1774, 4to, p. 56.

[2] Briefe aus Welschland. Prag, 1773, 8vo, p. 114, 136, 223.

[3] Blue enameled figures of the Egyptian deities may be found in Marbres de la Galerie de Dresde, tab. 190.

[4] [The blue colour of the glass, of which the beautiful Portland Vase is composed, is owing to cobalt.]

[5] Déscription de la Chine, ii. p. 223, 230, 232. I have, however, often heard, and even remarked myself, that the blue on the new Chinese porcelain is not so beautiful as that on the old.

[6] De Cæruleo Vitro in Antiquis Monumentis, in Comment. Soc. Götting. 1779, vol. ii. p. 41.

lated foot-pavement at Montbeillard; and likewise on the blue paint of the mummy which was presented to our university by the king of Denmark[1]. He has also mentioned various articles on which a blue colour is produced by the vitrification of iron. Of this nature are in particular those slags found near the smelting-houses at the iron-mines of the Harz forest; and I myself have seen slags which were of a blue colour exceedingly beautiful. Volcanic slags, or scoriæ, found in the neighbourhood of Verona, Vicenza, and other parts of Italy, are mentioned also by Ferber[2], which seems to confirm the conjecture of Dr. Bruckmann[3], that the ancients may have used such slags for their works. It is probable that the ancients were first induced by the blue slag of their smelting-houses to make experiments on the colouring of glass with iron, and that in this art they acquired a dexterity not possessed at present, because it was abandoned by our ancestors after the invention of smalt, which is much more beautiful; and which can be used more easily and with more certainty. I cannot, however, deny that I have often lamented this loss when I saw the excellent blue in the painted windows at Gouda, Goslar, and other places; though its beauty is much heightened by the transparency of the glass, and the strong light that falls upon it from without.

I shall now proceed to the invention of the colour prepared from cobalt. About the end of the fifteenth century, cobalt appears to have been dug up in great quantity in the mines on the borders of Saxony and Bohemia, discovered not long before that period. As it was not known at first to what purpose it could be applied, it was thrown aside as a useless mineral. The miners had an aversion to it, not only because it gave them much fruitless labour, but because it often proved prejudicial to their health by the arsenical particles with which it was combined; and it appears even that the mineralogical name *cobalt* then first took its rise. At any rate, I have never met with it before the beginning of the sixteenth century; and Mathesius and Agricola seem to have first used it in their writings. Frisch derives it from the Bohemian word *kow*, which signifies metal; but the conjecture that it

[1] Comment. Soc. Götting. 1781, iv. p. 20.
[2] Briefe, p. 30.
[3] Beytrage zu der Abhand. v. Edelsteinen. Bruns. 1778, 8vo, p. 55.

was formed from *cobalus*, which was the name of a spirit that, according to the superstitious notions of the times, haunted mines, destroyed the labours of the miners, and often gave them a great deal of unnecessary trouble, is more probable; and there is reason to think that the latter is borrowed from the Greek. The miners, perhaps, gave this name to the mineral out of joke, because it thwarted them as much as the supposed spirit, by exciting false hopes and rendering their labour often fruitless[1]. It was once customary, therefore, to introduce into the church service a prayer that God would preserve miners and their works from *kobolts* and spirits.

Respecting the invention of making a useful kind of blue glass from cobalt, we have no better information than that which Klotzsch[2] has published from the papers of Christian Lehmann. The former, author of an historical work respecting the upper district of the mines in Misnia, and a clergyman at Scheibenberg, collected with great diligence every information in regard to the history of the neighbouring country, and died, at a great age, in 1688. According to his account, the colour-mills, at the time when he wrote, were about a hundred years old; and as he began first to write towards the end of the thirty years' war, the invention seems to fall about 1540 or 1560. He relates the circumstance as follows: "Christopher Schurer, a glass-maker at Platten, a place which belongs still to Bohemia, retired to Neudeck, where he established his business. Being once at Schneeberg, he collected some of the beautiful coloured pieces of cobalt which were found there, tried them in his furnace; and finding that they melted, he mixed some cobalt with the vitreous mass,

[1] Mathesius, in his tenth Sermon, p. 501, where he speaks of the *cadmia fossilis*, says, "Ye miners call it *kobolt*; the Germans call the black devil, and the old devil's whores and hags, old and black *kobel*, which by their witchcraft do injury to people and to their cattle."……Whether the devil, therefore, and his hags gave this name to cobalt, or cobalt gave its name to witches, it is a poisonous and noxious metal. Agricola, De Animantibus Subterraneis, says, at the end, "Dæmones, quos Germanorum alii, aut etiam Græci, vocant cobalos, quod hominum sunt imitatores." Bochart, in his Canaan, i. 18, p. 484, gives a Hebrew derivation of κόβαλος. It appears to be the same as *covalus* and *gobelinus*, the latter of which was used by Ordericus Vitalis in the eleventh century as the name of a spirit or phantom. See Menage, Diction. Etymol. i. 681.

[2] Sammlung zur Sächsischen Geschichte, iv. p. 363.

and obtained fine blue glass. At first he prepared it only for the use of the potters; but in the course of time it was carried as an article of merchandize to Nuremberg, and thence to Holland. As painting on glass was then much cultivated in the latter, the artists there knew better how to appreciate this invention. Some Dutchmen therefore repaired to Neudeck, in order that they might learn the process used in preparing this new colour. By great promises they persuaded the inventor to remove to Magdeburg, where he also made glass from the cobalt of Schneeberg; but he again returned to his former residence, where he constructed a handmill to grind his glass, and afterwards erected one driven by water. At that period the colour was worth seven dollars and a half per cwt., and in Holland from fifty to sixty florins. Eight colour-mills of the same kind, for which roasted cobalt was procured in casks from Schneeberg, were soon constructed in Holland; and it appears that the Dutch must have been much better acquainted with the art of preparing, and particularly with that of grinding it, than the Saxons; for the elector John George sent for two colour-makers from Holland, and gave a thousand florins towards enabling them to improve the art. He was induced to make this advance chiefly by a remark of the people of Schneeberg, that the part of the cobalt which dropped down while it was roasting contained more colour than the roasted cobalt itself. In a little time other colour-mills were erected around Schneeberg. Hans Burghard, a merchant and chamberlain of Schneeberg, built one by which the eleven mills at Platten were much injured. Paul Nordhoff, a Frieslander, a man of great ingenuity, who lived at the Zwitter-mill, made a great many experiments in order to improve the colour, by which he was reduced to so much poverty that he was at length forced to abandon that place, where he had been employed for ten years in the colour-manufactory. He retired to Annaberg, established there in 1649, by the assistance of a merchant at Leipsic, a colour-manufactory, of which he was appointed the director; and by these means rendered the Annaberg cobalt of utility. The consumption of this article however must have decreased in the course of time; for in the year 1659, when there were mills of the same kind at more of the towns in the neighbourhood of mines, he had on hand above 8000 quintals." Thus far Lehmann.

This information is in some measure confirmed by Melzer[1], who says that the mines of Schneeberg, which were first discovered in the middle of the fifteenth century, had declined so much towards the middle of the sixteenth, that it was impossible to get any profit by them till the year 1550, when a greater advantage arose from the new method of using cobalt. About this period a contract was entered into with the Dutch, who agreed to take the roasted cobalt at a certain price. Lehmann[2] says, but without adducing any proofs, that a manufactory for making blue glass was erected by Sebastian Preussler, between Platten and Eybenstock, so early as 1571. Rossler[3], who died in 1673, in the seventy-sixth year of his age, gives us to understand that a century and a half before his time, cobalt was procured and sold as zaffer; but that the colour-mills in the country had been established only about sixty years. I conjecture therefore that the roasted cobalt, to which sand was added, in order that the nature of it might be better concealed, and the further preparation of it rendered more difficult, was given up to the Dutch, even so early as the beginning of the sixteenth century[4], and that these people by melting it anew, or at any rate by pounding it finer, derived the greatest benefit from it long before the Saxons themselves constructed mills according to the model of those used in Holland. At present many Dutchmen grind German cobalt with very great advantage[5].

[1] Melzer's Berglauftige Beschreibung der Stadt Schneeberg, 1684, 4to, p. 405. The same account is given in his Historia Schneebergensis, 1716, 4to. In these works one may see the dispositions made from time to time by the electors of Saxony, to support this highly profitable manufacture. The latest information on this subject is to be found in Hoffmann's Abhandlung über die Eisenhütten, Hof. 1785, 4to. [2] Cadmiologia, i. p. 14.

[3] Speculum Metallurgiæ Politissimum. Dresden, 1700, fol. p. 165.

[4] I say, in the beginning of the sixteenth century, on the authority of the following information in Melzer, which seems not to have been noticed by others:—"Peter Weidenhammer, a Franconian, came hither poor; but by means of a colour he procured from pounded bismuth, and of which he exported many quintals to Venice, at the rate of twenty-five dollars per quintal, he soon acquired great riches, and built a beautiful house in the market-place. His name is inscribed in the lower window of the chancel of the great church, with the date 1520." At that period a great deal of this paint was prepared at Venice, and it may therefore be easily comprehended how Vannuccio could be so early acquainted with zaffera.

[5] How early manufactories for blue paint were erected beyond the

It appears that this new colour was not made known in books till a late period. Agricola was not acquainted with the blue glass, nor is zaffera mentioned either by him or Mathesius. Albin also, who indeed derived the greater part of his information from these two writers, says not a word respecting it; but he tells us that bismuth when put in vessels grew together again[1]. He seems therefore to allude to cobalt roasted and mixed with sand, which when packed up becomes a solid body, whereas bismuth which has been purified by roasting can never assume that state. Vanuccio Biringoccio, the oldest writer in whose works I have as yet observed the name *zaffera*, describes its use for painting glass, and calls it a heavy mineral, without defining it any further. Cardan[2] gives the name of zaffera to an earth which colours glass blue. Cæsalpin says it is a stone[3]; and Julius Scaliger must have known as little of it, else he would have mentioned it in his Exercitations on Cardan. Porta, who employed great diligence to acquire knowledge of this kind, often mentions *zaphara figlinorum*, without telling us what it is; but he describes how it must be melted, poured into water, pounded, sifted, and reduced into a fine powder in order to be employed for making artificial precious stones[4]. Neri, who wrote about the year 1609[5], knew nothing more of it; and Merret, the commentator on Neri, who lived in the middle of the sixteenth century[6], confesses that he knew not what zaffera was, but he believed that it was a new German invention, at least that it was brought from Germany, and that it seemed to him to be made from copper and sand, with the addition perhaps of calamine. The first person who properly explained zaffera in his writings, and gave a correct account of the method of preparing it, is, in my opinion, Kunkel[7] in his annotations on Neri and Merret. That writer says, zaffera was by the miners called *zafloer*, and that sand was mixed with it only that the

boundaries of Saxony and Bohemia I do not know, as I have found no information on that subject. We are however told by Calvor, in Beschreibung des Maschinenwesens am Oberharze, ii. p. 202, that a person was engaged to superintend the blue-paint-manufactory at St. Andreasberg in the year 1698.

[1] Meisnische Bergchronik, p. 133, tit. 16. [2] Lib. v. De Subtil.
[3] Lib. ii. cap. 55. [4] Magiæ Naturalis lib. vi.
[5] De Arte Vitriaria. Amst. 1668, 12mo, lib i. cap. 12, p. 32.
[6] Ibid. p. 327. [7] Glasmacherkunst. Nurnb. 1743, 4to, p. 46.

powder-blue used by women for linen, and by painters called blue smalt, might not be imitated in other countries.

Rosler says the Bohemian cobalt is not so good as that of Misnia, and that its colour is more like that of ashes. That Brandt, a member of the Council of Mines in Sweden, first asserted that cobalt contained a peculiar kind of metal, must be so well known to mineralogists, that it scarcely deserves to be mentioned[1].

TURKEYS.

That these fowls, which at present are everywhere common, were brought to us from a different part of the world, is, I believe, generally admitted; but respecting their original country, and the time when they were first introduced into Europe, there is much difference of opinion among those who in later times have made researches on that subject[2]. I shall therefore compare what has been advanced on both sides with what I have remarked myself, and submit my decision to the judgement of the reader.

The question, whether turkeys or turkey-fowls were known to the Greeks and the Romans, will depend upon defining what those fowls were to which they gave the name of *meleagrides* and *gallinæ Africanæ*; for in the whole ornithology of the ancients, there are no other kind that can occasion doubt. It has however been justly remarked by Perrault and others, that every thing which we find related by the ancients of the *meleagrides* can be applied only to the pintado or Guinea fowl (*Numida meleagris*, Linn.), and not to the turkey; and that the *gallinæ Africanæ* were only a variety of the former, or a

[1] Act. Lit. et Scient. Upsal, 1733. Wallerii Syst. Min. ii. p. 164.

[2] The principal works in which information may be found on this subject, are Perrault in Mémoires de l'Académie Royale des Sciences depuis 1666 jusqu'à 1699.—Traité de la Police, par De la Mare, ii. p. 726.—Buffon, Hist. Nat.—Pallas, Spicilegia Zoologica, fascic. iv. p. 16.—Pennant, in the Philosophical Transactions, vol. lxxi. part i. p. 72.—Pennant's Arctic Zoology, vol. ii.—Miscellanies by Daines Barrington. London, 1781, 4to, p. 127.

species that approached nearly to them. Their spots, disposed in such a manner as if formed by drops, on account of which, in modern times, they have been called *pintados* and *pientades*, and the marks on the feathers of the wings, accord perfectly with the description given of them by Clytus, the scholar of Aristotle[1]; though in northern countries, some Guinea fowls are found, the colour of which is more mixed with white. But this is a variation not uncommon among birds in general when removed from their native country, as is proved by the white peacocks, which were first observed in Norway. The coloured hood of thick skin which covers the head has also been accurately described by Clytus, as well as the coloured fleshy excrescence on the bill (*palearia carunculacea*). In size the *meleagrides* were like our largest common fowls, which is true also of the pintado; and we must acknowledge with Clytus, that its naked head is too small in proportion to the body. The figure of the pintado, like that of the partridge, and its drooping tail, correspond equally well with the epithet *gibberæ*, especially as the position of its feathers occasions its back to appear elevated or bent upwards. The feet are like those of the domestic fowl, but they are destitute of the spurs with which those of the latter are furnished; and the pintado lays spotted eggs, as described by Aristotle; but these, by the manner in which the fowls are reared in Europe, are liable to variations. It deserves to be remarked above all, that both sexes of the *meleagrides* are so like, that they can scarcely be distinguished; and this circumstance alone is sufficient to confute those who pretend that the *meleagrides* were our turkeys. Had that been the case, it is impossible that Clytus in his description, which seems to have been drawn up with great care, should have omitted the proud and ridiculous gestures of the turkey-cock when he struts about with his tail spread out like a fan, or thrown into a circular form, and his wings trailing on the ground, or the long excrescence that hangs down from his bill, and the tuft of black hair on his breast. The un-

[1] Athenæus, Deip. lib. xiv. p. 655. Most of those passages of the ancients in which this fowl is mentioned have been collected by Gesner, in his Histor. Avium, p. 461, and by Aldrovandus in his Ornithologia, lib. xiii. p. 18. When we consider the feathers as delineated by Perrault, we shall find the comparison of Clytus more intelligible than it has appeared to many commentators.

pleasant cry, and the unsocial disposition of the *meleagrides*, are observed in the Guinea fowls, which, as the ancients justly remarked, frequent rivers and marshes, where turkeys on the other hand never thrive.

The ancients assure us that the native country of the *meleagrides* was Africa[1], where the Guinea fowls are still found in a wild state, but where our turkeys were never seen wild. When writers however mention places not in Africa, to which the former were brought, we are not to suppose that they were carried thither directly from Africa. The difference which Columella and Pliny[2] make between the *meleagrides* and *gallinæ Africanæ* is so trifling, as to imply only a variety of the species; and the opinion of Pallas, who has occasionally collected a number of important observations which may serve to explain the natural history of the ancients, is highly probable, that we are to understand under it the *Numida mitrata*, which he has described. The red crest which the last-mentioned bird always has, and which almost alone distinguishes it from the common Guinea fowl, seems fully to prove this opinion[3]. I shall here take occasion to remark, that Buffon erroneously affirms that the Guinea fowls, which were transmitted from the Greeks and the Romans, be-

[1] Plin. Strabo. The following passage of the Periplus Scylacis, p. 122, which I have never found cited in the history of the *meleagrides*, is worthy of remark. This geographer, speaking of a lake in the Carthaginian marshes, says, "Circa lacum nascitur arundo, cyperus, stœbe et juncus. Ibi meleagrides aves sunt; alibi vero nusquam nisi inde exportatæ."

[2] Columella, viii. 2, 2, p. 634.

[3] I have here quoted nothing more than what I thought requisite to prove that the *meleagrides* of the ancients were our Guinea fowls, because I had no intention of treating fully on a subject which has been handled by so many others; and because I had only to show that they were not turkeys. Had not this been the case, it would have been necessary for me to collect into one point of view everything that the ancients have said of these fowls, with the words used by the different writers. It may however be said, that by this mode of examining a disputed point, a mode indeed practised by many, the reader may be led to an ill-founded approbation, because what is not agreeable to the author's assertion may be easily concealed. But this observation is not applicable to me; for I confess that I do not know with certainty whether the Guinea fowls are as careless of their young as the *meleagrides* are said to have been; whether their cry, which I have often enough heard, and which is indeed unpleasant, agrees with the κακκάζειν of Pollux, v. § 90; and whether the ἀλεκτρυόνες μεγέθει μέγιστοι, mentioned in Ælian's Hist. Animal. xvi. 2, belong to the Guinea fowls, or, as Pennant will have it, to the *Pavones bicalcarati*.

came extinct in Europe in the middle ages; for we find mention made of them in English writers, under the name of *Aves Africanæ, Afræ*, so early as about the year 1277[1].

That the ancients were not acquainted with our turkeys is still further confirmed by the testimony of various historians and travellers, who assure us in the first place, that these birds are still wild in America; secondly, that they were brought to us from that country; and thirdly, that before the discovery of the New World they were not known in Europe. Besides, we are enabled, from the information which they give us, to see how and when these animals were conveyed to those countries where they at present are reared as domestic fowls; and these proofs appear to me so strong, that I conclude Barrington asserted the contrary, that he might obtain assent not so much by the force of truth as by advancing absurdities. All animals multiply more easily, and become larger, stronger, and more fruitful in those places which nature has assigned to them for a residence, that is, where they originally lived wild; and this observation seems to hold good in regard to the turkeys in America. It is indeed probable that the number of wild animals will always decrease in proportion as countries are peopled, and as woods are cut down and deserts cultivated; it is probable also, that at last no wild animals will be left, as has been the case with sheep, oxen and horses, which have all long ago been brought into a state of slavery by man. The testimony therefore of those who first visited America, and who found there wild turkeys, deserves the greater attention.

The first author in whom I find mention of them is Oviedo, who wrote about the year 1525[2]. He has described them minutely with that curiosity and attention which new objects generally excite; and as he was acquainted with no name for these animals, till then unknown to the Europeans, he gave them that which he thought best suited to their figure and shape. He calls them a kind of peacocks, and he relates that even then, on account of their utility, and the excellent taste

[1] Kennet's Parochial Antiquities, p. 287. The *meleagrides* also, which Volateran saw at Rome in 1510, were of the same kind.

[2] Sommario dell' Ind. Occid. cap. 3. In the third volume of the Collection of Voyages by Ramusio, Oviedo describes them with great minuteness, which it is unlikely he would have done had these fowls been so well known in Europe as Barrington thinks they were.

of their flesh, they were not only reared and domesticated by the Europeans in New Spain, where they were first found, but that they were carried also to New Castille, and to the West India islands. The other fowls likewise which he describes we have without doubt procured from America, such for example as the *Crax alector*[1]. Lopez de Gomara, whose book was printed in 1553, makes use of the name *gallopavo*; and says that the animal resembles in shape the peacock and the domestic cock; and that of all the fowls in New Spain its flesh is the most delicious[2]. In the year 1584 wild turkeys were found in Virginia[3]. René de Laudonniere found them on his landing in North America in 1564[4]. Fernandez also reckons them among the birds of Mexico; and takes notice of the difference between those that were wild and those which had been tamed[5]. Pedro de Ciesa saw them on the isthmus of Darien[6], and Dampier in Yucatan[7]. Besides the testimony of many other later travellers which have been already quoted by Buffon, and which I shall not here repeat, the accounts of Kalm and Smyth in particular deserve to be noticed. The former, who visited Pennsylvania in 1784, says, "The wild turkeys run about here in the woods. Their wildness excepted, they are in nothing different from ours, but in being generally a little larger, and in having redder flesh, which is, however, superior in taste. When any one finds their eggs in

[1] The peacock pheasant of Guiana, Bancroft; Quirissai or Curassao, Brown; the crested curassow, Latham.

[2] Hist. de Mexico, p. 343. [3] Hakluyt, vol. iii. p. 274.

[4] Pennant quotes also De Bry, but that author I never consulted.

[5] "Huexolot gallus est Indicus, quem gallipavonem quidam vocant, noruntque omnes."—Thesaur. Rerum Med. Novæ Hispaniæ, in Append. Barrington remarks that Fernandez would not have said *quem norunt omnes*, had these animals been first made known from America; for Mexico was discovered in 1519, and Fernandez appears to have written about 1576. This reason, however, appears to me of little weight; especially as it is certain that these fowls, like many other productions which excited universal curiosity, were soon everywhere common. Besides, it is not certain that these words were really written by Fernandez.

[6] An English translation of Ciesa's Voyage may be found in Stevens's New Collection of Voyages and Travels.

[7] Vol. ii. part ii. p. 65, 85, 114. Leri seems also to have found them in Brazil, see Laet, in his Novus Orbis, Lugd. Bat. 1633, fol. p. 557. As his description, however, is not clear, and as the diligent Marggraf does not mention it among the animals of Brazil, this information appears to be very uncertain.

the woods, and places them under a tame hen to be hatched, the young, for the most part, become tame also; but when they grow up they make their escape. On this account people cut their wings before they are a year old. These wild turkeys, when tamed, are much more mischievous than those tamed by nature[1]." Smyth assures us that wild turkeys are so abundant in the uncultivated country behind Virginia, and the southern provinces, that they may be found in flocks of more than five thousand[2].

These testimonies, in my opinion, are sufficiently strong and numerous to convince any naturalist that America is the native country of these fowls; but their weight will be still increased if we add the accounts given us when and how they were gradually dispersed throughout other countries. Had they been brought from Asia or Africa some centuries ago, they must have been long common in Italy, and would have been carried thence over all Europe. We, however, do not find that they were known in that country before the discovery of America. It is certain that there were none of them there at the time when Peter de Crescentio wrote, that is to say, in the thirteenth century[3]; else he would not have omitted to mention them where he describes the method of rearing all domestic fowls, and even peacocks and partridges. The earliest account of them in Italy is contained in an ordinance issued by the magistrates of Venice, in 1557, for repressing luxury, and in which those tables at which they were allowed are particularised. About the year 1570 Bartolomeo Scappi, cook to pope Pius V., gave in his book on cookery several receipts for dressing these expensive and much-esteemed fowls[4]. That they were scarce at this period appears from its being remarked that the first turkeys brought to Bologna were some

[1] Kalm's Reise, ii. p. 352.

[2] Tour in the U. S. of America, by J. F. D. Smyth, 1784, 2 vols. 8vo.

[3] Crescentio lived about the year 1280. [His work Ruralium Commodorum lib. xii. was first printed in 1471.]

[4] Opera di M. Bartolomeo Scappi, Venet. 1570, 4to. The copy in the library of our university contains eighteen copper-plates, which represent different kitchen utensils, and various operations of cookery. Among the former is a smoke-jack, *molinella a fumo*. I am inclined to think that turkeys at this period were very little reared by farmers; for I do not find any mention of them in Trattato dell' Agricoltura, di M. Affrico Clemente, Padovano, in Venetia 1572, 12mo; though the author treats of all other domestic birds.

that had been given as a present to the family of Buonocompagni, from which Gregory XII., who at that time filled the papal chair, was descended.

That these fowls were not known in England in the beginning of the sixteenth century, is very probable; as they are not mentioned in the particular description of a grand entertainment given by archbishop Nevil[1]; nor in the regulations made by Henry VIII. respecting his household, in which all fowls used in the royal kitchen are named[2]. They were, however, introduced into that country about the above period; some say in the year 1524; others, in 1530; and some, in 1532[3]. We know, at any rate, that young turkeys were served up at a great banquet in 1555[4]; and about 1585 they were commonly reckoned among the number of delicate dishes[5].

According to the account of some writers, turkeys must have been known much earlier in France; but on strict examination no proofs of this can be found. The earliest period assigned for their introduction into that country is given by Beguillet[6], who confidently asserts that they were brought to

[1] It is certain that the name does not occur in the List of archbishop Nevil's feast, nor is it mentioned in the Earl of Northumberland's Household-book, so late as the year 1512. See Latham's Birds.

[2] This order, which is worthy of notice, may be found in the Archæologia, vol. iii. p. 157.

[3] Anderson, Hist. Commerce. Hakluyt, ii. p. 165, gives the year 1532; and in Barnaby Googe's Art of Husbandry, the first edition, printed in 1614, as well as in several German books, the year 1530 is mentioned.

[4] Dugdale's Origines Juridiciales, 1671, p. 135.

[5] Pennant quotes the following rhyme from Tusser's Five Hundred Points of Husbandry:—

> Beefe, mutton and porke, shred pies of the best,
> Pig, veale, goose and capon and turkie well drest;
> Cheese, apples and nuts, jolie carols to heare,
> As then in the countrie, is counted good cheare.

These lines he places in the year 1585, in which the edition he quotes was printed; but as there was an edition in 1557, a question arises whether they are to be found there also. [They are not there.—Ed.]

[6] Déscription du Duché de Bourgogne, par MM. Courtépée et Beguillet. Dijon, 1775, 8vo, vol. i. p. 193, and in Déscription Générale et Particulière de la France, Paris, 1781, fol. In the Description of Burgundy, p. 196, the following passage occurs:—"C'est sous le règne de Philippe le Hardi, que les gelines d'Inde furent apportées d'Artois à Dijon en 1385; ce qui montre la fausseté de la tradition, qui en attribue l'apport à l'Amiral Chabot au seizième siècle. Cent ans avant Chabot, Jaques Cœur en avoit trans-

Dijon under the reign of Philip the Bold, about the year 1385. Had this French author quoted his authority, we might have discovered what gave rise to his mistake; but as he has not, one cannot help suspecting that the whole account is a fiction of his own. De la Mare also is in an error when he relates that the first turkeys in France were those which Jaques Cœur, the well-known treasurer to Charles VII., brought with him from the Levant, and kept on his estate in Gatinois, after he had received the king's permission to return to the kingdom. This Cœur, however, who was banished in 1450, never returned, but died in the island of Chio in the year 1456[1]. Equally false is the account given by Bouche in his History of Provence, that René, or Renatus, king of Naples and duke of Anjou, first brought turkeys into the kingdom, and reared them in abundance at Rosset[2]. This author gives as his authority the oral tradition of the neighbourhood, which certainly cannot be put in competition with testimony of a more authentic nature. Another Bouche[3], who a few years ago wrote also a History of Provence, and who has collected many things that do honour to Renatus, makes no mention of this service, though he could not be ignorant of what had been before related by his namesake. Had these fowls been known so early as the time of that monarch, who died in 1480, it is impossible that they could have been so scarce in France as they really were above a hundred years after. The assertion, often repeated, but never indeed proved, that they were first brought to France by Philip de Chabot, admiral under Francis I., is much more probable. Chabot died in 1543; and what Scaliger says, that in 1540 some turkeys were still remaining in France, may be considered as alluding to the above circumstance. This much however is certain, that Gyllius, who died in 1555, gave soon after the first scientific description of them, which has been inserted both by Gesner and Aldrovandus in their works on ornithology. The same year

porté de Turquie en son château de Beaumont en Gatinois, et Americ Vespuce en Portugal."—What impudence to make such an assertion without any proof!

[1] See the works which give a particular account of this Jacques Cœur, and which have been quoted by Meusel in Algemeine Welt Historie, xxxvii. p. 615. [2] La Chorographie ou Déscription de Provence, par Honoré Bouche, Aix, 1664, 2 vols. fol. ii. p. 479. [3] Essai sur l'Histoire de Provence, à Marseille, 1785. 2 vols. 4to.

the first figure of them was published by Bellon. About the same time they were described also by La Bruyere-Champier, who expressly remarks that they had a few years before been brought to France from the Indian islands discovered by the Portuguese and the Spaniards[1]. How then could Barrington assert that this Frenchman meant the East and not the West Indies? They must, however, have been a long time scarce in France; for, in the year 1566, when Charles IX. passed through Amiens, the magistrates of that place did not disdain to send him, among other presents, twelve turkeys[2]. This information seems to agree with the account often quoted, that the first turkeys were served up, as a great rarity, at the wedding dinner of that monarch in the year 1570[3]; but it seems the breed of these fowls was not very common under Charles IX.; for they are not named in the ordinances of 1563 and 1567, in which all other fowls are mentioned. In the year 1603, Henry IV. caused higglers to be punished who carried away turkeys from the country villages without paying for them, under a pretence that they were for the use of the queen[4]. I shall here also remark, that I can nowhere find that the Jesuits are entitled to the merit of having introduced these fowls into France[5].

As these American fowls must have been carried to Germany through other lands, we cannot expect to find them in that country at an earlier period. Gesner, who published his Ornithology in 1555, seems not even to have seen them. We are, however, assured by several authors, such as B. Heresbach[6], Colerus[7] and others, that turkeys were brought to

[1] De Re Cibaria, lib. xv. cap. 73, p. 632. This work was first published by the author in 1560, but it was written thirty years before. Turkeys, therefore, at any rate, must have been in France in 1630.

[2] Histoire de la Vie Privée des Français, par Le Grand d'Aussy, i. p. 292.

[3] Anderson. Keysler's Travels.

[4] This is related by Le Grand, from the Journal of L'Etoile.

[5] "On lit, dans l'Année Littéraire, que Boileau, encore enfant, jouant dans une cour, tomba. Dans sa chute, sa jaquette se retrousse; un dindon lui donne plusieurs coups de bec sur une partie très-délicate. Boileau en fut toute sa vie incommodé; et de-là, peut-être, cette sévérité de mœurs, ... sa satyre contre les femmes..... Peut-être son antipathie contre les dindons occasionna-t-elle l'aversion secrette qu'il eut toujours pour les Jésuites, qui les ont apportés en France."—Helvetius de l'Esprit. Amst. 1759, 12mo. i. p. 288.

[6] De Re Rustica. Spiræ Nemet. 1595, 8vo, lib. iv. p. 640.

[7] Hausbuch, vol. iv. Wittenberg, 1611, 4to, p. 499.

Germany so early as 1530; and in the same year carried to Bohemia and Silesia[1]. Respecting the northern countries, I know only, on the authority of Pontoppidan, that they had been in Denmark two hundred years before his time.

As these fowls are found at present both in Asia and Africa, it may be worth while to inquire at what period they were carried thither, especially as these quarters of the world have been by some considered as their native countries. In China there are no other turkeys than those which have been introduced from other parts, as we are expressly assured by Du Halde, though he erroneously adds that they were quite common in the East Indies. They were carried to Persia by the Armenians and other trading people, and to Batavia by the Dutch[2]. In the time of Chardin they were so scarce in Persia that they were kept in the Emperor's menagerie[3]. In the kingdom of Congo, on the Gold Coast, and at Senegal, there are none but those belonging to the European factories. According to Father de Bourzes there are none of them in the kingdom of Madura; and we are told by Dampier that this is the case in the island of Mindanao. Prosper Alpinus also gives the same account in regard to Nubia and Egypt; and Gemelli Carreri says there is none of them in the Philippines; though I agree with Buffon in laying very little stress upon the Travels known under that name, which we have reason to suppose not genuine.

[1] Œkonomische Nachrichten der Schlesischen Geselschaft, 1773, p. 306. For the festival of the university of Wittenberg, in 1602, fifteen Indian or Turkey fowls were purchased at the rate of a florin each. They were in part dressed with lemon-sauce.

[2] Bell's Travels, i. p. 128.

[3] "Turkeys (*poulets d'Inde*) are there foreign and scarce birds. The Armenians, about thirty years ago, carried from Constantinople to Ispahan a great number of them, which they presented to the king as a rarity; but it is said that the Persians, not knowing the method of breeding them, gave in return the care of them to these people, and assigned a different house for each. The Armenians, however, finding them troublesome and expensive, suffered them almost all to perish. I saw some which were reared in the territory of Ispahan, four leagues from the city, by the Armenian peasants; but they were not numerous. Some imagine that these birds were brought from the East Indies; but this is so far from being the case, that there are none of them in that part of the world. They must have come from the West Indies, although they are called *coqs d'Inde* because, being larger than common fowls, they in that resemble the Indian fowls, which are of much greater size than the common fowls of other countries."—Voyages de Chardin, iv. p. 84.

It is worthy of remark, that Cavendish found a great number of turkeys in the island of St. Helena so early as the year 1588; and Barrington misapplies this circumstance to prove that these fowls did not come from America. It is, however, very doubtful whether Cavendish really meant our turkeys, as he says, "Guiney cocks, which we call turkeys[1];" for the first name belongs to what are at present called pintados; and it is therefore uncertain which kind ought here to be understood. But even allowing that they were turkeys, is it improbable that they should be on an island which had often been visited by the Portuguese? The account of De la Croix is of as little weight; for he says that in the woods of Madagascar there are many *coqs d'Inde*[2]. De la Croix published his book in 1688, at which time there were in South America wild horses and wild cattle. Does this, therefore, invalidate the certainty of these animals being carried thither from Europe?

I intended to enter into a critical examination of those grounds upon which Barrington endeavours to prove that turkeys were originally brought from Africa; but on reading over his essay once more, I find the greater part of his arguments are sufficiently refuted by what I have proved from the most authentic testimony; and nothing now remains but to add a few observations. Barrington considers it improbable that these fowls should be so soon spread all over Europe, as Cortez first visited Mexico in 1519, subdued the capital in 1521, and returned to Spain in 1527. To me, however, it does not appear incredible; for I could prove by several instances, that the curiosity excited by the most remarkable American productions soon became general. Those, for example, who take the trouble to inquire into the history of maize or Turkish corn will make the same remark; though it is a truth fully established that we procure that grain from America. How soon did tobacco become common! In the year 1599 the seeds were brought to Portugal; and in the beginning of the seventeenth century it began to be cultivated in the East Indies. When Barrington asserts that these fowls were carried to America by the Europeans, in the same manner as horses and cattle, this argument may be turned against himself; for he must doubtless find it equally improbable that

[1] Hakluyt, ii. p. 825.

[2] Rélation Universelle d'Afrique. Lyon 1688, iv. p. 426.

they should so soon become common, numerous and wild, in the New World, as they must have been according to the authorities above quoted.

As many fat turkeys were purchased yearly in Languedoc and sent to Spain in the time of cardinal Perron[1], it is thence concluded that these fowls were not brought to France through the latter. Perron died in 1620. At that period turkeys were very common; and whoever is acquainted with the industry of the Spaniards will not find it strange that the French should begin earlier to make the rearing of these animals an employment. How falsely should we reason, were we to say that it is impossible the English and French should procure the best wool from Spain, because the Spaniards purchase the best cloth from the French and the English!

One proof by which Barrington endeavours to show that turkeys were esteemed so early as the fifteenth century is very singular. He quotes from Leland's Itinerary that *capons of Grease* were served up at an entertainment, under Edward IV., in 1467. The passage alluded to I cannot find; but an author must be very self-sufficient and bold indeed, to convert *capons of Grease* into *capons of Greece*, and to pretend that these were turkeys[2].

What, however, most excites my surprise is, that the name of these fowls even should be assumed by this writer as a ground for his assertion. Had they, says he, been brought from America, they would have been called American or West Indian fowls; as if new objects had names given to them always with reflection. Names are often bestowed upon objects before it is known what they are or whence they are procured. Ray, Minshew[3], and others have been induced by the name turkey-fowls to consider Turkey as their original country; but whoever is versed in researches of this kind must know that new foreign articles are often called Turkish, Italian, or Spanish. Is Turkey the original country of maize? or is Italy the original country of these birds, because they have been sometimes called Italian fowls? Even allowing that turkeys had acquired their German name (*kalekuter*) from Calicut, this, at any rate, would prove nothing further than that it was once falsely believed that these animals were brought

[1] Perroniana, p. 67. [2] Leland's Itinerary. Oxford, 1744, vol. vi. p. 5.
[3] Minshew's Guide into Tongues, 1617, fol.

from Calicut to Europe: but I suspect that the appellation *kalekuter*, as well as the names *truthenne*, *putjen*, and *puten*, were formed from their cry. Chardin offers a conjecture which is not altogether to be neglected. That traveller thinks that these fowls were at first considered as a species of the domestic fowl, and that they were called Indian, because the largest domestic fowls are produced in that country

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BUTTER.

Milk, the most natural and the commonest food of man, is a mixture of three component parts, whey, butter, and cheese. The caseous part is viscous; the butter is the fat, oily, and inflammable part, and properly speaking, is not perfectly dissolved in the serum or whey, but rather only diffused through it like an emulsion, so that it may be separated by rest alone, without any artificial preparation. When milk is in a state of rest, the oily part rises to the surface, and forms what is called cream. When the milk has curdled, which will soon be the case, the caseous parts separate themselves from the whey; and this separation may be effected also by the addition of some mixture, through means of which the produce is liable to many variations. The caseous part, when squeezed and mixed with salt, and sometimes herbs, and when it has been moulded into a certain form and dried, is used under the name of cheese, which will always be better, the greater the butyraceous part is that has been left in it. The cream skimmed, and by proper agitation in a churn or other vessel separated from the whey and caseous parts, becomes our usual butter.

This substance, though commonly used at present in the greater part of Europe, was not known, or known very imperfectly, to the ancients[1]. The ancient translators of the

[1] The works with which I am acquainted that treat on this subject, are the following:—M. Schoockii Tractatus de Butyro: accessit ejusdem Diatriba de aversatione Casei. Groningæ, 1664, 12mo.—H. Conring De habitus corporum Germanicorum antiqui et novi caussis. Helmst. 1666, 4to, or Frankf. 1727, 8vo.—Vossii Etymologicon, art. Butyrum.—Traité de la

Hebrew writers[1] seem however to have thought that they found it mentioned in Scripture[2]: but those best acquainted with biblical criticism, unanimously agree that the word *chamea* signifies milk or cream, or sour thick milk, and at any rate does not mean butter[3]. The word plainly alludes to something liquid, as it appears that *chamea* was used for washing the feet, that it was drunk, and that it had the power of intoxicating; and we know that mares'-milk, when sour, will produce the like effect. We can imagine streams of milk, but not streams of butter. This error has been occasioned by the seventy interpreters, who translate the Hebrew word by the word *boutyron*. These translators, who lived two hundred years after Hippocrates, and who resided in Egypt, might, as Michaelis remarks, have been acquainted with butter, or have heard of it; but it is highly probable that they meant cream, and not our usual butter. Those who judge from the common translation, would naturally conclude that the passage in Proverbs, chap. xxx., describes the preparation of butter by shaking or beating; but the original words signify squeezing or pressing, *pressio, frictio mulgentis educit lac*; so that milking and not making butter is alluded to.

The oldest mention of butter, though it is indeed dubious and obscure, is in the account given of the Scythians by Herodotus[4]. "These people," says he, "pour the milk of their

Police, par De la Mare, lib. v. 7. ii. p. 799.—Tob. Waltheri Dissert. de Butyro. Altorfii, 1743.—Conr. Gesneri Libellus de lacte et operibus lactariis, 1543, 8vo. This small treatise I have hitherto sought for in vain.

[1] Bochart, Hierozoicon, ii. 45, p. 473.

[2] Genesis, chap. xviii. ver. 8: "And he took butter and milk, and the calf which he had dressed, and set before them." Deuteron. chap. xxxii. ver. 14: "Butter of kine and milk of sheep." Judges, chap. v. ver. 25: "He asked water, and she gave him milk; she brought forth butter in a lordly dish." 2 Samuel, chap. xvii. ver. 29: "And honey, and butter, and sheep." Job, chap. xx. ver. 17: "He shall not see the rivers, the floods, the brooks of honey and butter." Ibid. chap. xxix. ver. 6: "When I washed my steps with butter and the rock poured me out rivers of oil." Proverbs, chap. xxx. ver. 33: "Surely the churning of milk bringeth forth butter." Isaiah, chap. vii. ver. 15: "Butter and honey shall he eat, that he may know to refuse the evil and choose the good." Ibid. ver. 22: "And it shall come to pass, for the abundance of milk that they shall give, that he shall eat butter; for butter and honey shall every one eat that is left in the land."

[3] Michaelis Suppl. ad Lex. Hebr. v. i. p. 807; and his Mosaisches Recht (on the Laws of Moscs), § 291 and 295.

[4] iv. 2. p. 281: "Postquam emulxere lac, in cava vasa lignea diffundunt;

mares into wooden vessels, cause it to be violently stirred or shaken by their blind slaves, and separate the part that arises to the surface, as they consider it more valuable and more delicious than that which is collected below it." The author here certainly speaks of the richest part of the milk being separated from the rest by shaking; and it appears that we have every reason to suppose that he alludes to butter, especially as Hippocrates, who was almost contemporary, mentions the same thing, but in a much clearer manner[1]. "The Scythians," says the latter, "pour the milk of their mares into wooden vessels, and shake it violently; this causes it to foam, and the fat part, which is light, rising to the surface, becomes what is called butter. The heavy and thick part, which is below, being kneaded and properly prepared, is, after it has been dried, known by the name of *hippace*. The whey or serum remains in the middle." This author, in my opinion, speaks here very distinctly of butter, cheese and whey. It is probable that the Scythians may have hastened the separation of the caseous part from the whey by warming the milk, or by the addition of some substance proper for that purpose. These passages therefore contain the first mention of butter, which occurs several times in Hippocrates, and which he prescribes externally as a medicine[2]; but he gives it another term (*pikerion*), which seems to have been in use among the Greeks earlier than the former, and to have been afterwards neglected. That this word signified butter, and was no longer employed in the time of Galen, appears from his translating it, in his explanation of the obsolete expressions of Hippo-

et compungentes ad illa vasa cæcos lac agitant (*δονέουσι τὸ γάλα*) cujus quod summum est, delibatur, pretiosiusque habetur; vilius autem quod subsidit."—That *δονέειν* signifies to shake or beat, there can be no doubt. Theocritus uses the same word in speaking of a tree strongly agitated by the wind. It is used also to express the agitation of the sea during a storm; and in Geopon. xx. 46, p. 1270, where the preparation of that sauce called *garum* is mentioned, it is said that it must be placed in the sun, and frequently shaken.

[1] De Morbis, lib. iv. edit. 1595, fol. v. p. 67. Also in his treatise De Aëre, Locis, et Aquis, sect. iii. p. 74, he says the Scythians drink mares'-milk, and eat cheese made of it.

[2] De Natura Mulierum, sect. v. p. 137.—De Morbis Mulier. 2. sect. v. p. 191, 235, and in several other places. Vossius therefore, in his Etymolog. p. 84, says erroneously, that this word was first used by Dioscorides.

crates, by the word *boutyron*[1]. It was even before that period explained in the same manner by Erotian, in his dictionary of the words used by that Greek physician; and he remarks, from an ancient writer, that the Phrygians called butter *pikerion*, and that the Greeks seemed to have borrowed the word from these people. It however occurs very seldom, and is to be found neither in Hesychius, Suidas, nor Pollux[2].

The poet Anaxandrides, who lived soon after Hippocrates, describing the wedding of Iphicrates, who married the daughter of Cotys, king of Thrace, and the Thracian entertainment given on that occasion, says that the Thracians ate butter[3], which the Greeks at that time considered as a wonderful kind of food.

It is very remarkable that the word butter does not occur in Aristotle, and that he even scarcely alludes to that substance, though we find in his works some very proper information respecting milk and cheese, which seems to imply careful observation. At first he gives milk only two component parts, the watery and the caseous; but he remarks afterwards, for the first time, in a passage where one little expects it, that in milk there is also a fat substance, which under certain circumstances, is like oil[4].

In Strabo there are three passages that refer to this subject, but from which little information can be obtained. This author says that the Lusitanians used butter instead of oil; he mentions the same circumstance respecting the Ethiopians; and he relates in another place, that elephants, when wounded, drank this substance in order to make the darts fall from their

[1] Edition of Basle, 1538, fol. v. p. 715.

[2] It occurs however in Phavorinus.

[3] Athenæus, iv. p. 131. Respecting Anaxandrides see Fabricii Bibl. Gr.

[4] Historia Animal. iii. 20, p. 384: *πᾶν δὲ γάλα ἔχει ἰχῶρα ὑδατώτη, ὃ καλεῖται ὀρρός, καὶ σωματῶδες, ὃ καλεῖται τυρός.* Omne lac habet succum aquosum, qui dicitur serum, et alterum corpulentum, qui vocatur caseus. —P. 388: *ὑπάρχει δ' ἐν τῷ γάλακτι λιπαρότης, ἣ καὶ ἐν τοῖς πεπήγοσι γίνεται ἐλαιώδης.* Inest in lacte pinguedo, quæ in concreto oleosa fit. This is the translation of Scaliger; but by Gaza the latter part of the passage is translated as follows: "quæ etiam concreto oleum prope habit." It appears to me doubtful what *ἐν τοῖς πεπήγοσι* properly means. The comparison of oil occurs also in Dioscorides and Pliny. Aristotle, in all probability, intended to say that the fat part of milk was observed under an oily appearance in cheese made of sweet milk from which the cream had not been separated; and that indeed is perfectly agreeable to truth.

bodies[1]. I am much astonished, I confess, to find that the ancient Ethiopians were acquainted with butter, though it is confirmed by Ludolfus[2]. It ought to be remarked also, that according to Aristotle, the elephants, to cure themselves, did not drink butter, but oil[3]. In this he is followed by Pliny[4]; and Ælian says, that for the above purpose these animals used either the bloom of the olive-tree, or oil itself[5]; but Arrian, who lived a hundred years after Strabo, and who has related everything respecting the diseases of the elephant and their cures, in the same order as that author, has omitted this circumstance altogether[6]. Is the passage of Strabo, therefore, genuine? Ælian however says, in another part of his book, that the Indians anointed the wounds of their elephants with butter[7].

We are told by Plutarch, that a Spartan lady paid a visit to Berenice, the wife of Dejotarus, and that the one smelled so much of sweet ointment, and the other of butter, that neither of them could endure the other. Was it customary, therefore, at that period, for people to perfume themselves with butter?

Of much more importance are the remarks made by Dioscorides and Galen on this subject. The former says that good butter was prepared from the fattest milk, such as that of sheep or goats, by shaking it in a vessel till the fat was separated. To this butter he ascribes the same effects, when used externally, as those produced by our butter at present. He adds also, and he is the first writer who makes the observation, that fresh butter might be melted and poured over pulse and vegetables instead of oil, and that it might be employed in pastry in the room of other fat substances. A kind of soot likewise was at that time prepared from butter for external applications, which was used in curing inflammation of the eyes and other disorders. For this purpose the butter was put into a lamp, and when consumed, the lamp was again filled till the desired quantity of soot was collected in a vessel placed over it.

Galen, who distinguishes and confirms in a more accurate

[1] Lib. iii. p. 233; xvii. p. 1176; xv. p. 1031.
[2] Histor. Æthiop. lib. iv. 4, 13.
[3] Histor. Animal. viii. 31, p. 977.
[4] Hist. Nat. viii. 10, p. 440.
[5] Hist. Animal. ii. 18.
[6] Indica. Amst. 1668, 8vo, p. 537.
[7] Lib. xiii. cap. 7.

manner the healing virtues of butter, expressly remarks that cow's-milk produces the fattest butter; that butter made from sheep's- or goat's-milk is less rich; and that ass's-milk yields the poorest. He expresses his astonishment, therefore, that Dioscorides should say that butter was made from the milk of sheep and goats. He assures us that he had seen it made from cow's-milk, and that he believes it had thence acquired its name[1]. "Butter," says he, "may be very properly employed for ointments; and when leather is besmeared with it, the same purpose is answered as when it is rubbed over with oil. In cold countries, which do not produce oil, butter is used in the baths; and that it is a real fat may be readily perceived by its catching fire when poured over burning coals[2]." What has been here said is sufficient to show that butter must have been very little known to, or used by, the Greeks and Romans in the time of Galen, that is, at the end of the second century.

The Roman writers who give an account of the ancient Germans, all relate that they lived principally on milk; but they disagree in one thing, because many of them tell us that they used cheese, while others affirm that they were not even acquainted with the method of preparing it[3]. Pliny, on the other hand, says that they did not make cheese, but butter, which they used as a most pleasant kind of food. He ascribes to them also the invention of it; for it is highly probable that under the expression "barbarous nations" he meant the people of Germany: and his description of butter appears to me so clear, that I do not see how it can be doubted[4]. He very justly remarks, that, in order to make butter in cold weather, the milk ought to be warmed, but that in summer this precaution is not necessary. The vessel employed for making it seems to have had a great likeness to those used at present; we are told at least that it was covered, and that in the lid there were holes[5]. What he says however respecting *oxygala* is attended with difficulties; and I am fully persuaded that

[1] De Simplic. Med. Facultat. lib. x. p. 151. Edit. Basil. ii. p. 134.

[2] De Aliment. Facultat. iii. cap. 15, p. 54. Edit. Basil. iv. p. 340.

[3] Cæsar de Bello Gall. iv. 1. vi. 22. Strabo, lib. iv. speaking of the Britons, says, "In their manners they are somewhat similar to Celts, but more simple and barbarous; so that many, although they abound in milk, are unable to make cheese, through want of skill."

[4] Lib. xi. c. 41, p. 637.

[5] Ib. lib. xxviii. cap. 9, p. 465.

his words are corrupted, though I find no variations marked in manuscripts by which this conjecture can be supported. Having made an attempt by transposing the words to discover the real sense, I found that I had placed them in the same order as that in which they had been before arranged by Dithmar, who, in his annotations on Tacitus, quotes them in the same manner as I would read them, and with so much confidence that he does not even hint they were ever read otherwise. Had we both been critics, this similarity might have given our conjecture perhaps more authority; but Dithmar also was a professor of the œconomical sciences[1].

Oxygala was evidently a kind of cheese, the preparation of which has been best described by Columella[2]. In order to make it, sweet milk was commonly rendered sour, and the serum was always separated from it. Of this process Pliny speaks likewise; but he first mentions under the above name a kind of cheese formed from the caseous parts which remained behind in the butter-milk, and which when separated from it by acids and boiling, were mixed and prepared in various ways. It must in general have been sourish; for, according to the account of Galen[3], it affected the teeth, though he mentions also another kind of cheese, under the name of *caseus oxygalactium*[4], which was perfectly mild. In the Geoponica[5] directions are given how this cheese may be kept fresh for a long time. If my reading be adopted, the medicinal effects spoken of by Pliny are not to be ascribed to the butter, but to the sour cheese[6]; and physicians undoubtedly will be much readier to allow them to the latter than to the former. Whether Tacitus by *lac concretum*, which he says was the most common food of the Germans, meant cheese or butter I cannot examine, as we have no grounds to enable us to determine this question, respecting which nothing more can be known[7].

[1] In my opinion the passage ought to be arranged as follows:—prælirato. Quod est maximum coactum, in summo fluitat. Id exemptum, addito sale, butyrum est, oleosum natura. Quod reliquum est decoquunt in ollis. Additur paululum aquæ (aceti?), ut acescat. Id quod supernatat, oxygala appellant. Quo magis virus resipit, hoc præstantius indicatur. Pluribus compositionibus miscetur inveteratum. Natura ejus adstringere, mollire, replere, purgare.—Dithmar's emendation may be found in Taciti Libel. de Moribus German. Francof. 1766, 8vo, p. 140.

[2] Lib. xii. 8, p. 786.

[3] De Aliment. Facultat. iii. cap. 16, p. 55.

[4] Ibid. cap. 17, p. 57.

[5] Lib. xviii. 12, p. 1188.

[6] See Mercurialis, p. 38.

[7] De Moribus Germ. cap. 23.

I have now laid before the reader, in chronological order, every thing that I found in the works of the ancients respecting butter; and it is certain, from what has been said, that it is not a Grecian, and much less a Roman invention; but that the Greeks were made acquainted with it by the Scythians, the Thracians and the Phrygians, and the Romans by the people of Germany[1]. It appears also, that when they had learned the art of making it, they employed it only as an ointment in their baths, and particularly in medicine. Besides the proofs already quoted, a passage of Columella[2] deserves also to be remarked, because that author, and not Pliny, as Vossius thinks, is the first Latin writer who makes use of the word *butyrum*. Pliny recommends it mixed with honey to be rubbed over children's gums in order to ease the pain of teething, and also for ulcers in the mouth[3]. The Romans in ge-

[1] On this account some conjecture, and not without probability, that the name also *βούτυρος* or *βούτυρον* is not originally Greek, but that it may have been introduced into Greece from some foreign country, along with the thing which it expresses. Conring, for example, is of opinion that it is of Scythian extraction. The Grecian and Roman authors, however, make it to be a Greek word, compounded of *βοῦς*, an ox or cow, and *τυρὸς*, cheese, as we learn from the passages of Galen and Pliny already quoted. Cheese was known to them much earlier than butter; and it is therefore possible, that at first they may have considered the latter as a kind of cheese, as it appears that *τυρὸς* once signified any coagulated substance. The first syllable of the word, indeed, one should hardly expect, as the Greeks used the milk of sheep and goats much earlier than cow's-milk; and for this reason Schook conjectures that the first syllable was added, as usual among the Greeks, to magnify the object, or to express a superior kind of cheese. Varro De Re Rustica, ii. 5, p. 274, says, "Novi majestatem boum, et ab his dici pleraque magna, ut *βούσυκον*, *βούπαιδα*, *βούλιμον*, *βοῶπιν*; uvam quoque bumammam;" and we find in Hesychius, "*βούπαις*, *νέος μέγας· βούπεινα*, *μέγας λιμὸς· βουφάγος*, *πολυφάγος*." But this supposes that the Greeks preferred butter to cheese; whereas they always considered the former as of less importance, and less proper for use. The same word being still retained in most languages determines nothing; especially as the Swedes use the word *smor*, which is totally different, and which was the oldest German name, and that most used in the ninth century; and Lipsius, in an old dictionary of that period, found the word *kuosmer* butyrum, the first syllable of which is certainly the word *kuh*, a cow. See Lipsii Epist. ad Belgas, cent. iii. 44, and Wormii Litteratura Runica, cap. 27. These etymological researches, which must always be uncertain, I shall not carry further; but only remark that, according to Hesychius, butter, in Cyprus, where I did not expect it, was called *ἔλφος*, which word may also be foreign. See Martini Lexic. Philol. art *Butyrum*, who derives *ἔλφος* from *albus*. [2] Lib. vi. 12, p. 582. [3] Lib. xxviii. cap. 19, p. 486.

neral seem to have used butter for anointing the bodies of their children to render them pliable[1]; and we are told that the ancient Burgundians besmeared their hair with it[2]. A passage of Clemens of Alexandria, in which he expressly says that some burned it in their lamps instead of oil, is likewise worthy of attention[3]. It is however certain, on the other hand, that it was used neither by the Greeks nor the Romans in cookery or the preparation of food, nor was it brought upon their tables by way of dessert, as at a later period was the custom. We never find it mentioned by Galen and others as a food, though they have spoken of it as applicable to other purposes. No notice is taken of it by Apicius; nor is there anything said of it in that respect by the authors who treat on agriculture, though they have given us very particular information concerning milk, cheese and oil. This, as has been remarked by other writers, may be easily accounted for, by the ancients having entirely accustomed themselves to the use of good oil; and in the like manner butter at present is very little employed in Italy, Spain, Portugal, and the southern parts of France, where it is sold in the apothecaries' shops for medicinal purposes[4]. It is certain besides, that in warm countries it is difficult to preserve it for any length of time.

To conclude, I shall offer one remark, which, in my opinion is entirely new. It appears to me, by the information which I have here collected from the ancients, that at the period when these authors wrote, people were not acquainted with the art of making butter so clean and so firm as that which we use on our tables. On the contrary, I am fully persuaded that it was rather in an oily state, and almost liquid. They all speak of butter as of something fluid. The moderns cut, knead and spread butter; but the ancients poured it out as

[1] A passage of Tertullian *adversus Jud.* alludes to this practice. The same words are repeated Adversus Marcion. iii. 13.

[2] Sidonius Apollinaris, carm. 12.

[3] Clemens Alexand. Pædag. i. p. 107.

[4] When Leodius accompanied the elector palatine Frederic II. in his travels through Spain, he was desirous of purchasing in that country several articles necessary for their journey. After much inquiry concerning butter, he was directed to an apothecary's shop, where the people were much astonished at the largeness of the quantity he asked for, and showed him a little entirely rancid, which was kept in a bladder for external use. H. Th. Leodii Vita et Res Gestæ Frederici Palatini. Francof. 1665, 4to, lib. vi.

one pours out oil. Galen tells us, that, to make soot of butter, the butter must be poured into a lamp. Had the ancients used in their lamps hard or solid butter, as our miners use tallow in the lamps that supply them with light under ground, they would not have made choice of the expression *to pour out.* We are told that the elephants drank butter; and liquid butter must have been very familiar to the Greek translators of the Sacred Scriptures, when they could mention it as flowing in streams. Hecatæus, quoted by Athenæus, calls the butter with which the Pæonians anointed themselves, oil of milk[1]. Casaubon observes on this passage, that the author makes use of these words, because butter was then employed instead of oil, and spoken of in the like manner, as was the case with sugar, which was at first considered to be a kind of honey, because it was equally sweet and could be applied to the same purposes. Hippocrates, on the like grounds, calls swine's seam, swine's oil[2]. This explanation I should readily adopt, did not such expressions respecting butter, as one can apply only to fluid bodies, occur everywhere without exception. In warm countries, indeed, butter may be always in a liquid state; but I am of opinion that the ancients in general did not know by means of kneading, washing and salting, to render their butter so firm and clean as we have it at present. On this account it could not be long kept or transported, and the use of it must have been very much limited.

I shall remark in the last place, that butter appears to have been extremely scarce in Norway during the ages of paganism; for we find mention made by historians of a present of butter which was so large that a man could not carry it, and which was considered as a very respectable gift[3].

[1] Lib. x. p. 447.

[2] What Hippocrates calls ἔλαιον ὑὸς Erotian explains by τὸ ὕειον στέαρ.

[3] Suhm, in the eighth vol. of the Transactions of the Copenhagen Society, where a reference is made, p. 53, respecting the above-mentioned circumstance, to Torfæi Histor. Norveg. pars. i. vi. sect. iii. cap. 2, p. 319.

AURUM FULMINANS.

If a solution of chloride of gold be precipitated by an excess of ammonia, a yellow powder will be obtained, which, when heated, or only bruised, explodes suddenly with a prodigious report. The force of this aurum fulminans is terrible, and, in the hands of incautious persons, has often occasioned much mischief. But, however powerful, it cannot, as some have imagined, be employed instead of gunpowder, even were not this impossible on account of the high value of the metal from which it is made; for explosion does not take place when the powder is confined. Phænomena of this kind are always of importance, and afford subject of speculation to the philosopher, though no immediate use can be made of them[1]. Experiments, however, have rendered it probable that this powder may possess some medicinal virtues, and we are assured that it can be employed in enamel-painting.

He who attempts to trace out the invention of aurum fulminans is like a person bewildered in a morass, in danger every moment of being lost. I allude here to the immense wilderness of the ancient alchemists, or makers of gold; to wade through which, my patience, though pretty much accustomed to such labour, is not sufficiently adequate. Those who know how to appreciate their time will not sacrifice it in

[1] [That this and other similar chemical phænomena may be of more advantage than as affording merely subjects for speculation to the philosopher, although not immediately applicable to any useful purpose, may be inferred from the valuable application of fulminating mercury, a somewhat similar compound to that under consideration, This, at first, as with fulminating gold at present, was a mere curiosity; it has recently caused the almost complete substitution of percussion for flint locks in fire-arms, which in addition to the greater certainty caused by the increased rapidity of the discharge, œconomises the quantity of powder requisite.

Fulminating mercury is made by dissolving mercury in nitric acid and pouring the solution into warm alcohol. Effervescence ensues. When this has ceased, the mixture is poured upon a filter, and well-washed with water; after draining, the filter is expanded upon plated copper or stone-ware, heated to 212° by steam or hot water. Dr. Ure recommends that the powder be mixed with a solution of mastic in spirits of turpentine, to cause attachment. Its extensive use in making percussion-caps is well-known. It is however a very dangerous substance to experiment with, owing to the readiness with which it explodes, and has caused many very serious accidents.]

endeavouring to discover the meaning of books which the authors themselves did not, in part, understand, or to comprehend passages in which the writer tells us nothing, or, at any rate, nothing of importance. I have, however, made my way through this labyrinth from Spielmann to the works which are ascribed to Basilius Valentin[1].

The period when this powder was invented is as uncertain as the accounts given of its composition. It is however probable that the discoverer was a German Benedictine monk, who lived about the year 1413[2]; and there is reason to think that he may have made many useful observations, of which we are yet ignorant. When new observations have been made respecting gold, they have always been found afterwards in the works of Valentin, in a passage which no one before could understand. Such writings are of no more utility than the answers of the ancient oracles, which were comprehended when a knowledge of them was no longer necessary, and which misled those who supposed that they comprehended them sooner. But the account of aurum fulminans in Valentin is so uncommonly intelligible, that it almost seems he either wrote in an explicit manner without perceiving it, or that the words escaped from him contrary to his intention. As the work in which it may be found is scarce, I shall transcribe the prescription[3]:—

"Take a pound of aqua regia made with sal-ammoniac; that is, take a pound of good strong aquafortis, and dissolve in it four ounces of sal-ammoniac, and you will thus obtain a strong aqua regia, which must be repeatedly distilled and rectified until no more fæces remain at the bottom, and until it becomes quite clear and transparent. Take fine thin gold-leaf, in the preparation of which antimony has been used; put it into an alembic; pour aqua regia over it; and let as much of the gold as possible be dissolved. After the gold is all dissolved, add to it some *oleum tartari*, or *sal tartari* dissolved in a little spring-water, and it will begin to effervesce. When the effervescence has ceased, pour some more oil into it; and do this so often till the dissolved gold falls to the bottom, and

[1] Spielmann, Institut. Chem. p. 288.

[2] See Preface of B. N. Petræus to the Works of Valentin, Hamb. 1717, 8vo.

[3] Fr. Basilii Valentini Letztes Testament; Von G. P. Nenter. Strasb. 1712, 8vo, p. 223.

until no more precipitate is formed, and the aqua regia remains pure and clear. You must then pour the aqua regia from the gold calx, and wash it well with water eight or ten times. When the gold calx is settled, pour off the water, and dry the calx in the open air when the sun shines, but not over the fire; for as soon as this powder becomes a little heated or warm, it explodes, and does much mischief, as it is so powerful and violent that no man can withstand it. When the powder has been thus prepared, take strong distilled vinegar and pour over it; keep it continually over the fire for twenty-four hours, without stirring it, so that nothing may fall to the bottom, and it will be again deprived of its power of exploding; but take great care that no accident happens by carelessness. Pour off the vinegar, and, having washed the powder, expose it to dry."

The latter part of the receipt shows that Valentin had made experiments in order to discover how aurum fulminans might be deprived of its power of exploding, and he found that this could be done by vinegar. It appears from his writings that he had discovered also that the same thing could be effected by sulphur [1].

After the time of Valentin, Crollius, who lived in the last half of the sixteenth century, seems to have been best acquainted with this powder, and to have principally made it known [2]: at any rate his works are referred to by most of the modern writers. He calls it *aurum volatile*, and speaks of its being useful in medicine. The name *aurum fulminans* was, as far as I know, first used by Beguin [3]. The method of preparing it is described by Kircher, who considers it as a thing uncommon, and who calls it *pulvis pyrius aureus* [4].

[1] See Bergmann on Pulvis fulminans, in his Opuscula Physica et Chemica, 1780, 8vo, ii. p. 133.

[2] O. Crollii Basilica Chymica. Franc. (1609), 4to, p. 211.

[3] J. Beguini Tyrocinium Chymicum was printed for the first time at Paris, in 1608, 12mo. In the French translation, Les élémens de chymie, revues, expliquez, etc., par J. L. de Roy; Paris, 1626, 8vo, the receipt for making *or fulminant* may be found p. 314.

[4] Kircheri Magnes. Coloniæ, 1643, 4to, p. 548. The author says that he found the receipt for preparing it in Liber insignis de incendio Vesuvii. That I might know whether this work contained anything respecting the history of aurum fulminans, I inquired after it. Kircher undoubtedly meant Incendio del Monte Vesuvio, di Pietro Castelli; in Roma 1632, 4to: but the directions given there, p. 46, for making *oro fulminante*, are taken from Crollius. Nothing further is to befound in Kircher's Mundus Subterraneus.

GARDEN-FLOWERS.

Some of the flowers introduced into our gardens, and now cultivated either on account of their beauty or the pleasantness of their smell, have been procured from plants which grew wild, and which have been changed, or, according to the opinion of florists, improved by the art of the gardener. The greater part of them however came originally from distant countries, where they grow, in as great perfection as ours, without the assistance of man. Though we often find mention of flowers in the works of the Greeks and the Romans, it appears that they were contented with those which grew in their own neighbourhood. I do not remember to have read that they ever took the trouble to form gardens for the particular purpose of rearing in them foreign flowers or plants. But even supposing that I may be mistaken, for I do not pretend to have examined this subject very minutely, I think I may with great probability venture to assert, that the modern taste for flowers came from Persia to Constantinople, and was imported thence to Europe, for the first time, in the sixteenth century. At any rate, we find that the greater part of the productions of our flower-gardens were conveyed to us by that channel. Clusius and his friends in particular, contributed very much to excite this taste; and the new plants brought from both the Indies by the travellers who then continued still more frequently to visit these countries, tended to increase it. That period also produced some skilful gardeners, who carried on a considerable trade with the roots and seeds of flowers; and these likewise assisted to render it more general. Among these were John and Vespasian Robin, gardeners to Henry IV. of France, and Emanuel Sweert, gardener to the emperor Rodolphus II., from whom the botanists at that time procured many rarities, as appears from different passages of their works. As this taste for flowers prevails more at present than at any former period, a short history of some of the objects of it may not be disagreeable, perhaps, to many of my readers.

Simon de Tovar, a Spanish physician, brought the tuberose to Europe before the year 1594 from the East Indies,

where it grows wild in Java and Ceylon, and sent some roots of it to Bernard Paludanus, who first made the flower publicly known in his Annotations on Linschoten's Voyage[1]. The full tuberoses were first procured from seed by one Le Cour, at Leyden, who kept them scarce for some years, by destroying the roots, that they might not become common[2]. The propagation of them in most countries is attended with difficulties; but in Italy, Sicily and Spain, it requires no trouble; and at present the Genoese send a great many roots to England, Holland and Germany. The oldest botanists classed them among the hyacinths, and the name *Polianthes tuberosa* was given them by Linnæus in his Hortus Cliffortianus.

The auricula, *Primula auricula*, grows wild among the long moss covered with snow, on the Lower Alps of Switzerland and Steyermark[3], whence it was brought to our gardens, where, by art and accident, it has produced more varieties than any other species of flower. I do not know who first transplanted it from its native soil. Pluche[4] says only that some roots were pulled up by Walloon merchants, and carried to Brussels. This much, at any rate, is certain, that it was first cultivated with care by the Flemings, who were very successful in propagating it. Professor Weismantel, who deserves to be ranked amongst the principal writers on flowers[5], says that the auricula was described and celebrated by Ovid, Pliny and Columella; but this I much doubt. The botanists even of the seventeenth century, who searched for plants in the works of the ancients with great diligence, and who took the liberty of making very bold assertions, were not able to find any name that would correspond with the auricula; for the conjecture of Fabius Columna, that it is the *alisma* of Dioscorides, is highly improbable, as that Grecian author extols his plant, which was fond of water, on account of its medicinal virtues only. In the time of Clusius, most of the varieties of the auricula were scarce.

The common fritillary, or chequered lily, *Fritillaria Meleagris*, was first observed in some parts of France, Hungary, Italy, and other warm countries[6], and introduced into gardens

[1] Hagæ, 1599, fol. [2] Miller's Gardener's Dictionary.
[3] Haller, Histor. Stirpium, i. p. 272, n. 612. [4] Spectacle de la Nature, ii. p. 49. [5] Des Blumisten vol. i. Erfurt, 1783, 8vo, p. 5.
[6] [It also occurs wild in the eastern and southern parts of England.]

about the middle of the sixteenth century. At first it was called *Lilium variegatum*; but Noel Capperon, an apothecary at Orleans, who collected a great many scarce plants, gave it the name of *Fritillaria*, because the red or reddish-brown spots of the flower form regular squares, much like those of a chess-board. It was called *meleagris* by Dodonæus, because the feathers of that fowl are variegated almost in the same manner[1].

The roots of the magnificent crown imperial, *Fritillaria imperialis*, were about the middle of the sixteenth century brought from Persia to Constantinople, and were carried thence to the emperor's garden at Vienna, from which they were dispersed all over Europe. This flower was first known by the Persian name *tusac*, until the Italians gave it that of *corona imperialis*[2], or crown imperial. I have somewhere read that it has been imagined that the figure of it is to be found represented on coins of Herod, and that, on this account, it has been considered as the lily so much celebrated in the Scripture.

The Persian lily, *Fritillaria Persica*, which is nearly related to it, was made known almost about the same time. The bulbs or roots were brought from Susa to Constantinople, and for that reason it was formerly called *Lilium Susianum*[3].

African and French marigolds, *Tagetes erecta* and *patula*, were, according to the account of Dodonæus and others, brought from Africa to Europe, at the time when the emperor Charles V. carried his arms against Tunis. This however is improbable; for these plants are indigenous in South America, and were known to botanists before that period under the name of *Caryophyllus Indicus*, from which is derived the French appellation *œillet d'Inde*. Cordus calls them, from their native country, *Tanacetum Peruvianum*[4].

Among the most beautiful ornaments of our gardens is the belladonna lily, *Amaryllis formosissima*, the flower of which, composed of six petals, is of a deep-red colour, and in a strong light, or when the sun shines upon it, has an agreeable yellow lustre like gold. The first roots of it ever seen in Europe were procured in 1593, on board a ship which had returned from South America, by Simon de Tovar, a physician at

[1] Clusii Hist. Plant. ii. p. 154.
[2] Ibid. i. p. 128. Dodonæi Pempt. p. 202. [3] Clusii Hist. Plant. i. p. 130.
[4] Dodonæi Florum Hist. p. 62. Bauhini Hist. Plant. iii. p. 98.

Seville. In the year following, he sent a description of the flower to Clusius; and as he had at the same time transmitted some roots to Bernard Paludanus and count d'Aremberg, the former sent a dried flower, and the latter an accurate drawing of it to Clusius, who published it in 1601[1]. One of the Robins gave in 1608 a larger and more correct figure, which was afterwards copied by Bry, Parkinson, and Rudbeck; but a complete description, with a good engraving, was published in 1742, by Linnæus[2], who in 1737 gave to that genus the name by which it is known at present[3]. Sweert, Bauhin, and Rudbeck, are evidently mistaken in assigning the East Indies as the original country of this plant; and Broke[4], who was not a botanist, but only a florist, is equally wrong in making it a native of the Levant. Tovar received it from South America, where it was found by Plumier and Barrere, and at a later period by Thiery de Menonville[5]. At first it was classed with the narcissus, and it was afterwards called *lilio-narcissus*, because its flower resembled that of the lily, and its roots those of the narcissus. It was named *flos Jacobæus*, because some imagined that they discovered in it a likeness to the badge of the knights of the order of St. James in Spain, whose founder, in the fourteenth century, could not indeed have been acquainted with this beautiful amaryllis.

Another species of this genus is the Guernsey lily, *Amaryllis Sarniensis*, which in the magnificence of its flower is not inferior to the former. This plant was brought from Japan, where it was found by Kæmpfer, and also by Thunberg[6], during his travels some years ago in that country. It was first cultivated in the beginning of the seventeenth century in the garden of John Morin, at Paris, where it blowed, for the first time, on the 7th of October 1634. It was then made known by Jacob Cornutus, under the name of *narcissus Japonicus flore rutilo*[7]. After this it was again noticed by John Ray[8], in 1665, who called it the *Guernsey lily*, which name it

[1] Hist. Plantar. i. p. 157. [2] Abhandl. der Schwed. Akad. iv.
[3] Hortus Cliffort. p. 135. [4] Beobacht. v. einigen Blumen, 1769, 8vo.
[5] Barrere, Hist. Nat. de la France Equinoxiale. Traité de la Culture du Nopal, par T. de Menonville, 1787, 8vo.
[6] Flora Japonica. The Japanese consider the bulbs poisonous.
[7] J. Cornuti Canad. Plantarum aliarumque Historia. Par. 1635, 4to.
[8] A complete Florilege, furnished with all the requisites belonging to a florist. London, 1665, fol. lib. i. cap. 10, p. 74.

still very properly bears. A ship returning from Japan was wrecked on the coast of Guernsey, and a number of the bulbs of this plant, which were on board, being cast on shore, took root in that sandy soil. As they soon increased and produced beautiful flowers, they were observed by the inhabitants, and engaged the attention of Mr. Hatton, the governor's son, whose botanical knowledge is highly spoken of by Ray, and who sent roots of them to several of his friends who were fond of cultivating curious plants[1]. Of this elegant flower Dr. Douglass gave a description and figure in a small treatise published in 1725, which is quoted by Linnæus in his Bibliotheca, but not by Haller.

Of the comprehensive genus *Ranunculus*, florists, to speak in a botanical sense, have obtained a thousand different kinds[2]; for, according to the manner in which they are distinguished by gardeners, the varieties are infinite and increase almost every summer, as those with half-full flowers bear seed which produce plants that from time to time yield new kinds that exhibit greater or uncommon beauties. The principal part of them, however, and those most esteemed, were brought to us from the Levant. Some were carried from that part of the world so early as in the time of the crusades; but most of them have been introduced into Europe from Constantinople since the end of the sixteenth century, particularly the Persian ranunculus (*R. asiaticus*, Linn.), the varieties of which, if I am not mistaken, hold at present the first rank. Clusius describes both the single and the full flowers as new rarities. This flower was in the highest repute during the time of Mahomet IV. His Grand Vizir, Cara Mustapha, well-known by his hatred against the Christians and the siege of Vienna in 1683, wishing to turn the sultan's thoughts to some milder amusement than that of the chase, for which he had a strong passion, diverted his attention to flowers; and, as he remarked that the emperor preferred the ranunculus to all others, he wrote to the different pachas throughout the whole kingdom to send him seeds or roots of the most beautiful kinds. The pachas of Candia, Cyprus, Aleppo, and Rhodes paid most regard to this request; and the elegant flowers which they

[1] Morisoni Plantarum Historia, pars 2. Ox. 1680, fol. p. 367.

[2] Miller's Gardener's Dictionary. [Of one species alone no less than eight hundred varieties were known at the end of the last century.]

transmitted to court were shut up in the seraglio as unfortunate offerings to the voluptuousness of the sultan, till some of them, by the force of money, were at length freed from their imprisonment. The ambassadors from the European courts in particular, made it their business to procure roots of as many kinds as they could, which they sent to their different sovereigns. Marseilles, which at that period carried on the greatest trade to the Levant, received on this account these flowers very early; and a person there, of the name of Malaval, is said to have contributed very much to disperse them all over Europe[1].

[Among the favourites of the present day may be instanced,—

The varied and social Pelargoniums (commonly called geraniums), which from their capability of living in the confined air of rooms almost form a part of the household furniture in this country. They are nearly all members of the Cape of Good Hope. A large number however of those with which we are familiar are not distinct species, but mere varieties. Geraniums were first introduced into this country at the end of the seventeenth century. Pelargoniums differ from geraniums principally in the irregularity of their flowers, their shrubby stems and tubular nectaries. They were first separated by L'Heritier.

The Dahlia, an universal favourite; its exquisite symmetry, when perfect, and the size of its flowers rendering it one of the most beautiful of our garden-plants. It is generally stated to have been introduced by Lady Holland in 1804; but it was introduced many years before that period, and was only brought from Madrid by Lady Holland, who apparently did not know that it was already in the country. The first species of Dahlia known to Europeans was *D. superflua* (*variabilis*, De C.); it was discovered in Mexico by Humboldt in 1789, and sent to Professor Cavanilles, of the Botanic Garden at Madrid, who named the genus in honour of the Swedish Professor Dahl. Cavanilles sent a plant of it to the marchioness of Bute. From this species, nearly all the varieties known in our gardens have been raised. There are now in England ten or twelve species, including innumerable varieties.

The Rose, which is one of our oldest favourites, and has

[1] Tournefort, Voyage du Levant, vol. ii. p. 15.—Traité des Renoncules (par D'Ardene), Paris, 1746, 8vo.—Pluche, Spectacle de la Nature, vol. i.

been known from time immemorial among the civilized nations of Europe and Asia. It occurs in almost every country of the northern hemisphere, both in the Old and New World. It is not found in South America nor in Australia. The name is derived from *rhos,* which signifies red in Armorican, whence *ῥόδον*, Greek, and *rosa*, Latin. More than one hundred species have been described, and more than two thousand varieties may be procured in the nurseries.

And lastly, the Calceolarias, which are natives of South America. Their great variety has rendered them especial favourites. They abound in Chili and Peru. The name is derived from *calceolus*, from the resemblance of the corolla (coloured part of the flower) to a slipper. In 1820, half-a-dozen species only were known in this country. During the next ten or twelve years, five or six more species were introduced from Chili. Innumerable hybrids are now raised every year, varying in colour through every possible shade of crimson, brown, orange, purple, pink, and yellow: there are one or two of a pure white colour.]

END OF VOL. I.

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