THE PHILOSOPHICAL MAGAZINE:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

AGRICULTURE, MANUFACTURES,

AND

COMMERCE.

BY ALEXANDER TILLOCH,

HONORARY MEMBER OF THE ROYAL IRISH ACADEMY, &c. &c. &c.

"Nec aranearum sane textus ideo melior quia ex se fila gignunt, nec noster vilior quia ex alienis libamus ut apes." JUST. LIPS. *Monit. Polit.* lib. i. cap. 1.

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I. *Memoir upon the Apes with imperfect Hands, or the Ateles.* *By* GEOFFROY ST. HILAIRE *.

OUR menagerie at Paris has lately acquired two apes without thumbs on the fore paws: hitherto one species only, remarkable for this singularity, has been recognised, viz. the *coaita* of Buffon, or the *simia paniscus* of Linnæus; it is an ape from America; its hair is entirely black, and it passes from branch to branch by using the extremity of its tail. Our two new apes resemble the coaita in the proportions of their bodies, by their slender shape, their spider-like limbs, and particularly by their long tail; but they differ from the coaita in the colour of the belly, which in the former is of a dirty white. If they are of a small size, it is only because they are not full grown; which we may judge from the circumstance of the canine teeth having scarcely yet made their appearance out of the alveoli, and from their skin being shaggy, and wanting equality and smoothness.

Nevertheless these circumstances do not induce us to regard them as young ones of the simia paniscus; because, on the one hand, we have seen a small individual of that species entirely similar to its father and mother; and, on the other hand, we have found that this species has already appeared in Europe, and has been described in its perfect state.

An adult ape, without thumbs to its hands, having a whitish belly, was publicly exhibited, in 1750, by the name of *belzebut:* after its death it passed into the cabinet of

* From *Annales du Muséum d'Histoire Naturelle,* tome vii.

Reaumur, where M. Brisson saw it: it was an exact counterpart of the species which this naturalist describes by the name of *simia belzebut*.

Buffon, when writing, some years afterwards, the last volume of his History of Animals, had before him only a single ape with four fingers, the coaita, which we have already mentioned: he applied to it all the descriptions of the authors who had spoken of apes deprived of one toe in the fore feet; and from this moment the species of Brisson, although nominally comprised in this work, was suppressed: two other apes are in the same situation; the ape of Brown, with brown hair, and the chamek, in which we find the root of a toe, and of which there is a detailed description by Buffon himself.

Linnæus was one of the first to adopt these reductions, in which he was followed by all the naturalists: thinking the name of *belzebut* to have no meaning, he transferred the name of a jumping ape, the *guariba* of Marcgrave, to it.

Thus these different apes had been regarded as so many individual varieties, and it must be confessed that it was scarcely possible to form any other opinion at that time: we are at present in a situation of retracing these first views. Time, in making us acquainted with a greater number of individuals of each of these apes, showing them by fixed and immutable traits, and furnishing us with the means of judging of them comparatively, admits of our giving here a more rigorous determination.

As these four apes are not only analogous by the want of the finger, but as they also resemble each other, besides, by the strange proportions of their bodies and by the form of the head, I think we should point out their degree of affinity by separating them from the other apes with the prehensile tail, and classing them under the same generic denomination: I have given the name of *ateles* to this small family, a denomination proper for describing the imperfection of their hands.

These apes are so remarkable on account of the disproportion between their limbs and their bodies, that some of them have received the name of *spider apes*. The orangs alone have longer

longer limbs; but the ateles seem to be in other respects very ill formed, their legs being altogether slender. The hand deprived of one finger seems to have no palm, and terminates, in a disagreeable manner, a very lank and ugly arm; and lastly, what adds principally to their disagreeable look is, that their tail is longer than the extremities, and which to embarrass them very much when they sit down.

The ateles, also, nearly approach the orangs by the form of their head: they have a prominent forehead, and a chin equally so: the occiput in all of them is remarkable for an inequality, rendered so much the more perceptible as the hair with which the head is covered, for the most part, inclines towards the front. The eyes are large, the ears small, and well rounded towards the top. In common with all the apes of America, their nostrils are open at one side, and separated by a large division.

The body is small and long: it is remarkably slender, and, as it were, strangled towards the belly; it appears, however, fuller about the chest, the capacity of which seems to be large enough. The skin is hindered from growing completely over the sides of the belly by the thighs, which, when the animal sits, approach very close to it.

The legs are nearly in the same proportions, if not a little shorter than the arms. The foot has a broader base than the hand, which can only be attributed to the existence of the additional toe or finger in the former; the metatarsal bones and the bones of the phalangs are at least as long as the analogous little bones in the fore extremities. The thumb is sensibly detached from the fingers; the nail, which protects the extremity of it, is large, and completely flattened. On the contrary, in the fore feet there only exists a mere root of a thumb, which is manifested by the metacarpal bone and a very small phalange, which may be easily felt in the living animal; no vestige of it, however, appears to the eye, whatever may be the movements of the animal: it is only in one species that this rudiment of a thumb is found.

The nails are crooked and very pointed, as in all the sapajous.

The tail, with which we see the animal so encumbered, plays a distinguished part in its various movements. We know no species of ape with a longer tail, and in particular there is none whose tail possesses more muscular strength. The ateles make use of it for every purpose: if they wish to remove themselves, it is always used to furnish them with a new place of rest; when they jump at any thing to catch it, they warp it round the branches in a spiral form; if they wish to seize any thing at a great distance, it displays at the extremity of a long lever all the properties of a hand, which seizes every thing with great address; the part of the tail which serves oftenest and most efficaciously for seizing any thing, that is to say, the lower extremity, is deprived of hair, and covered with a thick and as it were callous epidermis.

The manners of the ateles differ very little from those of the sapajou; they send forth the same shrill cry, resembling the whistling of small birds in the night; at other times it is a weaker cry, soft and melodious, by which they seem to express complaints or fatigue. They are also very sensible to the cold of our climate.

Although kept in a heated place they are not the less attentive to sitting down and folding themselves forward, and in this situation their tail serves for an excellent fur for covering the parts most exposed. Our two young individuals are more careful still: they combat every loss of heat by combined operations; they often embrace each other belly to belly, with the legs and arms entwined, and besides surrounded by their tails, and soon forget the cold in this attitude. I have often seen the curious very much struck with this spectacle, and testify how singular it appeared to them to see two heads thus continually in motion and agitated by different sensations, while their bodies were so closely joined together in a manner which naturally expresses the most affectionate sentiments, without being actuated by any real mutual tenderness.

They are sometimes, however, susceptible of mutual tenderness: those in our possession, which are of the same sex, both females, are upon a good understanding with each other, and they cannot be separated without testifying the most

most lively regret, following each other with their eyes, and stretching towards each other. When shut up in the same cage, they were rarely separate from each other; the one either negligently rests upon the other, or mounts its back and picks off the vermin to which this species is very subject. They feed together in common; and on these occasions the sentiment of self-love seems not to prevail, or at least does not excite any serious disputes between them: when one has tasted an apple or a vegetable and left it, the other lays hold of it; a thing that often happens with them.

This character of gentleness indicates the social affections, and we know, in fact, that the ateles live in troops. In a savage state they feed at first on fruits, preferring such as belong to the palm tree; they afterwards eat vegetables and small animals, such as worms and insects. It is also said that with the assistance of their tail they fish extremely well for crab fish and other kinds of shell fish, and that they are by no means at a loss for a method of breaking the shells.

We did not remark that our ateles made any uncommon use of their tail, nor did they ever seize their food with it; for this purpose they use their hands, and they do it in an awkward manner to appearance, but really with great address.

The ateles, when left to their natural impulse, evince boldness and courage; they fight together often, and very bitterly; it is said that they come to the assistance of each other.

Dampier relates the ingenious manner in which these animals cross a river when there are trees on each side of it: one of them hangs by the tail to one of the highest branches, and the others attach themselves to this one by their tails: they then begin to swing themselves across the river until the one at the lower extremity catches hold of the opposite tree; and when he has laid hold of it he climbs up to the top, and the animal at the other extremity then lets go his hold, and thus the whole chain swings across the river.

The ateles are natives of South America: there is a little uncertainty respecting a fifth species without the thumb; but it is, perhaps, very different from these apes, and cannot be comprised in the same genus: I here allude to the full-bottomed monkeys of Pennant. The drawing and description given by this gentleman represent the full-bottomed monkey with all the characteristics of our guenous, and it is asserted that they come from the same place; but, on the other hand, Boddaert ascribes to the latter, among other characters, that of a prehensile tail. At first sight one is almost inclined to recognise this ape as an atele, and to suppose that Pennant has been deceived by inaccurate information, when he ascribes his species to Guinea, and talks of the high value attached by the negroes to their skin, which, according to his account, forms one of the most costly articles of dress.

Admitting the existence of this latter species, this new genus, of the general characters and habitudes of which I have presented a view, would be composed of five species, viz. the chamek, the coaita, the ape of Brown, the belzebut, and the full-bottom of Pennant. The following are the distinguishing characters of each:

1. The *chamek.* It has never yet been distinguished from the coaita, nor is it even described as distinct by Buffon. This ape, which came from the coast of Bancet, in Peru, was presented to him alive some years before he began to write the last volume of his History of Quadrupeds. M. Buffon intrusted his draftsman with taking a drawing of it, which he did very minutely. Having afterwards compared this description with that of the coaita by M. Daubenton, and having found them different in some respects, he thought proper to publish them both, without renouncing the opinion he entertained, that the chamek and the coaita were one and the same animal.

The carcase of this chamek was not preserved in the museum; but we possess another which was taken at Guiana, and for which we are indebted to the enlightened zeal and indefatigable activity of M. Martin, botanist to the government of Cayenne. I took this carcase, upon its arrival, for that of the coaita. I was imposed upon by the colour of the skin being similar in both species; but the presence of a thumb, however short it may be, creates such a great difference

ference between the chamek and the coaita, that I was forced to consider them as two distinct species; and in order to verify my first opinion on this subject, I took the cranium from the carcase sent to me by M. Martin, in order to compare it with that of the coaita. These two crania appeared to me to be sensibly different: that of the chamek is larger, shorter, flatter towards the suture of the parietal bones, and more swelled at the temples. The coronal bone is a little depressed towards the sides, in such a manner that the chamek has a slight tuft; the forehead of the coaita, on the contrary, is perfectly rounded. The lower jaw is in particular much longer; its lower edge is straight, while it is arched in the coaita: lastly, the ascending branches of it are so extended that we are led to think that they might, as in the alouati, serve as a kind of partition to a hyoidal bone with a cavernous base.

The thumb is very different in the two species: in the coaita the metacarpal bone is, for the most part, as long as the half of its neighbouring one, and the phalange that terminates it is so small, that it only forms a fifth part of the length of this first bone; these two bones are slender in proportion, so that they are lost in the common integuments, without showing any traces externally. In the chamek there are the same bones: the principal difference is in their thickness; the metacarpal bone is, besides, a little longer. The first and the only phalange is longer; it makes nearly a third of it; it is much larger, particularly towards the extremity. It is this phalange which, detaching itself from the second metacarpal bone, constitutes the thumb of the chamek; we see it is very short, and that it is not complete, insomuch as it wants the second phalange, and the nail which terminates the latter in all the other apes.

The chamek is generally a little different from the coaita; it is covered, like the latter, with rough and coarse hair, dry, and a deep black; its face is naked and of a mulish colour, as well as the ears; the iris of the eye is brown, and surrounded by a small yellowish circle: besides, the hairs of the arm and fore-arm are in these two species directed towards the hand, and those of the head towards the forehead.

head. There is no difference in the shape and proportions of the chamek from those of the coaita.

The following description agrees with the chamek: Ateles pentadactylus; *ateles niger, palmis pentadactylis.*

2. The *coaita*. This is the only species of this genus that has been established in a precise manner: Buffon and Daubenton were the first to publish a good description and a drawing of it. Linnæus afterwards made his *simia paniscus* of it. M. d'Azzara has latterly proposed to join it with the orang, regarding it as the male of this jumping ape; but we are certain that these animals even belong to two different genera. The coaita had been seen long before by Barrere and Edwards; since then M. Vosmaer has given us a new drawing and a long description, because it is of this ape he speaks when he describes it by the name of the *devil of the woods,* or the American jumping and whistling ape. Audibert, in his History of Apes, has also given a new drawing of it. These two latter authors charge Buffon's plate with representing the coaita with an excessive slenderness: I think his plate, however, as faithful as theirs. I have seen coaitas which resemble it completely; I have also seen others that were squatter: of this number is the individual sent by M. Leblond to the Society of Natural History, and which at present forms part of the collection of M. Dufresne at the head of the zoological cabinet in the Museum of Natural History.

I shall not repeat what I have said above of the characters by which it differs from the chamek: I shall only add that the coaita has a clear copper-coloured face. It is sufficiently distinguished from the preceding species by the following description: Ateles paniscus; *ateles niger, palmis tetradactylis.*

3. The *arachnoides*. I give this name to the brown atele, and I borrow it, in some measure, from Edwards, who relates that it was exhibited some time ago in London by the name of the *spider monkey*; a description which principally relates to the length and the slenderness of the limbs of this atele. Edwards also saw a coaita about the same time; so that when he speaks of the colour of this ape he could not have

have been mistaken. Brown (History of Jamaica) also speaks of an ape with tetradactylous hands, the skin of which is brown, and the tail strong and muscular. It is upon these two authorities that I class this species in the catalogue of the mammiferæ; and I am besides led to do so, because I have not yet seen what may be regarded as a young or a female atele. It also seems that in point of shape they do not differ.

Brown only mentions a few of its habits, which we have already repeated. He adds that it exists in the continent of America, and that it furnishes the greatest part of the food of the Indians. It may be thus described: ATELES ARACHNOIDES; *ateles fuscus, palmis tetradactylis.*

4. The *belzebut.* Brisson described it, but it has been since forgotten. It has a round head, the muzzle lengthened and prominent; the ears like those of a man; the eyes black; the pupils of a flesh colour, which makes a singular contrast with the rest of the figure of a red or blackish brown; its lips are capable of great extension, and furnished, like the chin, with white hairs.

The direction of the hairs is, in some respects, different from that which exists in the coaita and chamek. On the forehead they lie forwards, and they meet in opposition with those in front; the tufts of the cheeks incline towards the ears, and partly conceal them: they are directed upwards on the neck; on the abdomen they are directed downwards, and a little inclined to one side; on the lower belly they are quite rough, which results from the crouching position in which they sit so often; the hairs of the fore-arm have a similar direction to that which we remark in the orang outang.

The hairs are black above, a little deeper upon the bottom, a dirty white under the belly of our young subjects, and of a yellowish white in the adult, according to Brisson. A straight and red line indicates upon the whole length of the flanks the meeting of the hairs of the upper parts with those of the abdomen.

The naked part of the tail is flattened and transversely ridged, but without callosities.

The

The following are the dimensions of our young subjects:

	Inches.	Lines.
The body measured from the crown of the head to the root of the tail -	15	0
The trunk - - -	9	6
The tail - - -	19	0
The arm - - -	3	6
The fore-arm - - -	6	6
The hand - - -	3	3
The thigh - - -	5	6
The leg - - -	6	0
The foot - - -	4	8
Brisson's individual had for the length of his body - - -	19	0
And the tail - - -	24	0

The belzebuth may be easily distinguished by the following description: Ateles belzebut; *atelocheirus supra niger, albidus infra, palmis tetradactylis.*

Observation.—The simia belzebut of Linnæus must not be confounded with our belzebut, which is the same with the ouarine of Buffon. I propose giving to this species the name of the *guariba*, which it bears in the Brasils, or at least in the work of Marcgrave, the only author who has spoken of the *visu*. The caraya of M. d'Azzara seems to me to be different from it, as well as the alouati (*simia seniculus*). These three species will constitute the genus of leapers (*hurleurs*).

In the work of Marcgrave the figures of the guariba and the exquima have been transposed. That placed opposite to the description of the guariba, p. 226, represents the exquima, or the simia Diana of Linnæus; and, *vice versâ*, the figure of the latter is placed opposite to the description of the guariba.

5. The *camail*. It is by this name that Buffon has described the full-bottomed monkey of Pennant. I cannot admit it among our ateles without caution; for, if the description given of it by Pennant is correct, it does not belong to them. Its name of *camail* and that of *polycomos* (see the *Elenchus animalium* of Boddaert,) are given to it on account of the long and thick hair which grows on its head hanging

over

over the face, neck, and chest. It is of a yellow colour mixed with black. The body, the legs, and the arms, are furnished with a very short shining hair, of a fine black; its tail is of a snow-white colour, and is terminated by a tuft of hair jet black.

This ape, which is nearly a metre in height when standing on its hind legs, according to Pennant, inhabits the forests of Sierra Leone and Guinea, where the negroes call it the *king of the apes*. We shall characterize it as follows: ATELES POLYCOMOS; *ateles comatus, palmis tetradactylis, cauda alba.*

II. *Account of the Success of the American Expedition of Discovery under the Command of Captain* LEWIS: *communicated in a Letter from Captain* CLARK *to his Brother General* CLARK.

DEAR BROTHER, St. Louis, Sept. 23, 1806.

WE arrived at this place at twelve o'clock to-day from the Pacific Ocean, where we remained during the last winter, near the entrance of the Columbia river. This station we left on the 27th of March last, and should have reached Saint Louis early in August had we not been detained by the snow, which barred our passage across the Rocky Mountains until the 24th of June. In returning through those mountains we divided ourselves into several parties, digressing from the route by which we went out, in order the more effectually to explore the country, and discover the most practicable route which does exist across the continent by the way of the Missouri and Columbia rivers. In this we were completely successful, and have therefore no hesitation in declaring, that, such as nature has permitted, we have discovered the best route which does exist across the continent of North America in that direction. Such is that by way of the Missouri to the foot of the rapids below the great falls of that river, a distance of 2575 miles; thence by land passing by the Rocky Mountains to a navigable part of the Kooskooske, 340: and with the Kooskooske 73 miles, Lewis's river

river 154 miles, and the Columbia 413 miles to the Pacific Ocean; making the total distance from the confluence of the Missouri and Mississippi to the discharge of the Columbia into the Pacific Ocean 3554 miles. The navigation of the Missouri may be deemed good; its difficulties arise from its falling banks, timber embedded in the mud of its channels, its sand-bars, and steady rapidity of its current; all which may be overcome, with a great degree of certainty, by using the necessary precautions. The passage by land of 340 miles, from the falls of the Missouri to the Kooskooske, is the most formidable part of the track proposed across the continent. Of this distance 200 miles is along a good road, and 140 miles over tremendous mountains, which for 60 miles are covered with eternal snows. A passage over these mountains is, however, practicable from the latter part of June to the last of September; and the cheap rate at which horses are to be obtained from the Indians of the Rocky Mountains, and west of them, reduces the expenses of transportation over this portage to a mere trifle. The navigation of the Kooskooske, Lewis's river, and the Columbia, is safe and good from the 1st of April to the middle of August, by making three portages on the latter river; the first of which, in descending, is 1200 paces at the falls of Columbia, 261 miles up that river; the second, of two miles, at the Long Narrows, six miles below the falls; and a third, also of two miles, at the Great Rapids, 65 miles still lower down. The tide flows up the Columbia 183 miles, and within seven miles of the Great Rapids. Large sloops may with safety ascend as high as tide water, and vessels of 300 tons burthen reach the entrance of the Multnomah river, a large southern branch of the Columbia, which takes its rise on the confines of New Mexico, with the Callerado and Apostle's rivers, discharging itself into the Columbia, 125 miles from its entrance into the Pacific Ocean. I consider this track across the continent of immense advantage to the fur trade, as all the furs collected in nine-tenths of the most valuable fur country in America may be conveyed to the mouth of the Columbia, and shipped from thence to the East Indies, by the 1st of August in each

year;

year; and will, of course, reach Canton earlier than the furs which are annually exported from Montreal arrive in Great Britain.

In our outward bound voyage we ascended to the foot of the rapids below the great falls of the Missouri, where we arrived on the 14th of June 1805. Not having met with any of the natives of the Rocky Mountains, we were, of course, ignorant of the passes by land which existed through these mountains to the Columbia river; and had we even known the route, we were destitute of horses, which would have been indispensably necessary to enable us to transport the requisite quantity of ammunition and other stores to ensure the remaining part of our voyage down the Columbia: we therefore determined to navigate the Missouri as far as it was practicable, or unless we met with some of the natives, from whom we could obtain horses, and information of the country. Accordingly, we took a most laborious portage at the fall of the Missouri, of 18 miles, which we effected with our canoes and baggage by the 3d of July. From thence, ascending the Missouri, we penetrated the Rocky Mountain at the distance of 71 miles above the upper part of the portage, and penetrated as far as the three forks of that river, a distance of 180 miles further. Here the Missouri divides into three nearly equal branches at the same point: the two largest branches are so nearly of the same dignity that we did not conceive that either of them could, with propriety, retain the name of the Missouri; and therefore called these streams Jefferson's, Madison's, and Gallatin's rivers. The confluence of these rivers is 3848 miles from the mouth of the Missouri by the meanders of that river. We arrived at the three forks of the Missouri on the 27th of July. Not having yet been so fortunate as to meet with the natives, although I had previously made several exertions for that purpose, we were compelled to continue our route by water.

The most northerly of the three forks, that to which we have given the name of Jefferson's river, was deemed the most proper for our purposes, and we accordingly ascended it 218 miles, to the upper forks, and its extreme navigable point.

point. On the morning of the 17th of August 1805, I arrived at the forks of Jefferson's river, where I met captain Lewis, who had previously penetrated, with a party of three men, to the waters of the Columbia, discovered a band of the Shosshone nation, and had found means to induce 35 of their chiefs and warriors to accompany him to that place. From these people we learned that the river on which they resided was not navigable, and that a passage through the mountains in that direction was impracticable. Being unwilling to confide in this unfavourable account of the natives, it was concerted between captain Lewis and myself, that one of us should go forward immediately with a small party and explore the river, while the other, in the interim, would lay up the canoes at that place, and engage the natives with their horses to assist in transporting our stores and baggage to their camp. Accordingly I set out the next day, passed the dividing mountains between the waters of the Missouri and Columbia, and descended the river, which I since called the East fork of Lewis's river, about 70 miles. Finding that the Indians' account of the country in the direction of that river was correct, I returned and joined captain Lewis on August 29, at the Shosshone camp, excessively fatigued, as you may suppose, having passed mountains almost inaccessible, and compelled to subsist on berries during the greater part of my route. We now purchased seventeen horses of the Indians, and hired a guide, who assured us that he could in fifteen days take us to a large river, in an open country west of these mountains, by a route some distance to the north of the river on which they lived, and that by which the natives west of the mountains visit the plain of the Missouri for the purpose of hunting the buffalo. Every preparation being made, we set forward with our guide on the 31st of August through these tremendous mountains, in which we continued till the 22d of September before we reached the lower country beyond them. On our way we met with the Olelachshook, a band of the Tuchapaks, from whom we obtained an accession of seven horses, and exchanged eight or ten others: this proved an infinite service to us, as we were compelled to subsist on horse beef about

eight

eight days before we reached the Kooskooske. During our passage over these mountains we suffered every thing which hunger, cold, and fatigue, could impose: nor did our difficulties terminate on our arrival at the Kooskooske; for although the Pollotepallors, a numerous nation inhabiting that country, were extremely hospitable, and for a few trifling articles furnished us with an abundance of roots and dried salmon, the food to which they were accustomed, we found that we could not subsist on these articles, and almost all of us grew sick on eating them: we were obliged, therefore, to have recourse to the flesh of horses and dogs, as food to supply the deficiency of our guns, which produced but little meat, as game was scarce in the vicinity of our camp on the Kooskooske, where we were compelled to remain, in order to construct our perogues to descend the river. At this season the salmon are meagre, and form but indifferent food. While we remained here I was myself sick for several days, and my friend captain Lewis suffered a severe indisposition.

Having completed four perogues and a small canoe, we gave our horses in charge to the Pollotepallors until we returned, and on the 7th of October re-embarked for the Pacific Ocean. We descended by the route I have already mentioned. The water of the river being low at this season, we experienced much difficulty in descending: we found it obstructed by a great number of difficult and dangerous rapids, in passing of which our perogues several times filled, and the men escaped narrowly with their lives. However, this difficulty does not exist in high water, which happens within the period which I have previously mentioned. We found the natives extremely numerous, and generally friendly, though we have on several occasions owed our lives and the fate of the expedition to our number, which consisted of thirty-one men. On the 17th of November we reached the ocean, where various considerations induced us to spend the winter: we therefore searched for an eligible situation for that purpose, and selected a spot on the south side of a little river called by the natives Netat, which discharges itself at a small bar on the south side of the Columbia, and fourteen miles within point Adams. Here we constructed some log-

log-houses, and defended them with a common stockade-work: this place we called Fort Clatsop, after a nation of that name who were our nearest neighbours. In this country we found an abundance of elk, on which we subsisted principally during the last winter. We left Fort Clatsop on the 27th of March. On our homeward bound voyage, being much better acquainted with the country, we were enabled to take such precautions as in a great measure secured us from the want of provision at any time, and greatly lessened our fatigues, when compared with those to which we were compelled to submit in our outward-bound journey. We have not lost a man since we left the Mandians; a circumstance which I assure you is a pleasing consideration to me. As I shall shortly be with you, and the post is now waiting, I deem it unnecessary here to attempt minutely to detail the occurrences of the last eighteen months. I am, &c.

Your affectionate brother,

WILLIAM CLARK.

III. *Extract of a Manuscript Memoir, by M.* PAYSSE, *upon Coffee. Communicated by M.* PARMENTIER*.

IN 1803 I wrote to M. Payssé, then professor of chemistry in the Military Hospital for Students at Metz, requesting to be informed if, during his stay among the Dutch, he made any remarks or collected any information on the subject of coffee. His answer transmitted to me a very complete memoir, in which was contained the history of that grain; the botanical characters of the tree which produces it; its culture, preparation, and use, as a beverage; and, lastly, an analysis of it.

The war, and my bad state of health, not permitting me to finish the work on which I was then engaged, and for which I had applied to M. Payssé for assistance, I kept his memoir for three years in my port-folio. Having seen, however, that the subject is now occupying the attention of

* From *Annales de Chimie*, tom. lix. p. 196

the

the French chemists *, I think it my duty to extract and publish from M. Payssé's memoir what may be useful. I presented it, therefore, at one of the meetings of the Pharmaceutical Society, and I now publish it in the form of an extract, beginning with its chemical examination: I shall adopt the author's own language.

Several chemists have successively occupied themselves with the examination of coffee; but as the methods of analysis formerly employed had not arrived at that degree of perfection to which modern chemistry has raised them by its numerous discoveries, I thought of resuming the subject, in the hope of throwing some more light upon the composition of a substance so generally in use. It would be superfluous to relate the different results obtained from each analysis. I shall therefore confine myself to pointing out those of the most recent authors who have taken up the subject, such as Ryhiner and Chenevix, subsequently to Geoffroy, and shall afterwards detail my own observations resulting from actual experiments.

Being desirous of knowing the particular principle newly discovered in coffee by Mr. Chenevix †, I proceeded to the chemical analysis of it as pointed out by him: it will be seen, however, that my results do not always agree with those of M. Chenevix, and that, in place of a principle in which he seems to have discovered nothing at all acid, I found, on the contrary, a new acid strongly characterized and very distinct from all the other acids.

I reduced into powder 122 grammes 286 milligrammes (four ounces) of coffee, said to be from Martinique: after having put 0·318 milligrammes (six grammes) in a glass containing tincture of turnsole, the violet-blue colour of the latter soon changed into red.

The same quantity of powder, mixed with a solution of sulphate of oxygenated iron, produced a very fine green colour inclining to violet.

* See Phil. Mag. vol. xxvi p. 17.

† Mr. Chenevix's paper on this subject was originally given in the Philosophical Magazine, vol. xii. p. 350, and afterwards copied into the foreign journals.

The solution of green sulphate of iron acquired, on a similar mixture, a very slight green tint, which became deeper on being exposed to the air.

The coffee powder remaining was put into a glass retort with thrice its weight of distilled water: having joined a receiver to the head and luted it, I heated it sufficiently to bring the liquor to the boiling point: having kept it six hours in this state, I unluted the apparatus and filtered the liquid, which I submitted to some experiments.

The liquor which came over during the distillation was charged with the aroma of coffee in a very sensible degree; it was of a sweetish taste; not altering the blue vegetable colours, nor the different re-agents with which it was put in contact.

The filtered water of the decoction had a greenish appearance; was of a slightly viscous consistence; had a bitter taste mixed with roughness; discolouring and changing into red the turnsole and violet tinctures; communicating suddenly a very fine green colour to the solution of oxygenated iron; a very clear green to the green sulphate; a sombre gray precipitate to the nitrate of mercury; a greenish gray to the precipitate of nitrate of silver; a yellowish white to the precipitate of nitrate of bismuth; a light and grayish green precipitate to the sulphate of copper; a green inclining to violet to the precipitate of sulphate of manganese; a sombre gray to that of the sulphate of zinc; a dirty white to that of the sulphate of alumine, with a discolouring of the liquor; a whitish gray to a very voluminous and very sudden precipitate of the muriate of tin; a more decided gray than the preceding to that of the muriate of lead, which is also very abundant; a white inclining to yellow to the acetite of the same metal; a white to a slight precipitate of muriate, nitrate, and acetite of barytes.

The sulphuric acid produces a yellow colour with a flaky precipitate, light and gray; the nitric and muriatic acids produce a yellow colour.

Potash, soda, ammonia, pure barytes and lime, give this decoction a saffron yellow colour; the hydrosulphurets give it the same colour, with a light precipitate.

Mixed

Mixed with a solution of glue, there results from it no precipitate nor change of colour different from that which is natural to the mixture of the two liquors.

A quantity of coffee equal to that above employed was pulverized, and boiled repeatedly like the foregoing in three times its weight of pure water, in order to convince myself that the husks were completely exhausted: the second and third decoctions gave a greenish appearance deeper than the first, without my being able to ascertain positively the cause of this slight difference. I merely presumed that, the latter decoctions being made in the open air, the extractive matter had been able to oxygenate itself sufficiently, and to produce this effect without precipitating it. These decoctions always maintain a muddy appearance, in spite of repeated filtrations.

All these liquors united were submitted to evaporation in a glass retort so managed as to avoid the contact of the air, and consequently the oxygenation of the extract. Condensed to the consistence of a syrup slightly boiled, I finished their evaporation in a glass capsule. This production became transparent in proportion as it acquired consistence, and viscous like an extract: its colour was that of horn, of a bitter acid taste mixed with a degree of roughness which I do not know how to describe, and it reddened the blue colours: its weight was 15·216 (4 drachms), which I put aside for the purpose of being examined, as we shall see hereafter.

Sixty-one grammes 143 milligrammes (2 ounces) of coffee in powder were digested in a glass vessel with 122 grammes 286 milligrammes (4 ounces) of alcohol, giving 34 degrees at Baumé's areometer: I filtered, after two hours' maceration at a temperature of 15° (65° of Fahr.); the alcohol was highly coloured; when evaporated it gave a product of 7 grammes 643 milligrammes (2 drachms) of a hyacinth-coloured matter, slightly viscous, bitter, acid, partly soluble in water, and precipitating, when diluted in this liquid, grayish flakes, burning, like the resins, with a thick smoke, and which I considered as a resinous substance. The portion dissolved, treated with the re-agents already mentioned,

 presented

presented phænomena very analogous to those of the decoction; I say analogous, because the decomposition of some of them appeared to have taken place more slowly and less completely; which made me presume that the presence of the greater quantity of extractive matter than the decoction contains was one of the causes which facilitated these decompositions, and increased the quantity of the precipitates. We shall return to this subject: this solution was moreover mixed with certain other re-agents, of which it is interesting to ascertain the action.

With the prussiate of iron and crystallized potash dissolved, the mixture of the liquor gave a green colour; with the prussiate of ammonia, a yellow colour; with the prussic acid, a colour slightly gray.

The preceding experiments only proving the existence of an acid combined, or simply mixed with foreign matters, which might perhaps have occasioned some of the phænomena observed, it became important to verify the processes employed by Mr. Chenevix (who has not ascertained the presence of the acid I remarked); and, in short, to take away every kind of uncertainty upon this matter by endeavouring to obtain it by the processes of the English chemist.

I boiled, in a glass alembic in a sand bath, 489 grammes 146 milligrammes (1 pound) of Martinique coffee, reduced into powder, in three times its weight of distilled water for about two hours: the water, when filtered, I replaced upon the husks as they were condensed in the distillation, with an addition of about a kilogramme of the same liquid. The operation being finished, I filtered and mixed the two liquors; I then poured muriate of tin, crystallized and dissolved in pure water, until no more precipitate was formed: I passed the whole through a filter, washed the husks remaining upon the paper in several waters, and afterwards introduced the whole into a flask with two apertures, with six times its weight of water: having carefully agitated the mixture, I introduced, by means of a suitable apparatus, sulphuretted hydrogen gas, which passed slowly through the liquor. The decomposition of the compound of tin and the acid of coffee was easily effected: the new combination of the hydrosulphuret of tin

was

was manifested in the form of a white precipitate, which I had the precaution to shake frequently with a glass tube, in order to make it present a greater surface and more points of contact to the hydrogen gas saturated with sulphur. The operation being finished, I unluted the apparatus and filtered the liquor of the flask, which passed very limpid, preserving, however, a slight smell of sulphuretted hydrogen. I proceeded to evaporate it in a glass capsule, with a moderate heat: the liquor, when reduced to one-third of its volume, no longer retained the hydrosulphuretted smell. I continued the evaporation in order to give to the liquid a pretty strong syrupy consistence: when brought to this point it was very transparent and of the colour of horn, as observed by Mr. Chenevix. In this state it was submitted to the following experiments:

Applied to the tongue, its bitter taste was mixed with an acidity and a roughness of which we have already spoken; mixing itself with water and even alcohol in any proportions; presenting no crystallization in spite of the care taken in its evaporation; liquefying in the fire, and afterwards swelling very lightly; spreading a sharp and pungent whitish smoke; leaving as a residue a charry matter, not voluminous, and very slightly salt.

I afterwards submitted the acid thus collected to an analysis by fire in close vessels. For this purpose I introduced 100 parts of it into a glass retort, to which I adapted the hydro-pneumatic tub and an intermediate flask with two necks: the first product which appeared was only water; this was coloured in proportion as I augmented the fire under the distillatory vessel, and during this time there passed into the flask a little oil highly coloured and very fetid: upon raising the temperature still higher, I succeeded in liberating some cubic inches of carbonic acid gas and carbonated hydrogen gas. When there was no more disengaged, I put out the fire and unluted the apparatus: when the retort was broken I found a charcoal weighing 0·36: made red-hot in a platina crucible for an hour, it was impossible to incinerate it; heated with the blow-pipe it lost in weight, and a very small portion of it was incinerated; yet it was

 impossible,

impossible, on account of its small quantity, to determine the nature of this residue, which was black inclining to gray.

The liquid product contained in the receiver contained in all 0·45 of the mass distilled; whence I concluded that the amount of the gas formed during the operation was nearly 0·19. The empyreumatic oil separated from the aqueous liquid, and a little soapy, weighed 0·15; the water 0·30.

The acid of coffee which I obtained pure was dissolved in six times its weight of pure water; in this state it was mixed with the following substances: with turnsole and violet tinctures, which it reddened very suddenly; with solutions of oxygenated and green sulphate of iron, the former solution immediately assumed a fine green colour, and after resting six hours there was a precipitate formed of the same colour; the latter solution at first only assumed an extremely slight green tint, but this became deeper upon being exposed some hours to the air. Gelatine was not precipitated by the acid of coffee; the muriates of tin and lead were precipitated very suddenly and very abundantly in grayish white; muriate of antimony in a flaky white, very suddenly; the nitrates of mercury and bismuth in dirty white; the nitrate and acetite of copper in a sombre brown; the nitrates of silver and cobalt, the sulphates of manganese, zinc, and copper, underwent no alteration; that of copper only lost in colour; the nitro-muriates of gold and platina lost nothing, not even their colour.

The action of the sulphuric, sulphurous, nitric, nitrous, muriatic, oxymuriatic, and phosphoric acids only gave this vegetable acid a yellow tint more or less beautiful in the cold; by heating them mixed, the sulphuric acid became highly coloured, and liberated vapours of sulphurous acid; the nitric acid was easily decomposed with a disengagement of gaseous oxide of azote and carbonic acid, which precipitated lime water. The residue of this kind of combustion, subjected to some trials, seemed to me to be only malic acid, not precipitating lime from its combinations like the oxalic, The oxymuriatic acid gave a similar product.

Among

Among the vegetable acids, the malic, oxalic, and tartarous, only gave, on their mixture with the acid of coffee, a clear yellow tint to the latter.

The pure or saturated alkalis of potash, soda, and ammonia, only gave as a product mixtures of a deep yellow inclining to orange.

Lime, barytes, strontian, and the hydrosulphurets, presented, upon being mixed with this acid, phænomena little different from those of the alkalis.

Among saline substances the prussiate of ammonia gives a product similar to that of the alkalis.

The prussiate of iron and potash develop a slight green tint, which indicates the decomposition of the little prussiate of iron that this re-agent always contains.

Sulphate of alumine, acetite of barytes, and the nitrate of this latter base, are partly precipitated in white powder by this acid, after the mixture of these liquids has remained some time at rest.

Tannin, as well as gallated alcohol, are sensibly discoloured on mixture with the acid of coffee*.

After having determined the chemical action of the acid of coffee upon the different re-agents which we have here enumerated, it was necessary to inquire among the known vegetable acids for that which presented the greatest analogy with the former acid. We first examined gallic acid, and afterwards the tanning principle; but we shall see, by comparing the most characteristic properties of these latter, that we cannot be permitted to establish an identity of a physical or chemical nature between them and the acid which is the subject of our present inquiry.

Tannin, very pure, precipitates in black the solution of sulphate of oxygenated iron; the acid of coffee communicates a green tint to it: the latter does not precipitate gelatine; while this is the most remarkable characteristic of tannin, and which would of itself suffice to establish the difference which exists between these two bodies, if there

* The precipitate of iron obtained from the solution of the sulphate of this base with the acid of coffee was dissolved in the nitric, sulphuric, phosphoric, and oxalic acids. The other acids did not attack it at all.

was

was not a crowd of other distinctions, which it would be superfluous to relate here.

As to the gallic acid and that of coffee, the former precipitates in black the sulphate of iron: it is very soluble in water; it precipitates solutions of gold and silver in brown, those of bismuth and mercury in yellow; and causes no change in that of the green sulphate of iron; while the acid of coffee gives to this last a very sensible green tint, and precipitates the iron from it in the same colour on exposure to the air; it gives precipitates of a dirty white with the nitrates of mercury and bismuth, without causing any change in the solutions of gold and platina.

The existence of an acid in coffee being once well demonstrated, it only remains to know in what proportions it does exist, what are the combinations it is capable of forming; and, in one word, the order it follows in its chemical attractions.

In order to attain these branches of knowledge I treated 2000 parts of coffee of the above species, and prepared as above described, with a sufficient quantity of pure water, by various decoctions and in close vessels. The extract, brought to the consistence of honey, was 280 parts: I took 100 parts of this and dissolved them in six times their weight of pure water; I afterwards proceeded, as already pointed out, with muriate of tin, and decomposed the new combination by sulphuretted hydrogen. This operation furnished, after having suitably evaporated the liquor containing the acid of coffee, 0·55 of this matter. Wishing to know the substances with which it was combined in the extract of coffee, I took 100 fresh parts of it, which I dissolved in an equal quantity of water, upon which solution I poured as much highly rectified alcohol; at the same instant the liquor became a little milky, and a whitish flaky matter was separated from it, which I collected on a filter: when dried it weighed 0·05, and when examined it presented all the characters which belong to vegetable albumen. Having afterwards mixed a great quantity of water with the mixture of alcohol and acid of coffee and extractive matter, the liquor formed a second deposit, more coloured, collected at one

single

single place of the vessel which contained it, and which I separated by decanting the liquid. This deposit stuck to the fingers, was insoluble in water, but completely soluble in alcohol; its weight while soft was 0·09; examined after having precipitated it from its alcoholic solution, it presented, on combustion, all the phænomena attending that of resinous bodies.

In order to ascertain the quantity of extract which the aqueous and alcoholic liquor contained, I evaporated it to the consistence of honey, and upon being weighed it was 0·83. I deducted from this quantity that of the acid, the weight of which I knew: that of the extract was then reduced to 0·28; the loss was 0·03; but not being able to examine in this state the extract mixed with acid, I endeavoured to isolate it, by pouring into the solution which I had made of it a sufficient quantity of liquid acetite of lead, and until no more precipitate was formed: I afterwards placed the whole upon a filter, washed the deposit with care, and evaporated the liquor until it had the consistence of a soft extract: this product being weighed, it was 0·25: its colour was hyacinth red; its consistence tenacious; its taste bitter; very soluble in alcohol; not precipitating either the solutions of muriates of tin, lead, or iron: it seemed to be nothing else than the acetous acid coming from the decomposition of the acetite of lead which had been made use of to isolate the acetite of copper, having made an alteration on it, and as it remained in part combined, since its weight was reduced to 0·25 in place of 0 28, as we have already remarked. This loss proceeded, without doubt, from what remained in the vessels in which it was prepared: as to the difference of intensity of colour it presented in this case, it may very probably have proceeded from the oxygen it had absorbed during its evaporation. In order to acquire the completest certainty on the subject, I took twenty parts of it, which I boiled with distilled acetous acid in a close vessel: the extract underwent no alteration, except acquiring a greater liquidity, but it resumed its primitive state by the evaporation of the vehicle which I had introduced into it. It remained to examine

mine the composition of the coffee from which I had separated the extract and the acid, &c.

We have seen that the 2000 parts lost 280 by the different decoctions they had undergone; and the residue was consequently reduced to 1720. I endeavoured to incinerate it by burning it in a Hessian crucible, which I kept red-hot for an hour: the matter began, at first, to spread a pungent smoke, which affected the eyes; inflammation afterwards took place, and the matter burned in this manner during some minutes. The residue of this operation was a very black charcoal, weighing 430 parts; it was reduced into powder and put into a platina crucible, which I kept red-hot for two hours in a reverberating furnace. It was only in this manner that I succeeded in reducing it to ashes, but still in an imperfect manner, since of 322 parts, which the crucible contained after calcination, 230 only were converted into ashes; 92 parts of a charry matter remaining, which refused all attempts at incineration. I poured 200 parts of water upon 230 of ashes, and filtered and evaporated the liquor: it furnished as a product ten parts of a saline substance, precipitated the nitrate of silver in a flaky muriate, and which I recognised, after examining it, to be nothing else than muriate of potash.

The residue was saturated with nitric acid, which entered into combination with a slight effervescence, and without leaving any residue. I decomposed the nitrate formed by the carbonate of potash, and collected the precipitate upon a filter; it was carefully washed, and calcined in a platina crucible; being weighed after this operation there were 216 parts of it, which, added to the ten of the alkaline muriate, yielded 226, from which the loss must have amounted to four parts. The taste of this earthy substance was caustic and burning, absorbing water greedily, and with a disengagement of heat. According to this, I did not hesitate to consider it as caustic lime: in order to ascertain it, however, in a more certain manner, I dissolved it a second time in nitric acid, and tried the liquid nitrate by the sulphuric and oxalic acids, which formed in it insoluble precipitates of of sulphate and oxalate of lime. The prussiate of ammonia indicated the presence of an atom of iron; the gallated alcohol acted in the same manner, by communicating to the solution of this salt a purple colour.

Being desirous of knowing the products which coffee not boiled in water would furnish by its decomposition, I reduced 200 parts of it into a rough powder, which I introduced into a glass retort, to which I joined a tubulated matrass, communicating by means of a tube with the hydro-pneumatic tub. The first portions of liquid which passed into the matrass after the apparatus was heated were only a white limpid liquid, which became brown in proportion as I augmented the heat: to this first product succeeded a citrine oil slightly fetid, which became black and thicker on the temperature being raised. Towards the end of the operation there was sublimed into the neck of the retort a saline matter, confusedly crystallized, mixed with black empyreumatic oil: I then augmented the fire until the bottom of the retort was reddened, in the hope of liberating some gaseous substances; but I did not succeed: so that from this I was led to believe, that the principles of which coffee is composed, and which are disengaged by fire, are combined in a state different from that in which they exist in the grain, and that the proportions of each of them are exactly those which ought to form the ammonia, carbonic acid, oil, water, and pyromucous acid, which are the products of this operation. The retort was broken: it contained a charcoal occupying all the capacity of the vessel; it appeared decorated with the most brilliant colours, and of various hues; the lead gray with the metallic aspect was very distinct towards that part which touched the bottom of the retort; its weight was 50 parts.

The liquid contained in the matrass was composed, as we have said, of thick black oil, very much charred, and of a brownish liquid, fetid and astringent: its total weight, isolated from the oil, was 88 parts; that of the oil was 33. The neck of the retort still contained a sublimed saline matter, of a fetid ammoniacal smell, weighing 22 parts, and which was only carbonate of ammonia: the loss was seven.

The

The astringent liquid tried with turnsole tincture made it quickly become red: solution of sulphate of oxygenated iron acquired a very slight green colour: the muriates of tin and lead were but very slightly precipitated: but in some other trials I made comparatively with pyromucous acid it presented the characters of the latter; from which I inferred that a portion of the acid of coffee was disengaged during the distillation without experiencing any alteration, and that it was mixed with the pyromucous acid. After having determined the proportion of the principles which appeared to me to compose coffee, I thought it necessary to examine if heat developed tannin in this grain, as Mr. Chenevix asserted. In order to convince myself of this I roasted some Martinique coffee until it was of a chestnut brown; after having reduced it into powder, a portion was infused in boiling distilled water, and a second was treated by the same vehicle and by decoction. These two liquors filtered were tried each separately with gelatine, but they gave no kind of precipitate which could indicate the presence of the tanning principle.

The difference between these results and those of the London chemist induced me to roast the coffee more strongly. After it was treated, like the former, by infusion, decoction, and mixed with the solution of glue, there did not even result any change in the transparency of the liquor. Not confining myself to this second experiment, I roasted some new coffee until it was of a brownish black, and at the same time examined all the species known in commerce under the names of Java, Bourbon, St. Domingo, Martinique, Moka, &c.; but none of them gave me any proofs of the existence of tannin treated as we have described. Each of these infusions and decoctions constantly reddened the blue vegetable tinctures; it precipitated, in fawn colour, the muriates of tin and lead; in green, the sulphate of oxygenated iron; in brown, the sulphate of copper; and in chocolate colour, the nitrate of mercury. The pure and carbonated alkalis, barytes, lime, and the hydrosulphurets, communicated to these infusions and decoctions a very deep saffron-yellow colour; which led me to suppose that

a part

a part of the acid of coffee existed in them free, merely entangled in a little extractive matter and a good deal of charcoal.

It remained, in order to render this analysis more complete, to consider the pure acid of coffee with respect to its chemical attractions for the different known bases. I observed, after a multiplicity of experiments, that the metallic oxides were the bodies which combined the most intimately; those of tin, lead, mercury, iron, antimony, bismuth, and copper, precipitated from their solutions or put in contact with this acid, on aiding its action by heat, were there combined, and formed saline compounds, of an austere and metallic taste in general, not crystallizable, pulverulent, and little soluble in water; that of mercury was, however, dissolved in about 160 parts of this liquid, combining itself with and precipitating several colouring matters, which fix very solidly, particularly when stuffs are impregnated and boiled with the compounds so formed with tin, lead, antimony, and alumine. The colouring particles of saffron, of yellow wood, madder, sorrel, and of some pharmaceutical extracts, &c., are those which have proved to me that this new mordant may become useful in the art of dyeing. All these saline combinations are decomposable by fire; but more easily by sulphuric acid; those of iron, tin, and antimony, excepted. The nitric acid decomposes only the combination which the acid of coffee forms with copper.

The earthy substances also form saline compounds with the acid of coffee; alumine is that which seemed to unite most easily; this combination, which is not very soluble, has a slightly saccharine and astringent taste, always pulverulent, and fixing some colours. Lime, barytes, strontian, and magnesia, combine with it also: the last of these earths adheres to it only very feebly.

Potash, soda, and ammonia, form compounds extremely soluble, of a bitter taste, little crystallizable, and decomposable by a slight heat, of a colour always yellow, which becomes brown upon heating it too long.

The muriates of tin and lead dissolved in water, speedily decompose these salts, as does also sulphuric acid, which,

 however,

however, does not act, upon that of alumine. The nitric, muriatic, and phosphoric acids decompose them also in a great measure; it happens at the same time that the acid of coffee is itself changed into malic acid by the nitric, after the latter has been isolated from its union with the bases, in such a manner that a malate and nitrate is obtained, as I was convinced by thus decomposing the cafiate of lime.

Conclusion.

1. It results from all that precedes, that coffee contains a particular acid, very distinctly characterized; that it there enjoys a sort of liberty, since the powder of this grain suddenly reddens the blue vegetable tinctures; and that infusions in cold water, and even in alcohol, may be separated from the acid in a state more or less pure.

2. That the acid decoction of coffee decomposes with facility almost all the metallic solutions, particularly those of lead, tin, iron, &c.*

3. That the precipitates obtained by the mixture of this decoction and metallic solutions, are more abundant and more highly coloured than those formed by the same acid in a pure state; that this difference, I say, proceeds from two causes, which must be considered: first, because the decoction of coffee, besides the caffic acid it contains, contains also extractive matter, colouring matter, albumen, &c.; that the colouring matter is partly precipitated by the affinity it has with the compound formed of caffic acid and the metallic base; that the albumen, on the other hand, isolated from the acid body which favoured the solution in the liquid, is deposited, and increases the volume of the precipitate; that in order to be convinced of this fact, in one word, it is only necessary to boil a cafiate of tin, lead, or alumine, in a coloured vegetable decoction, in order to obtain the result now mentioned.

4. That the acid of coffee may be obtained very pure by mixing watery decoctions of coffee or alcohol macerations of it, with muriate of tin or of lead, and afterwards decom-

* Ryhiner (*Journal de Physique*, tom. xiii. August 1778, p. 238.) has ascertained that the infusions of the different species of the coffee of the Levant and its islands are astringent.

posing

posing these combinations by sulphuretted hydrogen, as practised by Mr. Chenevix as well as by myself, or rather on decomposing the cafiate of lead by the sulphuric acid.

5. That this new acid is not crystallizable in the state in which I obtained it, and that it is completely soluble in alcohol and water.

6. That it is capable of decomposing the prussiate of iron contained in the prussiate of potash (a common re-agent in the laboratories) by forming with the metal a green compound, which is precipitated; and in this respect it may, perhaps, be of great use to chemists, in order to obtain very pure, prussiate of potash, which hitherto could not be deprived of some portions of iron which it obstinately retained.

7. That the colour which it communicates to the solution of oxygenated and green sulphate of iron, seems to be completely new.

8. That the attraction of the compounds which it forms with tin, lead, antimony, and alumine, and with the colouring matter of infusions or vegetable decoctions, may render it very useful in the art of dyeing.

9. That the different species of coffee contain it in proportions little variable; and that it exists at the same time, without alteration, in a smaller quantity, in the infusions and decoctions of coffee roasted at different degrees, as well as in the products of the distillation of this grain.

10. That the comparison I have made of the properties of this acid with the gallic acid and the tanning principle, showed no kind of identity of nature among these three very different substances.

11. That the particular principle obtained by Mr. Chenevix is nothing else than the acid in question, but which had not been subjected by this accurate chemist to a strict enough examination.

12. That, having examined the infusions and decoctions of different kinds of roasted coffee, they gave me no evidence of the existence of the tanning principle on mixing them with gelatine, as asserted by Mr. Chenevix.

13. That the acid of coffee is susceptible of being united

with various bases, of forming particular salts, decomposable in the fire, with more or less facility; and that its attractions, in one word, seem to follow a law completely different from that of most of the known acids, since its union with the alkalis seems to be weaker.

14. That it is decomposed by warm sulphuric acid, by the nitric, muriatic, and oxymuriatic acids, and reduced by the latter, as well as by the nitric, into malic acid.

15. That it seems to me to be composed, according to the products obtained by its analysis in the retort, of much of carbon, and little hydrogen and oxygen.

16. That 100 parts of watery extract of coffee, produced from about 750 parts of coffee, yielded 0·55 of caffic acid, 0·25 of extractive matter, 0·05 of vegetable albumen, 0·09 of resinous matter, and 0·06 of loss.

17. That in order to conform ourselves to the language of modern chemistry, the acid of coffee ought to be called *caffic acid*, as the denomination which best suits it.

18. That the charry and incinerated residue of coffee is composed of muriate of potash, lime, and a quantity of iron which I was unable to appreciate.

19. Finally, that coffee, from all we have seen, is a substance in which carbon is in a much greater proportion than hydrogen, oxygen, or azote; the existence of all these bodies having been plainly demonstrated by the formation of oil, pyromucous acid, carbonic acid, and ammonia, formed in it by the distillation of this grain.

IV. *Description of a Compound Gasometer, for Purposes where uniform Pressure is essential, by the Application of the Hydrostatic Regulator. By* JOSEPH STEEVENS, *Esq.**

A, (fig. 1. Plate I.) is a tin or brass cylinder three feet six inches long and nine inches diameter, supported on two pillars

* Communicated by the inventor, Mr. Steevens.

pillars B B, which are fixed into the base *c c*. D and E are two glass jars eleven inches diameter and eighteen inches high, fixed to the base by means of two brass rings about one inch broad. F is a glass globe twelve inches diameter, sustained in its place by means of the tripod *m m*; this, and the two glass jars, are provided with brass collars and caps *n*, *n*, *n*; into these are screwed, and properly fixed, the tubes and cocks *o*, *h*, *p*, *k*, *q*, *l*, *s*, *i*, *t*. Through a collar of leathers on the cylinder A passes the metal tube Y, about four-tenths of an inch diameter, extending down the tin or brass tube G (of about two inches and a half diameter) to H: this tube is moveable through the collar of leathers, and may be elevated and depressed at pleasure until the desired pressure is attained. *h* and *i* are two tubes passing from the cylinder A into D and E, and are recurved under the cap, as represented at *y*, fig. 2. *q* is a cock for exhausting the balloon F, and behind it is a glass tube through which passes the wire *b*, nearly meeting the end *c* of the recurved tube *k c*, for igniting the gas by the electric spark in the composition of water by the combustion of hydrogen in oxygen, as described by M. Van Marum (Phil. Mag. vol. ii. p. 85). The jars D and E are provided with cocks *x x*, cemented into apertures formed for that purpose. The tubes *h*, *i*, *k*, *l*, being fixed with screwed flanches, may be easily removed, as also the caps *n*, *n*, *n*, which are screwed to the collars so as to be perfectly air-tight.

The gasometer being thus prepared, nothing more is necessary to charge it than to fill the cylinder A, screw in the collar of leathers, and adjust the tube Y H, so that the end H be on a level with the upper parts of the plugs of the cocks *o*, *p*, *s*, *t*, all of which must be opened. Open also *h* and *i*, by which means D and E will be filled. Shut *h*, *p*, *s*, *i*, and, having the gas-holder V ready, screw the cocks *v* and *z* on to *t* and *x*. Open these cocks, and the gas in V will be transferred into E: charge it again with the gas intended for D, and proceed in the same manner. The vessels D and E should be provided with a scale expressing in cubic inches the quantity of gas at any time in them. Having determined the requisite pressure, adjust the tube Y H accordingly *, exhaust the globe F, and proceed with the experiment as described by M. Van Marum.

An operation may be continued any length of time with this gasometer, without altering the pressure, by filling D and E with the requisite gas during the experiment, which is performed thus: the gas-holder V being charged, screw the cocks v and z on to u and x, and the water will run into V until the gas is exactly of the same density as that in D or E: shut u and v, and screw on to t; open t, v, x, and z; and the gas in V will be transferred into E, without altering the effective pressure. Proceed in the same manner with the gas intended for D.

V. *Experiments upon the various Species of Cinchona.* By *M.* Vauquelin †.

§ I.

Physical Properties of Cinchona.

In commerce, many different species of cinchona are known; the principal and most frequently employed species, however, are the following:

The first, antiently known by the vague name of Peruvian bark, appears to be that produced from the tree called by Linnæus *cinchona officinalis*. This species has a grayish colour externally, and a pale red internally; it is very thin, rolled inwards on the side which adhered to the wood; having a glossy and as it were a resinous fracture, sometimes slightly fibrous; an astringent and bitter taste. It yields a fawn-coloured powder mixed with gray.

* The effective pressure will always be as the height of the orifice H above that of the recurved tube y; and this pressure will continue uniform and precisely equal in both vessels, without regard to the quantity of water in A.

For the mode of filling A during an experiment, as well as for further particulars relative to the principles of this instrument, see description of the Hydrostatic Regulator, Phil. Mag. vol. xx. p. 289.—J. S.

See also Mr. Steevens's description of his Single Gasometer, vol. xxiv. p. 163. —Edit.

† From *Annales de Chimie,* tom. lix. p. 113.

The

The second species, called *red cinchona*, and erroneously *cinchona pitton*, is of a deeper colour than the first, generally very thick, not rolled or but little so, presenting a fibrous and by no means a resinous fracture, having an astringent and slightly bitter taste.

Lastly, the third species, more recently discovered, and which ought not to be confounded with the bark of the *angustura*, as sometimes happens in laboratories, is designated by the name of *yellow cinchona*.

Its colour is of a pale yellow; its taste is bitterer and less astringent than that of the two former species; its fracture is partly ligneous and partly resinous; it is a little more or less rolled inwardly, according as it is more or less thick.

Such are the three most commonly known species of cinchona, and those most generally employed in medicine; but there are many other species which are confounded with them, the several varieties of which are perhaps regarded as different species. These varieties may be occasioned by the age, the soil, the climate, or the parts of the tree from which the bark has been taken*.

Although the bark called *angustura* is not a true cinchona; yet as it has some of the exterior characters of it, and as it may be easily confounded with it, it is right to make known its distinguishing properties. This bark is yellow, extremely bitter, by no means astringent, and not at all rolled up like the cinchonas.

§ II.

Are there any Characters by which to distinguish the good Species of Cinchonas from such as are bad, or as have been adulterated?

This is certainly an important object to attain for the success of this medicine in the treatment of intermittent fevers,

* M. Mutis distinguishes seven different species of cinchona; but the most of them are unknown in France. The only species known at Paris, besides those mentioned above, are thus denominated: *quinquina rouge ordinaire, quinquina gris canelle, quinquina gris plat, quinquina Santa-Fè*; but we are by no means certain that they belong to different species of trees. We shall see, a little further on, that several of them resemble each other in almost every point, and that others of them are not true cinchonas.

as well as for commercial people who deal in the article by wholesale.

If we had an accurate and simple method of ascertaining the best species of cinchona, or of distinguishing them from the false, or from such as had been any way adulterated, it would be wise in government, in my opinion, to institute a commission, formed of physicians and apothecaries, in every sea-port town, in order to examine all the cinchonas which arrive there, and to prevent from being circulated in commerce such as do not undergo the tests prescribed. But, unfortunately, the judgment hitherto formed upon the good or bad quality of this medicine has been made to depend upon some physical properties, often deceitful; such as the colour, smell, taste, fracture, compactness, &c.; qualities which are too arbitrary, because the senses and custom are the tests here employed.

M. Seguin has lately endeavoured, by experiments, to throw a light upon this subject more certain than what we have hitherto had. According to him, the aqueous infusion of the best sorts of cinchona possesses exclusively the property of precipitating an infusion of tan; while, on the contrary, the bad species precipitate a solution of animal gelatine: thus he not only judges of the absolute qualities of these substances, but he can also give the measure of the respective qualities of the different species of cinchona, by the greater or less abundance of the precipitates he obtains.

If the observation of M. Seguin held true in all the good cinchonas, and if the phænomenon which occasioned it was owing to the principle, which in this substance is a febrifuge, they would furnish a strong argument why government should adopt the measure above recommended.

But I shall have occasion, hereafter, to make some remarks upon the assertions of M. Seguin, in showing that there are several species of true cinchona which do not precipitate a solution of tan, but which, however, are capable of curing fevers.

§ III.

§ III.

Treatment of different Species of Cinchona by Water; Manner in which their Maceration and their Decoction act upon the Re-agents.

I have compared, by physical and chemical properties, infusions of all the species of cinchona known in commerce, to which I joined the examination of some other vegetable substances which appeared to be analogous to cinchona, and which have been also resorted to in the treatment of fevers.

The infusions were prepared with the same quantities of water, the same quantities of bark at an equal temperature and during equal times; so that the differences we shall observe could not proceed from the mode of preparation.

First Species.—*Yellow Cinchona**.

1. 122 grammes (4 ounces) of this cinchona, infused for 24 hours in two litres of water at 12° (60° Fahr.), communicated a yellow colour to the water, a very bitter and slightly astringent taste.

2. This infusion formed a very abundant flaky white precipitate in a solution of isinglass.

3. It gave to a solution of sulphate of iron a green bile colour, and formed in it, some time afterwards, a precipitate of the same shade.

4. It precipitated, in yellowish white, the solution of tartarite of antimoniated potash.

5. The oxalate of ammonia produced a precipitate in it, which was oxalate of lime.

6. Lastly, this infusion reddened very sensibly the tincture of turnsole.

The infusion of cinchona of which I am now speaking, completely precipitated by the solution of glue and filtered, has no longer any colour, and hardly any astringency; but

* It was brought to Spain in 1788, where, having been employed for the royal family, it got the name of royal cinchona. According to M. Vestrumb it came from Moxos, in the south part of America, and is named by the Spaniards *calisaya*. They prefer it to the gray cinchona of Peru; it is yellowish brown, fibrous, large, flat, and easily reduced into fine powder.

it still preserves its bitter taste. Mixed in this state with a solution of sulphate of lime, it turns it green as before; alone, the colour inclines more to yellow. It precipitates the emetic solution with this difference, that the precipitate is whiter.

Another portion of the infusion of the same cinchona, completely precipitated by the emetic and filtered, still rendered turbid the solutions of glue and of sulphate of iron, but much less abundantly than formerly. The precipitate formed by the emetic became slightly green by the addition of some drops of sulphate of iron.

It would seem, according to these experiments, that the principle which precipitates emetic, glue, and sulphate of iron, is the same; and that, if the liquor still preserves the property of precipitating glue and sulphate of iron, it is because it retains some portions of the combination of this principle with antimony. This supposition, however, cannot be reconciled with the very abundant precipitation of glue by certain cinchonas, which by no means precipitate emetic. It therefore follows, that the principle which precipitates glue may be different from that which decomposes emetic.

Such are the phænomena which the infusion of yellow cinchona presented to me with the above re-agents.

I was desirous of ascertaining if this same cinchona, already exhausted by cold water, would present, by boiling it, any differences with the same substances. But I found an almost perfect analogy in this respect; its decoction was turbid upon cooling, and the precipitates which it furnished with the re-agents were more abundant, and were more promptly separated from the liquor.

I shall add, that this decoction precipitates, like the infusion, the solution of sulphate of copper in reddish yellow, and that of the acetate of lead in yellowish white.

Second Species.—*Cinchona of Santa-Fè.*

This species of cinchona, newly introduced into commerce, has been tried, with respect to its febrifuge effects, by by several excellent physicians, who have obtained from it the happiest results.

It is gray externally, red within, thick, little rolled, having an astringent and slightly bitter taste. Its infusion has a much redder colour than that of yellow cinchona. Subjected to the same experiments with the above infusion, it presented the following effects:

It precipitated the solution of glue in reddish flakes; the infusion of yellow cinchona, in very abundant red ones; this last effect, which as far as I know has not been announced by any person, is worthy of remark.

It produced no change in the emetic solution: this establishes a difference between this and the yellow bark, which, as we have seen above, precipitates very abundantly this metallic salt.

It precipitates the solution of sulphate of iron in a fine deep green; sensibly reddens tincture of turnsole; is precipitated by oxalate of ammonia in oxalate of lime, but much less abundantly than the infusion of yellow cinchona.

It precipitates acetate of lead and sulphate of copper in reddish brown.

On comparing the phænomena produced by the cinchona of Santa Fè with those of the yellow bark, we find among them some analogies and several differences. They both precipitate a solution of glue; but the infusion of the yellow cinchona precipitates emetic, and that of the cinchona of Santa-Fè does not precipitate it: from this it may be concluded, that, both of them precipitating the other metallic solutions, the principle which precipitates copper, iron, lead, &c. is not the same as that which precipitates the emetic; and that, consequently, the yellow cinchona contains a substance which is not to be found in the Santa-Fè bark.

It is evident besides, that, if these infusions were perfectly similar, no turbidness would follow their reciprocal mixture: there are therefore in each of these infusions different substances, which by combining become insoluble.

Decoction of Santa-Fè Cinchona.

This decoction produced the same effects with the reagents

agents as its infusion; but the latter differs from the decoction of yellow cinchona in not becoming turbid during cooling: thus the Santa-Fè bark not only does not contain the matter which precipitates emetic, but is also deficient in the quantity of the principle which precipitates the other metallic solutions; for I am assured that the deposit formed in the decoction of cinchona, upon cooling, is the substance which in this species precipitates iron green, lead yellow, copper brown, &c.; and that it has no action upon emetic. Thence we may presume, at least, that it would be necessary to employ in intermittent fevers a greater quantity of this than of the yellow bark.

Third Species.—*Gray Cinchona, called Superior Cinchona.*

The infusion of this kind of bark is almost colourless; its taste is bitter and astringent.

It precipitates very abundantly the solution of glue white; the infusion of tan red; the solution of emetic white, and very abundant; sulphate of iron a very fine emerald green: it produces no change in the infusion of yellow cinchona.

Fourth Species.—*Gray Cinnamon Cinchona.*

The infusion of this bark has a deep red colour, a bitter and astringent taste.

In solution of glue it yields a fawn-coloured precipitate, and communicates a green colour to solution of sulphate of iron, but does not precipitate the emetic solution like the gray and yellow cinchona. It occasions no change in the infusion of superior gray cinchona.

This species differs, therefore, from the yellow and superior gray cinchona, in so far as it does not seem to contain that principle which precipitates the emetic; and in this respect it resembles that of Santa-Fè.

The infusion of this bark yields a very abundant fawn-coloured brown precipitate in an infusion of yellow cinchona, and does not precipitate the infusion of tan.

These vegetable infusions, precipitated the one by the other as completely as it is possible, have no effect upon emetic; whence it follows, that the principle which in the yellow

low bark precipitates the emetic, is combined with a certain substance found in the gray cinnamon cinchona and in tan: but these infusions, thus mutually precipitated, still precipitate abundantly the solution of glue; whence again it follows, that the principle which in these two cinchonas precipitates glue is not the same as that which decomposes the emetic: what confirms this opinion is, that the infusion of the yellow cinchona, precipitated as completely as possible by glue, and afterwards filtered, still precipitates the emetic, —a little less abundantly, however.

We cannot attribute the precipitation of the emetic to the excess of glue, for this animal substance causes no change whatever in emetic.

The precipitate which is formed by the infusions of the yellow and gray cinnamon cinchonas, mixed together, is brown; it dries easily, bubbles up by heat, exhales a smoke which has no pungency, and which has some analogy with that of animal matters: it leaves a spongy and light charcoal.

Sixth Species.—*Gray Cinchona* *.

It was in very slender and rolled barks, and must have been taken from the branches, or from very young trees. It would seem to be of the species of the loxa cinchona, which will be described in the course of this memoir.

The infusion of this species had a red colour like Malaga wine, and an astringent and bitter taste: it precipitated abundantly glue in white; infusion of tan in reddish yellow; infusion of yellow cinchona in gray; emetic in flakes of yellowish white; sulphate of iron in green; and acetate of lead in white. It did not precipitate sulphate of copper nor an infusion of Santa-Fè cinchona. This bark possesses the febrifuge property in a very high degree.

Seventh Species.—*Flat Gray Cinchona* †.

The infusion of this species of bark has a red colour like

* This species was transmitted to me by M. Bouillon-Lagrange.

† This seems to be the white cinchona of Santa-Fè, brought by M. Humboldt, which will be afterwards described.

Malaga wine, a fetid taste, without astringency or bitterness.

It precipitates abundantly the infusion of yellow cinchona in brown flakes; it gives to the solution of red sulphate of iron a fine green colour, and produces therein, some moments afterwards, a precipitate of the same colour.

Emetic, glue, cinnamon cinchona, experience no change by the infusion of this bark.

These phænomena seem to announce that this bark is not a true cinchona, or, if it does belong to this class of vegetables, that it has none of their chemical properties: from this we may presume that it does not possess the same medicinal virtues, because it has neither the bitterness nor the astringency proper to all cinchonas in a greater or less degree: if we add to this, that it does not precipitate either glue, emetic, or infusion of tan, properties which belong to the best species of cinchona, we may be almost certain that it is not a febrifuge.

Eighth Species.—*Yellow Cinchona.* (*Cinchona pubescens of Walh*.*)

100 grammes of this cinchona in fine powder, macerated for 24 hours in distilled water, yielded a transparent liquor of a golden-yellow colour, very bitter, and becoming frothy on agitation. Tried by the re-agents, this liquor presented the following effects:

Gallated alcohol formed an abundant precipitate, which an excess of this alcohol redissolved, and which the addition of water reproduced: this proves that it is not a purely animal matter which the tannin separates from it.

It precipitates the solutions of emetic and of nitrate of mercury in yellowish-white, and causes a solution of sulphate of iron to assume a very decided green colour, without precipitating any thing from it.

Solution of size effects no change on it: it does not redden turnsole tincture. During the evaporation, this li-

* The physical description of this cinchona has been made by Walh and other medical botanists.

quor

quor deposited a red substance upon the sides of the pan: when reduced to the consistence of a syrup, it still deposited, upon cooling, a new quantity of matter of a chestnut-brown colour. The filtered liquor was still coloured, and contained the salt proper to cinchonas, which we shall presently describe.

This brown substance, washed with a small quantity of cold water, is completely soluble in warm water and in alcohol; it is very little soluble in cold water; its taste is very bitter.

In the aqueous solution of this deposit, gall-nuts form an abundant precipitate. Emetic and nitrate of mercury produced the same effects in it as in the infusion. The sulphate of iron is turned green by it. The oxymuriatic acid loses its smell, and soon forms a flaky precipitate with the solution of this substance.

Glue produces no more effect than in the infusion: the sulphuric and acetic acids cause no change in it. Diluted with caustic potash, it does not exhale any ammoniacal smell.

225 grammes of this substance dry, submitted to distillation, yielded plenty of water, a sensible quantity of ammonia, and a purple oil, which loses this colour on being dissolved in alcohol, but which resumes it in proportion as its solvent, when exposed to the air, is dissipated.

It left in the retort 11 decigrammes of charcoal, which on combustion yielded a decigramme of ashes soluble with effervescence in the muriatic acid, and the solution of which furnished lime and iron.

It is evident, from what has been stated, that it is this bitter coloured substance, which, in the maceration of the species of cinchona now under consideration, produces with the re-agents all the phænomena we have remarked above. This substance seems to hold the middle place, by its nature and properties, between vegetable and animal substances. It is probably the substance which is the efficacious principle in the cure of intermittent fevers. The liquor separated from this substance was treated by alcohol, which took up the colouring part, and it was nothing else than a portion of the

the same matter retained by water. The portion not soluble in the alcohol was of the consistence of thick mucilage, and had no longer any taste or colour; it was abundantly dissolved in water, and its solution yielded, on spontaneous evaporation, lamellous crystals slightly coloured with a salt, which we shall afterwards describe.

The seventh maceration of the same quantity of cinchona still precipitating with gall-nuts, it was thought that cold water had not dissolved the whole of the principle which produced this effect: the refuse of this cinchona was therefore boiled, and we obtained a liquor which presented all the characters of the infusion, except that it did not precipitate the emetic solution; probably because it was too much diluted with water.

This species of cinchona, therefore, is not the same as that which has been examined above under the same name.

Ninth Species.—*Cinchona officinalis.*

Eighty-four grammes of this bark, treated like the *cinchona pubescens*, yielded a liquor less coloured and more mucilaginous than the latter, although equally bitter. This infusion slightly reddened the tincture of turnsole; tried by the re-agents it presented phænomena similar to those of *cinchona pubescens*.

All the waters of maceration, when evaporated, furnished a deposit, the properties of which were so confounded with that obtained from the *cinchona pubescens* that it was thought they might be mixed together; but the liquor floating above, containing the essential salt of cinchonas, was submitted separately to evaporation and to the spontaneous crystallization: after having separated from it the colouring matter by means of alcohol, it furnished crystals after a few days. Here, therefore, are two species of cinchona which do not precipitate glue, and which, consequently, are deprived of the principle to which this effect is owing in other kinds; according to M. Seguin, they would be ranked among the best kinds.

After several washings in cold water, the last washings always precipitating by gall-nuts, the husks were treated by

warm

warm water, which acquired a deep enough colour; it was less bitter than the water of maceration, and it was still more mucilaginous than the decoction of *cinchona pubescens.*

It precipitated gall-nuts and nitrate of mercury, and greened the sulphate of iron; but neither emetic nor glue produced any change upon it. This species, therefore, is not the same as that which has been above examined under the name of *gray cinchona,* called *superior.*

Tenth Species.—*Cinchona magnifolia.*

100 grammes of this bark, reduced into a fine powder, and macerated for 24 hours, yielded a solution which passed through the filter with difficulty; it was of a ruby red, little mucilaginous, of a slight bitterness, and a very decided astringency.

The tincture of turnsole was not reddened by this solution; neither gall-nuts nor emetic formed any precipitate in it; the solution of glue precipitated it abundantly; the sulphate of iron made it assume the green colour of oxide of chrome, which the oxymuriatic acid turned into a dirty green.

It also precipitated the maceration of *cinchona pubescens* and of *cinchona officinalis.*

It is necessary to remark, that the second washing of this cinchona, made with cold water, did not precipitate glue.

The macerated aqueous extracts of this cinchona, evaporated to the consistence of extract, while still hot were treated with alcohol, which acquired a very fine colour. This alcoholic solution, diluted with water, and tried by the reagents which had been made use of for the first macerated extracts, presented the same results. Thus the matter which produced the effects above announced is soluble in alcohol.

The part not soluble in alcohol was of an ochre red, which was blackened by the air; it was redissolved in water; its solution would neither precipitate glue nor gall-nuts, but it precipitated emetic and nitrate of mercury, and turned sulphate of iron green.

Ten grammes of this substance, insoluble in alcohol, being distilled,

distilled, yielded ammonia, and a charcoal weighing 41 centigrammes.

Tenth Species.—*Cinchona which was sold to me without any Name* *.

100 grammes of this bark, macerated for 24 hours, gave a less deep colour to water than the *cinchona magnifolia;* but it was more bitter and less astringent. It reddened perceptibly the tincture of turnsole; it neither precipitated the emetic nor gall-nuts; but it precipitated glue, and nitrate of mercury, and greened the sulphate of iron.

In general, this species presented all the characters of the *cinchona magnifolia,* and ought to be ranked in the same class.

The decoction of the husks of this cinchona presented no difference on maceration, nor did it precipitate emetic.

Eleventh Species.—*True Pitton Cinchona.*

This species of bark, which was given me by M. Solomè, apothecary at Paris, has a good deal of resemblance, in colour and bitterness of taste, to the cinchona of St. Domingo, which M. Fourcroy analysed about fifteen years ago.

100 grammes of this cinchona, treated like the other species, communicatd to water a blood red colour. Its taste was more bitter and disagreeable than that of the others. Gallated alcohol, emetic, nitrate of mercury, and sulphate of iron, produced abundant precipitates with this solution; glue produced no change in it. The oxymuriatic acid precipitated it, which no other acid effected.

The infusion evaporated left a residue which was partly dissolved in alcohol, and communicated to it a fine red colour. The portion insoluble in alcohol had a gray colour and an earthy appearance: that which was dissolved presented the same phænomena as the infusion from which it was produced. This substance yielded ammonia upon distillation.

* It had all the characters of the *cinchona magnifolia.*

Cinchonas

Cinchonas brought to Europe by Messrs. Humboldt and Bonpland.

Twelfth Species.—*Cinchona of Loxa, coming from Branches of two Years of Age, and made use of in the Laboratory of the King of Spain.*

It is gray externally, yellowish within, very thin, rolled up, and has a bitter and astringent taste.

Eight grammes of this bark, infused in 150 grammes of water for 24 hours, at the temperature of 15° (60° Fahr.), yielded a reddish yellow slight-coloured liquid, having a slight musty smell and a bitter taste: it precipitated gall-nuts, emetic, and acetate of lead, in yellowish-white; iron in blueish-green; oxalate of ammonia, white; and glue in large glutinous white flakes. The precipitates formed by glue and by emetic are redissolved in an excess of warm infusion.

According to these properties, this cinchona ought to be accounted an excellent febrifuge.

Thirteenth Species.—*White Cinchona of Santa-Fè.*

This bark has a yellow colour, rusty externally, deeper internally: it is flat and thick; its fracture resembles that of beech bark; its taste is neither bitter nor astringent, like that of other cinchonas.

Eight grammes, infused for 24 hours in 150 grammes of water, gave a deeper yellow colour than the cinchona of Loxa: this infusion does not precipitate gall-nuts, emetic, nor glue: it turns solution of iron green, and precipitates the acetate of lead in brownish yellow. According to these properties, this is not a true cinchona.

Fourteenth Species.—*Orange Cinchona of Santa-Fè.*

This species, which was brought to Europe by Messrs. Humboldt and Bonpland, has a yellow colour like cinnamon: as this bark has no epidermis, it is thick, and its fracture extremely fibrous; the thinnest pieces are rolled up within each other; the thickest are flat, and it is by no means astringent; its infusion, made as above directed, is almost colourless; its taste is decidedly bitter; it gives in

 tannin

tannin and emetic an abundant white precipitate, but no precipitate in glue, and a slightly green colour with iron; it does not make the infusion of Loxa cinchona turbid. This differs from the Loxa cinchona, and, it would seem, does not possess the properties of a febrifuge in any remarkable degree.

Fifteenth Species.—*Common Cinchona of Peru.*

This species is gray externally, of an ochre red internally, and its surface is wrinkled; it is rolled, and of various thickness; its taste is bitter and astringent.

Eight grammes, infused for 24 hours in 150 grammes of water, communicated a slight yellow colour to it, and a bitter and astringent taste. This infusion precipitates emetic, glue, and tannin, in yellowish-white, and sulphate of iron in green. It reddens turnsole paper.

This species of cinchona seems to be the same as the gray cinchona called *superior*. According to the properties it presented to me, it ought to be excellent for fevers.

Sixteenth Species.—*Red Cinchona of Santa-Fè.*

It did not seem to differ perceptibly from that which we described above by the name of Santa-Fè cinchona.

Eight grammes of this cinchona, infused like the preceding, gave to the water a red colour like Malaga wine, and a taste not very bitter, but astringent. It precipitates glue in brown, but neither emetic nor tannin; it greens the sulphate of iron, and reddens slightly turnsole paper. These chemical properties agree with those of the Santa-Fè cinchona above described.

Seventeenth Species.—*Yellow Cinchona of Cuença; Branches of four or six Years of Age*.*

This cinchona is gray externally, covered with a white moss, yellowish-brown internally, having a fibrous fracture and hardly any taste; its maceration is neither bitter nor astringent; precipitates neither emetic, glue, nor tannin; it merely greens sulphate of iron, and precipitates acetate of lead. This cinchona does not seem to have any febrifuge virtue.

* It seemed to have been adulterated.

Table

Table of the Effects produced by the Cinchonas brought by Messrs. Humboldt and Bonpland, with the Re-agents marked against them.

Species.	Glue.	Tannin.	Iron.	Emetic.	Observations.
1. Common gray cinchona of Peru.	Abundant precipitate.	Ditto.	Green colour.	Abundant precipitate.	Taste bitter and astringent, and it reddens turnsole.
2. Red cinchona of Santa-Fè.	Abundant precipitate.	0	Green colour.	0	Colour red, like Malaga wine; taste not very bitter, but astringent.
3. Yellow cinchona of Cuença.	0	0	Green.	0	It is neither bitter nor astringent; it precipitates acetate of lead.
4. Loxa cinchona, Royal Spanish.	Abundant precipitate.	0	Green.	Abundant precipitate.	Colour reddish, a little deep; a bitter mouldy smell.
5. White cinchona of Santa-Fè.	0	0	Green.	0	Deep yellow colour, neither bitter nor astringent; it precipitates acetate of lead.
6. Yellow cinchona of Santa-Fè.	0	Abundant precipitate.	Green.	Abundant precipitate.	Very decided bitter taste; little astringency; liquor very little coloured.

In order to acquire some more light upon the nature of the principles of the cinchonas, I examined comparatively several other vegetable substances which seemed to have analogies with them, and the composition of which is a little less known; such as gall-nuts, oak bark, the angustura, and some others.

Gall-Nuts.—The infusion of this substance gave in a solution of glue an abundant white precipitate; with iron, a blue; with emetic, a yellowish-white precipitate; with infusion of yellow cinchona, dirty white flakes; with copper, yellowish-brown; and with lead, a yellowish-white precipitate.

It did not precipitate the infusion of Santa-Fè cinchona, nor the infusion of tan.

The infusion of gall-nuts, therefore, comprehends, like

the

the yellow cinchona, the principle which precipitates glue along with that which precipitates emetic; and in this respect these two substances resemble each other: but they differ in respect of the bodies which act upon tan and upon iron, since this metal is precipitated green by cinchona, and blue by gall-nuts; they also differ in another respect, as they mutually precipitate each other.

Tan Bark.—The infusion of this substance, made as carefully and with the same quantity of water as cinchona, gives in the solution of glue a yellow precipitate; with iron, a blue; with copper, a brown precipitate: but it did not cause any change in the solution of Santa-Fè cinchona, nor in the emetic solution: it reddens the tincture of turnsole, and is precipitated by the oxalate of ammonia.

We see by this that oak bark does not contain, like gall-nuts, yellow cinchona, and some others, that substance which precipitates emetic; and that, although both of them precipitate glue, yet they differ in this respect.

Bark of the Cherry Tree.—This bark, which has been sometimes fraudulently substituted for cinchona, has nothing in common with the latter, except the property of giving a green precipitate with a solution of sulphate of iron. It produces no change upon glue, emetic, nor decoction of tan. It is therefore very doubtful if the cherry tree bark possesses any febrifuge property.

Centaurium and *Chamædrys.*—These two plants furnished the same results as the cherry tree bark, and it is equally doubtful if they can cure fevers.

Bark of the White Willow.—This bark, to which febrifuge virtues were formerly attributed, certainly possesses some of the chemical properties of some species of cinchonas; it precipitates glue, sulphate of iron green, and the acetate of copper brown. Thus, as it unites bitterness and astringency, it may be a febrifuge.

Angustura.—The infusion of this bark does not precipitate glue; but it precipitates abundantly the infusion of gall-nuts and infusion of yellow cinchona, but not at all that of Santa-Fè cinchona; it only produces a slight turbidness in it.

It

It precipitates iron, emetic, copper, lead, and infusion of tan, all in yellow.

This bark differs, as we see, from several cinchonas and other substances examined by comparison, in so far as it does not precipitate animal gelatine: it has no astringent taste, and yet it has an extremely bitter one. There is reason to believe that the principle which in this substance precipitates the metallic solutions is not entirely similar to that of the cinchonas, at least the colour of the precipitates which it furnishes is very different. Nevertheless, according to these properties, the bark of the angustura may be a very good febrifuge.

[To be continued.]

VI. *On the Culture of Turnips by the Drill and by the Broad-cast Method, showing the Superiority of the former. By* CHARLES LAYTON, *Esq., of Reedham Hall, Norfolk* *.

SIR,

I BEG leave to send you an account of an experiment on the comparative culture of turnips; and have the honour to be

Your very humble servant,

CHARLES LAYTON.

To Dr. C. Taylor,
Secretary to the Society of Arts, &c.

Being desirous of ascertaining, by experiment, the best mode of cultivating turnips, I prepared, in 1805, 20 statute acres of land well calculated for such trial. The whole spot was level, and the soil similar in every part. By manuring it equally with ten cart loads per acre of rotten farm-yard dung, after it had been properly summer tilled, it was fit, by the 24th of June, for the reception of the seed. In order

* From *Transactions of the Society of Arts,* &c. vol. xxiv.—The silver medal of the Society was granted to Mr. Layton for this communication.

 to

to make the experiment perfectly accurate, I divided the field, which is square, into ten equal parts, and sowed the whole of them alternately by drill and broad-cast at the same time. The drills were 12 inches asunder. The seed was of the white-loaf stock, and I had the satisfaction to find that no part failed. The divisions were all of them hoed at the same time; and care was taken to set the plants, as well the broad-cast as the drilled, 12 inches apart. The expense for the whole was 7*s.* per acre; but from the drilled plants requiring an extra man and horse per acre beyond the broad-cast, I estimate the relative expense as eight to seven. Sixteen perches of each were set out and weighed by three respectable farmers and graziers who reside in the parish of Reedham, where the experiment was made, and who have set their names to the certificate sent herewith.

A certificate in proof of the above account was received by the Society, signed by John Baker, Dan. Cockerill, Robert Long.

The certificate also states that	T.	ct.	st.
16 perches of the drilled crop weighed	1	19	0
——— of the broad-cast - -	1	14	4
	0	4	4

Difference in favour of the drill, 4 cwt. 4 stone.

Reedham Hall, Norfolk,
Feb. 27, 1806.

CHARLES LAYTON.

VII. *Description of the Fire-Escape invented by* DANIEL MASERES, *Esq. Communicated by* B. M. FORSTER, *Esq.*

To Mr. Tilloch.

SIR,

I HEREWITH send you a figure and description of a machine for escaping from windows when houses are on fire, which appears to me to be preferable, on several accounts, to any I have yet seen. The originals, from which this was made,

made, were invented by my friend the late John Daniel Maseres, esq. who at his death bequeathed some of them to me, with a view, I understand, to their being made public. I have made some alterations, by which the machines can with much greater ease be drawn up for a second person to descend; and the cost of them will be considerably less. My friend had himself made very great alterations from the machines which he first invented (and for which he obtained a patent); which perhaps was partly the reason why he did not make them more public, having scarcely decided which was the best possible form. I can speak with some degree of confidence as to the safety and ease with which they may be used, having let myself out of window with one or other of them a great number of times; and am persuaded that, if there were a necessity for it, I could safely bring down a child in my arms: but as this way might be attended with some danger with persons not well practised in the use of the machine, it would be well, in nurseries and other rooms where little children sleep, to be provided with one or more strong sacks, about three feet and a half in depth and one and a half diameter, kept open at the top with a thick wooden hoop having a long rope fastened to it: into these sacks the children are to be put, and let down; then the person may descend by the Sling Fire-Escape, or such other as may be at hand. A friend of mine used to keep sacks of this sort when his children were young; which is a plan I wish to see generally adopted.

Having shown this machine to many different people, who have greatly approved of it, I beg leave, by means of your entertaining and useful Magazine, to make the invention public. The great and extensive sale which your work has, and the superior manner in which the plates are executed, make me prefer it to any other periodical publication. Hoping it may have an early insertion,

I remain, &c.

B. M. FORSTER.

Walthamstow,
December 1806.

P. S. Mr.

P. S. Mr. James Decker, No. 321, Strand, an ingenious mechanic, who some years ago ascended with an air-balloon of his own construction, now undertakes to make these fire-escapes, also the hoop-topped fire-sacks above mentioned, when ordered; and I hope and believe he may be trusted for executing them with great security. The price will vary according to the length of the rope required. The separate articles of that of which I send you the figure amounted to 1*l.* 8*s.* 5*d.*; more than half of which cost was the rope (26 yards). What a tradesman may think a reasonable profit I am not able to say.

Description and Method of using the Machine called a Sling Fire-Escape.

The principal parts of this machine are the following:

1. The suspension iron A (Plate II.), which is formed like a ramhead commonly used for slinging goods from warehouses, with this difference, the bottom hooks are turned up close to the upright part, to form two close rings or eyes: the length of this iron is about four inches and a half, thickness of the iron out of which it is hammered is about half an inch.

2. The rope B. This is made of flax, and platted in a peculiar manner, for which there was a patent taken out. It is sold by Armstrong, St. John's-square, Clerkenwell, and measures about three-eighths of an inch in diameter. The rope must be in length somewhat more than twice the height of the window from the ground.

3. The regulator C. This is an oblong piece of beach wood, six inches and a half in length, three inches and a quarter broad, and about seven-eighths of an inch thick: in this there are four holes pierced for the rope to pass through; one of these is open at the side: there is also a notch at the top of this piece of wood, and an oblong hole about seven-eighths of an inch from the bottom.

4. The upper belt D is a stout leathern strap, about four feet three inches long and one and a half broad, with a buckle to it.

5. The lower belt E is a strap of the same sort as the other;

other; but the end, after being put through the buckle, is sewed down: this is for the purpose of security, in case the tongue of the buckle should by accident break.

6. The union strap F, so called from its connecting the regulator to the other parts of the machine. This is leathern, and is about a foot and a half long and an inch and a quarter broad: it has, like the others, a buckle to it. It is stained black, which distinguishes it from the other leathern straps.

The method of putting together all these parts of the machine is, first to pass one end of the rope through the holes in the regulator, then through the two lower rings of the suspension iron: the upper belt is then to be passed through a doubling of the union strap; after which the rope is to be tied to that belt, and the knot secured by a string from slipping (which string is to pass through two small holes in the leather); and at about a foot below the rope is to be tied to the lower belt in like manner. Next, the union strap is to be put through the oblong hole in the regulator, and buckled; by which the upper belt and the regulator will be connected. The other end of the rope may be kept wound on a wooden roller, to prevent it from getting entangled.

Persons who purchase these machines should have a very strong iron hook, with a spring-catch, fixed to some secure part of the window-frame, or elsewhere; on this hook the suspension iron is to be hung by the upper ring, when any one wishes to descend from the window. The next operation is to step into the lower belt with both feet, and draw it up sufficiently high, so as to form a kind of swing to sit in: the part of the strap which is through the buckle is to be laid hold of with the left hand; and the buckle, with the right hand, is to be slipt to its proper place, according to the size of the person: the tongue is then to be put into one of the holes, as in buckling common straps. After this is done, the upper belt is to be somewhat loosely buckled round the chest, and then the rope which is on the roller is to be thrown out of window on the ground.

Now all being ready for descending, the person is to get out of the window, grasping tight, with one or with both

hands,

hands, the rope at some convenient part, taking especial care not to meddle with the suspension iron until quite out of window; after which the rope below the regulator is to be laid hold of with the right hand, and to be let to run through the holes as fast as there may be occasion; for which purpose, if necessary, it may be easily slipped out of the open hole; it will then have the check of only three holes: if the motion is wanted to be retarded, the rope is to be put into the notch at the upper part of the regulator.

When one person has descended, and there is a necessity for a second immediately to follow, the union strap is to be unbuckled; when the regulator will be separated from the upper belt: the belts may then be very easily drawn up, having the friction of the suspension iron only, and the person above is to put on the belts as the other did, and is to be let down gradually, partly by the one below, and partly by managing the rope as the first did: in this case great care must be taken, as the check occasioned by the regulator is gone.

Observations and Cautions.

It is not easy to lay down exact rules for what number of holes the rope must pass through, as this must vary according to the weight of the person, and other circumstances. It would be well, before the person gets out of window, to examine, first, (absolutely necessary), whether the suspension iron is on the hook; then, that the three buckles are fast, the two knots tied, and that the rope is in the hole of the regulator which has the opening. Great care must be taken that there is not any impediment to the free running of the rope; for which the wall of the house must be examined, and any nails or hooks which may chance to be there removed; also iron scrapers, and every thing wherein the rope may be likely to hitch.

VIII. *On*

VIII. *On preserving Turnips as Food for Cattle in Winter. By Mr.* James Dean, *of Exeter**.

SIR,

When surveying an estate in the South-Hams of Devon, in February last, my attention was attracted by the singular appearance of a crop of turnips in an orchard; so thick as to touch each other, and closely surround the stems of the apple trees. I inquired of the farmer the reason of so unusual a crop, and I received from him some curious information. It was the constant practice, he said, in his neighbourhood, for farmers, after they had broken up ley ground, first to take a crop of turnips; and in the autumn, or rather winter, to sow wheat in the same ground. Should winter fodder be scarce, they then preserved the turnip crop for stock, and consequently could not put in wheat before January; and even then with no probability of having more than two-thirds of an usual crop, because of the late sowing. This was an evil of great magnitude, and led him, he added, to make trial of a mode peculiarly successful, enabling him to sow his seed in the proper season, and to save the most valuable of his turnip crop during the winter.

He got, he said, his turnip seed into the ground early in June; and in October, by which time the turnips would have grown to a large size, he had the largest of them drawn without injuring the leaves, and then placed close to each other on the grass in the orchard, in the same position in which they grew. Their leaves preserved them from external injury; and their tap roots put out, in a short time, other fibrous roots into the grass, which, in orchards, is generally long in the autumn; and thus the turnips were preserved good for use.

I inquired whether the turnips acquired any additional size after their removal into the orchard, and whether, from the warmth occasioned by the turnips to the ground, any advanta cous effect was apparent in the apple trees. On these questions he was not able to speak positively, though he

* From *Transactions of Society of Arts*, &c. vol. xxiv.

thought

thought the turnips had increased in size; and he thought, likewise, that the crops of apples appeared larger, and the annual bearings more certain in the orchard I was observing, than in those where no turnips were put; though, till the time I spoke, he had not even guessed at the cause.

I have the honour of being,
With due respect,
Your obedient servant,
JAMES DEAN.

Exeter, April 28, 1805.
To C. Taylor, M. D. Secretary, &c.

IX. *Some Account of Polyautography; a Discovery lately made of Printing from Stone*.*

THIS very ingenious art was first discovered in Germany by Aloys Senefelder, and was introduced into this country in 1801, when it obtained a patent.

The following is the process :—A drawing is made with a pen and a prepared liquid upon a level stone with a smooth surface, in the manner and with the same facility as a pen and ink drawing: the stone is then, by a very simple process, rendered capable of repelling the printing ink, except in those parts which have been drawn upon by the before-mentioned liquid, to which it adheres: it is then dabbed over with the balls as in printing, and the impression is taken by a cylinder being passed over it; and by this means you have an exact reversed fac-simile of the original sketch. There is also a prepared pastil of the consistence of Italian chalk, and with which you can also draw on the stone, which, when printed, cannot be distinguished from a chalk drawing.

The stone is of a yellowish gray, of a very compact texture, smooth grained and brittle.

This invention, from the extreme facility with which a person totally ignorant of any method of engraving may, in a few hours, multiply as many originals as he pleases at a very trifling expense and trouble, is certainly deserving of

* Communicated by H. B. Ker, Esq. Sloan-street.

the serious attention of the artists and amateurs in general of this country.

One of its great advantages is, that instead of a copy, as in the case of an engraving or etching, you produce a perfect fac simile of the original design. And I here take an opportunity of correcting an error, in a short and inaccurate account given by Mr. Nicholson in his Journal, which states that the liquid with which the drawing is made required two or three days to dry before it can be printed. The fact is, the impressions may be taken the minute the drawing is made, as the liquid dries almost immediately. Any number of impressions may be taken from the drawing: between 4000 and 5000 impressions have already been taken from a drawing, without the least alteration.

This art is also applicable to the printing of the finest writing; and music also has been printed from it with great success.

Mr. Volwieler, the proprietor of the patent, No. 9, Buckingham-place, Fitzroy-square, is now publishing a work entitled *Specimens of Polyautography*, consisting of fac-similes of sketches of the most eminent artists of this country.

Mr. Volwieler also furnishes stones, &c. for those desirous of multiplying their drawings. H. K.

X. *The Reviewer of Mr.* Bonnycastle's *Trigonometry in Reply to the Observations of Mr.* Thomas Keith.

To Mr. Tilloch.

SIR,

If Mr. Keith had, in his remarks upon Mr. Bonnycastle's Trigonometry, confined his animadversions to that work alone, I should have left that gentleman either to notice or to disregard the attack, as he thought proper. But, as Mr. Keith has gone out of his road to throw some imputations upon the judgment of the person who wrote the account of Mr. Bonnycastle's treatise, I conceive it to be an act of justice to myself to reply concisely to Mr. Keith.

This

This gentleman writes ostensibly to correct my "erroneous statements," and yet does not point out *one* such erroneous statement. He cavils, it is true, at my asserting that every part of Mr. Bonnycastle's work bears evident marks of the same hand; and affirms, that such an assertion "could not possibly have been made had the writer seen his treatise." Now, the fact is, I *had* seen it: I was one of the few persons who purchased Mr. Keith's book in 1801; and one of the comparatively many of that few who have been much disappointed on perusal, finding the work to give no adequate representation of the science of trigonometry as it now exists. I did not turn aside to speak of Mr. Keith's book when I was reviewing Mr. Bonnycastle's; but this gentleman now compels me to say, that, although his work may exhibit traces of his industry, it displays little else. I must likewise remark, that the assertion with which he quarrels is perfectly correct; for, although Mr. Bonnycastle may have selected many of his examples from other authors (and he would know little of the value of time if he endeavoured to frame a complete set of new ones himself), he has, especially in the spherical trigonometry, modified all their solutions according to the ten commodious and judicious rules he has given at pages 80, 102, and 121, which comprehend the whole doctrine of that branch of the science.

The charges which Mr. Keith has adduced against Mr. Bonnycastle it is not *my* immediate business to refute. I may remark, however, that Mr. Keith's principal celebrity arises from his prevailing habit of advancing insinuations of plagiarism, or incapacity, against every author whose character he feels inclined to attack; from those of Horsley, Maskelyne, and Vince, down to the lowest scribbler who falls in his way. As to his accusations against Mr. Bonnycastle, on page 330 of your last number, I will assert most positively in general terms that they are not correct. No two performances on the same subject can be less alike than the two now spoken of. Mr. Bonnycastle may probably have taken some practical examples from Mr. Keith's book; but not *two,* I may safely affirm, which contain any essentially new principle; and a great proportion of what he may have

taken

taken are, I doubt not, such as Mr. Keith had previously borrowed from other authors; for Mr. Keith has himself borrowed practical examples from at least *ten* authors on similar topics whose treatises I have read, and to which I am at any time prepared to refer him, if such a reference were necessary. Indeed, *all* authors follow the practice of selecting examples from preceding writers on similar subjects; and Mr. Keith has, in conformity with this practice, copied into some of his former works matter from other performances of the very person against whom he is now preferring complaints. But there is this difference, it seems, between the habits of Mr. Bonnycastle and Mr. Keith: when the former collects from different works, he is accused of *copying*; when the latter copies from one work, as from the Nautical Almanac, he calls it *collecting*; and then, when another adopts the same tables from the same place, he is accused of *copying* from Mr. Keith!

Mr. Keith, when particularizing the plagiarisms with which he accuses Mr. Bonnycastle, refers to *two* diagrams, which he says are the same size "as if pricked from his plates by schoolboys." Now, sir, this I will without hesitation assert, from a careful examination of the matter, is *far from true*. There are lines in Mr. Bonnycastle's figures not to be found in Mr. Keith's: and further, those figures are *not* the same size as Mr. Keith's; neither are the respective points of intersection *at the same relative distance*. So that what Mr. Keith asserts positively, in a case where detection is easy, is directly impossible; and the public will therefore be able to give a due degree of credit to all his sweeping charges.

Since there is in general but one method of constructing these figures, a great similarity must necessarily prevail, as is really the case amongst all the works in which this part of the subject is introduced; so that the cry of plagiarism on such an occasion is perfectly ridiculous, as I have no doubt Mr. Keith very well knows. How far Mr. Bonnycastle may judge it right to enter into any altercations with Mr. Keith, in consequence of the liberties he has taken with his character, is not for me to decide. I have only to add, that

what

what I have stated in this letter will probably be just as "erroneous" in Mr. Keith's views, that is, just as conformable to the opinion of all mathematicians who are competent judges, as my various statements in the critique inserted in your Magazine for November.

I am, sir, yours, &c.

The Reviewer of Bonnycastle's Trigonometry.

February 12th, 1807.

XI. *A third Series of Experiments on an artificial Substance, which possesses the principal characteristic Properties of Tannin; with some Remarks on Coal. By* Charles Hatchett, *Esq. F. R. S.**

§ I.

In my former papers upon this subject, some account has been given of the effects produced by sulphuric acid upon turpentine, resin, and camphor; and I shall now state the results of other experiments made with the same acid upon a great number of the resins, balsams, gum resins, and gums, the greater part of which afforded that modification of the artificial tanning substance, which, for the sake of distinction, I have in the preceding papers denominated the third variety.

The process was simple digestion in sulphuric acid, after which, the residuum was well edulcorated, and was then digested in alcohol. This was separated by distillation, the dry substance which remained was infused in cold distilled water, and the portion dissolved was examined by solution of isinglass, muriate of tin, acetite of lead, and sulphate of iron.

Much sulphureous acid, carbonic acid, several of the vegetable acids, particularly benzoic acid, (when the balsams were employed,) and apparently water, were produced during the operation; but in this paper I shall only notice two of the products, namely, the tanning substance and the coal.

* From the *Transactions of the Royal Society for* 1806.

The

The sulphuric acid almost immediately dissolved the resins, and formed transparent brown solutions, which progressively became black.

The same effect was produced on most of the other substances, but the solutions of the balsams and of guaiacum were at first of a deep crimson, slightly inclining to brown.

Caoutchouc and elastic bitumen were not dissolved, but, after having been digested for more than two months, were only superficially carbonized.

The gums and the saccharine substances required many evaporations and filtrations before the whole of their carbonaceous residua could be obtained.

These were the principal effects observed during the experiments, and I have stated them in this manner, that tedious and useless repetitions may be avoided.

§ II.

Turpentine, common resin, elemi, tacamahac, mastich, copaiba, copal, camphor, benzoin, balsam of Tolu, balsam of Peru, asa fœtida, and amber, yielded an abundance of the tanning substance.

Oil of turpentine also afforded much of it; asphaltum yielded a small portion; some slight traces of it were even obtained from gum arabic and tragacanth; but none was produced by guaiacum, dragon's blood, myrrh, gum ammoniac, olibanum, gamboge, caoutchouc, elastic bitumen, liquorice, and manna. I am persuaded, however, that many of these would have afforded the tanning substance had not the digestion been of too long a duration.

Olive oil was partly converted into the above-mentioned substance, and also linseed oil, wax, and animal fat; but the three last appear to merit some attention.

Linseed Oil.

This oil with sulphuric acid very soon formed a thick blackish-brown liquid, which, after being long digested in a sand-bath, was still partly soluble in cold water, and passed the filter. This solution precipitated gelatine; the residuum was a tough black substance, which became hard on exposure to air. A great part was soluble in alcohol, and formed

 a brown

a brown liquid, which became turbid by the addition of water. When this was evaporated, a brown substance remained, which was partially dissolved by cold water, and the solution thus formed was rendered turbid by gelatine.

The undissolved portion left by the alcohol was of a blackish-brown; it was soft and tenacious, and appeared to retain many of the properties of an inspissated fat oil.

Bleached Wax.

That which was employed in this experiment was the white wax of the shops, which is sold in the form of small round cakes. It formed with sulphuric acid a thick black magma, and was not acted upon by cold distilled water when washed with it upon a filter. Upon being digested with alcohol in a sand-bath, a brownish solution was formed, which upon cooling became very turbid, and appeared as if filled with a white flocculent substance. The same operation was repeated with different portions of alcohol until this ceased to act. The whole of the solutions in alcohol were then mixed, a large quantity of distilled water was added, and the alcohol was separated by distillation.

On the surface of the remaining liquor, when cold, a white crust was formed, which being separated was found to possess the properties of spermaceti, and weighed 18 grains. The filtrated liquor was then evaporated to a small quantity, became of a pale brown colour, and was rendered turbid by solution of isinglass.

Animal Fat.

This experiment was made upon the kidney fat of veal, but I cannot take upon me to assert that the results would have been the same with every kind of fat. 100 grains of it with one ounce of concentrated sulphuric acid, after some time, formed a blackish soft mass; a second ounce of sulphuric acid was then added, and the whole was digested and occasionally heated during nearly three months. Six ounces of distilled water were poured upon the black pulpy mass, and formed a thick uniform liquid, which, after digestion for six or seven days, was when cold filtrated. The liquor which passed was of a brown colour, and upon evaporation

poration became black, leaving a considerable portion of a blackish substance upon the filter, which was added to that which had been collected by the first filtration. The whole was washed with cold water, which passed colourless. Boiling water was then poured upon the filter, by which a considerable portion was rapidly dissolved, and a brownish-black solution was formed, which copiously precipitated gelatine.

The residuum on the filter was then dried, and being collected was digested in alcohol, which dissolved the greater part.

The solution in alcohol was filtrated, but (apparently by the effect of air) a considerable deposit was formed on the filter, which was again dissolved by alcohol. Water rendered the solution turbid, and a black light flaky substance, which weighed 41 grains, remained upon the filter. The filtrated liquor was then evaporated, and left a grayish-black substance, which weighed 30 grains. This last substance was highly inflammable, and when burned emitted a very peculiar odour, resembling partly that of fat and partly that of asphaltum. It easily melted, and also immediately dissolved in cold alcohol, from which, like the resinous substances, it was precipitated by water.

The black light flaky residuum, which weighed 41 grains, was found to consist partly of the substance above mentioned and partly of coal, but the proportion of this last was not ascertained.

Coagulated albumen and prepared muscular fibre were also separately exposed to the action of sulphuric acid in the manner above described, but did not afford any substance by which gelatine could be precipitated, coal being the only product which remained.

Almost every one of the bodies which have been employed in these experiments, seem to be in some measure different in respect to the progressive effects produced upon them by sulphuric acid; and all other circumstances being similar, there appears to be a certain period of the process when the production of the tanning substance has arrived at its maximum, after which, a gradual diminution of it takes place,

 and

and at length total destruction. These effects are produced at different periods, according to the substance which may be the subject of the experiment, and therefore it is impossible at present to state the utmost quantity of the tanning substance which, under equal circumstances, may be obtained from each of the resins, balsams, &c.

The tanning substance appears to be always the same, whether obtained from turpentine, or common resin, or from the balsams, or from asa fœtida, or camphor, or indeed from any of the bodies which have been enumerated; its effects on the different reagents are similar; by the addition of a small portion of nitric acid, and subsequent evaporation, it is converted into that which I have called the first variety; or if digested with sulphuric acid, it is speedily destroyed, and becomes mere coal. In the latter case, therefore, the same agent which at first produced it becomes at length the cause of its destruction; and thus we find that although a tanning substance may be obtained from resinous and other bodies by means of sulphuric and by nitric acid, yet in the former case the product is variable, and is formed at or about the mean period of the operation, whilst the latter is an ultimate and invariable effect, beyond which no apparent change can be produced by any continuation of the process*.

§ III.

I have already stated, that caoutchouc, and elastic bitumen, were only superficially acted upon when digested for a very long time in sulphuric acid; and it is remarkable, that these substances, which in their external characters so much resemble each other, should be similar in their habits when exposed to the effects of this acid; for, unlike the resins and most of the other bodies which were subjected to the preceding experiments, and which were almost immediately dissolved when the acid was poured upon them, these on the contrary remained undissolved, and only became partially carbonized on their surfaces. Even nitric acid does

* In the former papers upon this subject I have observed, that the tanning substance produced by sulphuric acid is very inferior in energy to that which is formed by nitric acid.

not

not so rapidly effect a change in the elastic bitumen as it does when applied to the other bituminous substances.

1. 100 grains of pure soft elastic bitumen were digested during three weeks in one ounce of nitric acid, diluted with an equal quantity of water; a tough and slightly elastic orange-coloured mass then remained. Another ounce of the acid, not diluted, was poured upon this mass, and the digestion was continued until the whole was evaporated. The residuum was tenacious, and of the colour above mentioned. Water partially dissolved it, and formed a deep yellow liquid, which copiously precipitated gelatine, and possessed the other properties of the tanning substance which is produced from the resins, &c. by nitric acid.

An orange-coloured mass still remained, which was speedily dissolved by alcohol, and was precipitated from it by a large addition of water.

This substance in many of its properties resembled the resins, but in others, seemed to approach those which characterize the vegetable extractive matter. It appeared to be similar to that which has been cursorily mentioned in my first paper, and which was obtained from many of the pit-coals and bitumens when treated with nitric acid. I have since paid more attention to this substance during the following experiments:

Kilkenny coal was digested with nitric acid, and progressively, although with difficulty, was converted into that variety of the tanning substance which has so often been mentioned. Similar experiments were made on the same sort of coal from Wales, which was given to me by my friend Mr. Tennant, as well as upon a coal sent to me by Professor Woodhouse, which was from Pennsylvania, and is there called Leigh high coal. All of these were converted into the tanning substance, but they did not yield any product similar to that obtained from the elastic bitumen.

The contrary, however, happened when the common pit-coal, or Cannel coal, or asphaltum, were employed. For when these were treated in the way which has been described, and when the digestion was not too long continued, then I obtained from 100 grains of each of the above substances (after the separation of the tanning matter) a residuum as follows:

From 100 grains of the common Newcastle coal 9 grains.
From 100 grains of Cannel coal - - 36 grains.
From 100 grains of pure asphaltum - - 57 grains.

The substances thus obtained were very similar in their external characters, being of a pale brown, approaching to Spanish snuff colour; their internal fracture was dark brown, with a considerable degree of resinous lustre. When exposed to heat they did not easily melt, but as soon as inflamed they emitted a resinous odour mixed with that of fat oil, and produced a very light coal, much exceeding the bulk of the original substance.

Alcohol completely dissolved them, and if water in a large proportion was added to a saturated solution, a precipitate was obtained; but after each precipitation a portion always remained dissolved by the water, which acted upon the different reagents in a manner similar to the solutions of vegetable extractive matter. The flavour was alo bitter, and in some degree aromatic, so that the residua, whether obtained from pit-coal, from Cannel coal, or from asphaltum, seemed to possess properties intermediate between those of resin and those of the vegetable extractive substance. They appeared, however, to be removed only by a very few degrees from the tanning substance; for if digested in a small quantity of nitric acid, and subsequently evaporated, they were immediately converted into it; or if digested with sulphuric acid, they speedily became reduced to coal.

§ IV.

In the 5th section of my second paper, some remarks were made on the decoctions obtained from vegetable substances which had been previously roasted; and although (excepting one instance) these decoctions did not afford any permanent precipitate with gelatine, yet I have there stated, that I did not think it right to conclude, that similar decoctions made under certain circumstances, might not occasionally possess those properties which characterize the tanning substances. Moreover I also observed in the same paper, that all of those decoctions, upon the addition of a small portion of nitric acid and subsequent evaporation, became converted into that variety of tanning matter which is produced by the action of nitric acid upon carbonaceous substances. I have since extended these experiments, and shall here give some account of them.

1. 200 grains of the fresh peels of horse chestnuts were digested for about 12 hours in three ounces of distilled water. The liquor was of a pale brown, and formed a slight pale brown precipitate when solution of isinglass was added to it.

2. 200 grains of the same peels were moderately roasted, and being afterwards digested with three ounces of water, formed a dark brown decoction, which was not rendered turbid by gelatine.

3. The above-mentioned roasted peels, after the termination of the preceding experiment, were added to the remainder of the filtrated liquor. A quarter of an ounce of nitric acid was poured upon the whole, which was then digested and evaporated to dryness. The mass was afterwards infused in water, and a dark reddish-brown liquid was obtained, which copiously precipitated solution of isinglass.

4. 200 grains of horse chestnuts, from which the peels employed in the former experiments had been taken, were bruised, and were digested with three ounces of water. The liquor was turbid, and of a pale red colour. It was filtrated, and some solution of isinglass was added, but without any effect.

5. 200 grains of the same horse chestnuts were moderately roasted, and being treated as above described with water, yielded a dark brown decoction which was not rendered turbid by isinglass.

6. The horse chestnuts, which had been employed in the preceding experiment with the remaining liquor, were digested with a quarter of an ounce of nitric acid until the whole was become dry. Water was then poured upon it, was digested, and a dark brown liquid was formed, which afforded a considerable precipitate by the addition of solution of isinglass.

From these experiments it appears, that the small portion of tannin which the horse chestnut peels originally contained, was destroyed by the process of roasting; that the brown decoction subsequently obtained from the roasted peels and from the horse chestnuts, did not act upon gelatine; but that these were speedily converted into the artificial tanning substance, by the addition of a small portion of nitric acid and subsequent evaporation.

The first preparations of the artificial tanning substance which have been mentioned in the former papers, were made from coal of different descriptions digested with nitric acid; and as similar products have been obtained by the same acid from various decoctions of roasted vegetable substances, there cannot be any doubt, that vegetable bodies when roasted, yield solutions by digestion in water, which essentially consist of carbon approaching to the state of coal, although not absolutely converted into it; for, if so, all solubility in water would cease.

But coal is apparently nothing more than carbon oxidized to a certain degree, and may be formed by the humid as well as by the dry way.

Examples have been already stated respecting operations in which sulphuric acid has produced this effect, but the same likewise appears to be produced with some modifications, whenever vegetable matter undergoes the putrefactive process; for when this takes place, as in dunghills, &c. a large proportion of the carbon of the original vegetable substances appears to be combined with oxygen sufficient to communicate to it many of the properties of coal, whilst the compound nevertheless is capable of being dissolved by water with the most perfect facility.

It must not however be understood that by this process all the other elementary principles are separated, so that only the carbon remains combined with oxygen, but merely, that the other principles are so far diminished, that these, namely carbon and oxygen, predominate in a state approaching to coal, although soluble in water.

Such solutions, I have every reason to believe, are nearly similar to those afforded by vegetable substances which have been previously roasted; and although I have examined but a few a few of them, yet I shall relate some experiments which I have lately made on the peels of walnuts.

It is well known that when these are kept in small heaps for a short time, they become soft, and break down into a black mass, which affords a brownish-black liquor. On these I therefore made the following experiments:

1. About one ounce of walnut peels, which were become soft and black, was digested in water.

A dark brown liquor was thus formed, and, being filtrated, was examined by a solution of isinglass, but not any apparent effect was produced.

2. On an equal quantity of the walnut peels, in the same soft black state, a small portion of nitric acid was poured, and after being digested for about five hours, the whole was evaporated to dryness. The residuum was of a brownish orange colour, and yielded a similar coloured solution to water when digested with it. This was filtrated, and upon the addition of solution of isinglass became turbid, and deposited a tough precipitate, which was not dissolved by boiling water.

3. Another portion of the walnut peels was moderately roasted, and was then digested in water; the brown solution was filtrated, and formed a slight precipitate with gelatine.

4. On the residuum of the last experiment, a small quantity of nitric acid was poured, some water was then added, the whole was digested during about five hours, and until it became perfectly dry.

Water formed with this a brown liquor, which yielded a very abundant precipitate by the addition of dissolved isinglass.

Upon these experiments we may remark, that the solution in the first instance contained carbon in a state approaching to coal, for when treated with nitric acid in the second experiment, a portion (although small) was produced of the same tanning substance which is formed from the different kinds of coal by nitric acid.

The third experiment appears to show, that a small quantity

tity of a substance approaching to tannin was produced by the simple process of roasting; and the fourth experiment corroborates those already described, in which the artificial tanning matter was copiously produced, whenever roasted vegetable substances were treated with nitric acid.

In respect to vegetable substances, especially those which contain tannin, I shall here relate a few other experiments.

It has been remarked in my second paper, that the tannin of galls was immediately destroyed by nitric acid. Since that time, I have made the following additional experiments:

1. 100 grains of galls reduced to powder were infused with four ounces of water, and part of the infusion upon the addition of solution of isinglass afforded (as usual) a copious precipitate of a brownish-white colour.

A quarter of an ounce of nitric acid was added to one ounce of the above infusion, which then was not in any manner affected by the dissolved isinglass.

2. 100 grains of the same galls were slightly roasted, and being digested with four ounces of water, formed a brown liquor, which was filtrated.

Solution of isinglass was then added to a part of the above liquor, and produced a precipitate not very unlike the former, but much less in quantity.

After this, a quarter of an ounce of nitric acid was added to one ounce of the same liquor, and some dissolved isinglass was subsequently poured into it; by which it was rendered turbid, and a small portion of a dark brown precipitate was produced, resembling that which is commonly afforded by the artificial tanning substance.

3. The remainder of the above-mentioned liquor, with the residuum of the roasted galls, were digested with a quarter of an ounce of nitric acid until the whole had become dry. Water was then poured upon it, and formed a dark brown solution, which yielded a copious brown precipitate by the addition of dissolved isinglass.

From these experiments on galls it appears, that the natural tannin contained in them is destroyed by nitric acid;

that

that the tannin is also diminished, and (I may add,) is ultimately destroyed by the process of roasting; that when galls have not been so far roasted as to destroy the whole of the tannin, then the remainder of this seems to be destroyed by the addition of nitric acid, whilst at the same time a small portion of the artificial tanning substance is produced; and that this last is always plentifully afforded by roasted galls when digested with nitric acid, similar to other vegetable bodies when thus treated.

These remarks are also partly confirmed by the following experiments upon oak bark.

1. 200 grains of oak bark, reduced into very small fragments, were infused in about four ounces of water, after which the infusion was examined by dissolved isinglass, and yielded a considerable precipitate.

2. 200 grains of the same sort of bark were slightly roasted, and afterwards digested in water; a much darker coloured liquor was obtained than in the former case; but although it afforded precipitates by the addition of muriate of tin, acetite of lead, and sulphate of iron, yet not the smallest effect was produced by solution of isinglass.

3. The residuum, with the remaining part of the abovementioned liquor, was then digested with a small portion of nitric acid; this was completely evaporated, and a brown solution was formed by water, which abundantly precipitated gelatine.

4. One ounce of oak bark, reduced into very small fragments, was repeatedly digested in different portions of water until the whole of its tannin was extracted. The residuum or exhausted bark (as it is called by the tanners) was dried, and was afterwards moderately roasted. It was then moistened with diluted nitric acid, which was evaporated in a heat not much exceeding 300° until the bark was become perfectly dry. This was digested in water, and speedily formed a yellowish-brown liquor, which abundantly precipitated gelatine.

5. The bark, which after being exhausted of its natural tannin had thus afforded the artificial tanning substance,

stance, was repeatedly treated with water until the whole of this last was extracted. The bark was then again slightly roasted, was again moistened with nitric acid, and was gently heated and dried as before. Water being poured on it and digested, formed a brown solution, which copiously precipitated gelatine.

6. The whole of the artificial tanning substance was extracted by different portions of water, and the remainder of the bark thus exhausted, was again treated in the manner above described, and again afforded a considerable quantity of the tanning substance, so that these processes evidently might have been continued until the whole of the bark had been converted into it.

This might also have been accomplished, if in the first instance the exhausted bark had been converted into charcoal, and digested in nitric acid, as described in my first paper; but then, the effects would have been more slowly produced, and much more nitric acid would have been consumed. I am now therefore fully convinced, not only by the results of the experiments related in this paper, but also by many others which it would have been superfluous to have stated, that the most speedy and most œconomical of all the processes which I have described, is that of treating roasted vegetable substances in the way which has been mentioned; and considering that all refuse vegetable matter may be thus converted into a tanning substance by means the most simple, and without any expensive apparatus, I cannot help entertaining much hope, that eventually this discovery will be productive of some real public advantage.

[To be continued.]

XII. *Report*

XII. *Report of Surgical Cases in the City Dispensary, Grocers-Hall-Court, Poultry, from the 1st of October to the 31st of December 1806: with Observations on a Case of umbilical Hernia of many Years standing, in which the Operation was performed, and attended with the most complete Success: and also Remarks on some Cases in which the mercurial Salivation has taken place, on the Exhibition of small Doses of Calomel.*

PATIENTS admitted 219.

Cured	- -	63
Relieved	- -	1
Died	- -	1
Under cure	-	154
		219

Mrs. A. B., æt. 62, has had an umbilical hernia for thirty years, which has been attended with much pain and inconvenience, from its size and irreducible state, during the greatest part of the above period, as the contents of the hernial sac have not been returned completely into the cavity of the abdomen for twenty years; but the size of the tumour has always increased considerably after standing or walking, from which she suffered much.

Dec. 6, 1806, Mr. Skinner was called to visit the above patient, and found her in great pain about the umbilical region, arising from inflammation of the contents of the hernial sac and parietes of the abdomen. She had not had any evacuation by stool for some days; was continually sick, and vomited every thing from the stomach as soon as it was taken.

Venæsectio ad ℥ viii.

℞. Extr. colocynth. cum calom.

Anodyne fomentations were applied to the umbilical region, and an enema was administered immediately.

Dec. 7. No mitigation of symptoms: the enema was returned, without any feculent matter; and the vomiting continued as before. Six leeches were applied to the tumour; the

the fomentations were continued, and an enema of nicotiana was administered.

Dec. 8. Mr. Skinner requested me to accompany him in his visit to this patient. No evacuation by stool had been procured, nor had any sleep been obtained during the night, and every thing was rejected by the stomach as soon as taken; but the pulse was softer than on the preceding day, was regular, and did not exceed eighty beats in a minute: the enema of nicotiana was repeated, the fomentations were continued, and the following pills were ordered:

℞. Calom. gr. xii. opii. gr. vi. F. pil. vi. quarum sumat i. secundâ quâque horâ.

Dec. 9. The poor sufferer was evidently worse in every respect: feculent matter was now vomited in large quantities, and the hiccup had distressed the patient extremely through the night. The operation was no sooner proposed than acceded to; and it was agreed that it should be performed at nine P. M.; and was done in the presence of Mr. Skinner, Mr. Hilliard, and Mr. Burgis. She underwent the operation with great fortitude and resignation, which was *prolonged considerably* by the *vast adhesions of the omentum to every part of the sac*; and it was not till a separation had been made in the substance of the omentum that the fold of the intestine contained in the sac could be exposed to view; when it was found of a dark colour, but not gangrenous; and was readily returned on dilating the stricture at the mouth of the sac. This part of the operation was attended with more difficulty than usually occurs, in part from the mouth of the sac being extremely deep seated, and in part from the very extensive adhesions of the omentum to the peritoneum around that part of the intestine where the stricture was formed: the firm adhesion of the omentum to every part of the internal surface of the sac prevented its being returned into the abdomen, and rendered the removal of a large portion absolutely necessary; which was accomplished by tearing its substance (in preference to using the scalpel), in order that hæmorrhage might not ensue: the integuments, being divided by a longitudinal incision only,

were

were easily brought in contact, and secured by adhesive plaister, without the aid of suture. She appeared as well after the operation as could possibly have been expected from its severity in point of time, though much pain was not experienced, as the omentum is not a very sensible organ. The pulse was languid, and did not exceed 70.

℞. Aq. ammonia acetat. aq. mentha sativ. āā ℥ iii. ss. M. cujus sumat cochl. ii. quârta quâque horâ.

Dec. 10. Passed a restless night, owing in part to a troublesome cough, and in part to pain experienced in the umbilical region. Pulse 75. Has less fever than might have been expected, and has had an evacuation by stool; but appears very low.

℞. Mixt. aloes. ℥ vii. cujus sumat cochl. ii. pro re nata. ℞. Haust. anodyn. omni nocte horâ decubitûs sumendus.

Dec. 11. She has had a better night, having slept about four hours. The cough is much relieved. Has had two natural evacuations by stool. Pulse about 80, but scarcely perceptible, and intermits at irregular intervals. She is much lower than yesterday, being only capable of articulating in a kind of whisper; but has not experienced much pain, excepting a little smarting in the wound occasionally. Medicines continued.

Dec. 12. Appears very low; pulse intermits about every fourth beat, but is more distinct than it was yesterday: has had regular evacuations, and is free from fever. Medicines continued.

Dec. 13. She has had a better night, and appears to be mending; but the pulse continues as it was yesterday. A little boiled rabbit was eaten. The medicines were discontinued, except the anodyne draught.

Dec. 14. She appears extremely low: the articulation more indistinct: the pulse less perceptible, but intermits as before; and there is scarcely any desire to take nourishment even in a liquid form, as broth, or beef tea. No fever: evacuations regular, but complains of a sense of heat in the scrobiculus cordis. The anodyne draught repeated.

Dec.

Dec. 15. She appears stronger, and is evidently mending; but the pulse continues to intermit. Haustus anodyn. o. n.

Dec. 16. Dressed the wound, which looked remarkably healthy, being nearly healed; and the patient is in every respect better.

Dec. 17. Continues free from pain: rests well at night: appetite is returning: and she is now able to sit up some hours daily. The anodyne draught omitted.

Dec. 18. Dressed the wound, from which there is a small discharge, but no other inconvenience: pulse regular.

Dec. 20. A little smarting pain has been experienced in the wound, from inflammation and excoriation of the integuments. The ung. sperm. ceti was applied, and an aperient medicine was taken.

Dec. 21, 22. The inflammation is nearly reduced, and the general health much improved.

Dec. 24—26. Continues to mend: the wound completely healed.

Dec. 29. Perfectly recovered.

In the recovery of this patient there were two remarkable occurrences: the intermission of the pulse, which began on the second and continued to the eighth day after the operation; and the extreme debility, or inability to move or speak: even the motion of the hand excited an uneasy sensation, and an attempt to articulate distressed the patient exceedingly. Might not these symptoms take place partly from peritoneal inflammation?

Several cases have recently occurred, in which, on the exhibition of small doses of calomel combined with jalap, the mercurial salivation has suddenly appeared, and in some instances has been continued even to an alarming extent.

In one instance, four grains of calomel and sixteen grains of jalap were divided into four pills, one of which was taken every third morning, and operated as a moderate cathartic, generally occasioning two or three extra evacuations in the day; which was also succeeded by ptyalism, that continued upwards of three weeks, and evidently arose from the mercury.

In

In another case, six grains of calomel and twenty-four grains of jalap were divided into six pills, one of which was taken every second morning, and operated as a powerful cathartic: at the end of ten days the gums became tender, and the saliva was secreted in a large quantity. The last pill was taken on the eleventh day, and I was requested to see the patient on the 14th day; when the head and face were much swollen, the tongue, gums, and inside of the cheeks were ulcerated very extensively, the saliva flowing in a profuse manner. No food could be taken, not even in a fluid state. The unfavourable symptoms continued to increase till the 20th day, when locked jaw came on, and the patient was in the most imminent danger. No medicine could be taken, nor even a gargle used, at this time. More benefit appeared to be derived from the use of steam, by holding the head over warm water, than by all the medicines which had been exhibited; and although the patient began to mend on the 26th day, yet the effects of the mercury did not disappear for upwards of a month.

Many cases similar to the above have come under my care within a few months; and although it is well known that very small doses of calomel will occasionally produce salivation, this seldom takes place when it acts as a cathartic, or when it is exhibited in combination with any other medicine having that property and producing that effect.

These facts would not have been noticed publicly, but from their frequent recurrence, without any apparent peculiarity of constitution, from the same combination of medicine, which I have been in the habit of prescribing for many years, as well in public as in private practice, and have rarely witnessed effects similar to the above.

JOHN TAUNTON,
Surgeon to the City and Finsbury Dispensaries, and Lecturer on Anatomy and Surgery, &c.

Greville-street, Hatton-garden,
February 25, 1807.

XIII. *Detected Imposition.*

To Mr. Tilloch.

Cambridge, Feb. 22, 1807.

SIR,

I write to inform you that a letter* signed by a person calling himself W. Peel is an imposture. The author of this low piece of witticism pretends to the title of chemist; but I recommend to him to consider that the first qualification for an interpreter of nature is the love of truth. Let him be detected in committing a second fraud in the republic of letters, and I shall send you his name.

Yours, &c. CHEM.

XIV. *On Mr.* A. G. Eckhardt's *Regulator for powerful Machinery; and on the Application of the Labour of Animals as a moving Power on the Outside of a Walking-wheel.*

To Mr. Tilloch.

SIR,

In the second volume of the Repertory of Arts, p. 364, in the specification of A. G. Eckhardt's patent of the 31st of January 1795, a fly or regulator for powerful machinery is described, consisting of an upright revolving shaft, having

* Two letters from W. Peel have been published in this work: one in vol. xxi. p. 279; the other in vol. xxii. p. 152. It is impossible, in conducting a work dedicated to the service of truth, and open for the communications of men of science, to guard against impositions authenticated by a false signature. To myself the injury might have been very serious; but this is a trifle compared with the mischief done to the public. Those meritorious individuals, who, pursuing Nature through her labyrinths, spare no personal labours to enlighten others, by such frauds as this are put into a wrong path, and robbed of what in their estimation is more valuable by far than money—their precious time. It is impossible even to conceive a motive for such unprincipled malignity; nor will any man of feeling and integrity envy the wretch who is guilty of it the gratification he may experience from the temporary imposition practised against those who never did him an injury. I am much obliged to the individual who has enabled me to communicate the above information to the public; and I believe I may add, in however trivial a light my own poor but well-meant efforts may be held by men of science in general, that he would be rendering them a real service by enabling me to expose the author of this low but mischievous trick.—A. T.

vanes

vanes or wings, which lave in the water of a circular cistern or well. In justice to a very ingenious man, Mr. William Robert, of the neighbourhood of Swansea, in South Wales, I beg to mention that a regulator on this principle was contrived by him, and executed in 1793; since which the same has been employed, with the most perfect success, in Messrs. Lockwood and company's collieries, where the coals from the upper veins of the mountain require to be let down in large quantities to the trainway tunnel below, in order to their being conveyed out of the hill to the navigation. It is difficult to conceive any regulator better adapted for harmlessly destroying the immense power generated by the long and almost constant descent of large baskets of coals in these mines; the velocity of the descent being adjustible to the greatest nicety by means of cocks, which let in or out water from the regulator well, as occasion may require: at the same time permit me to remark, that few situations seem less adapted for this kind of regulator, or rather destroyer of power, than the one in which Mr. Eckhardt has exhibited it in the work above quoted, where the expensive and cruelly-excited labour of animals ought to have been more œconomically regulated. A more serious defect attends Mr. Eckhardt's mode of applying the labour of animals, viz. on the outside of a walking-wheel, owing to the increase of power, (instead of its decrease,) whenever the animal abates its muscular exertion, and the wheel is moving, as on all occasions of ceasing work. This will evidently appear from an inspection of the 21st plate as above; where an ox is represented standing with his fore feet upon a stage fixed nearly over, but a little before the top of a walking-wheel, while his hind legs rest and act on the wheel at a considerable distance beyond its top. Whenever the animal's hind legs happen, by the motion of the wheel, to be carried further than usual from his fore legs, how is he to recover himself? Not only will the weight of his hind quarters, acting on an increased radius, accelerate its motion, but his hind legs, brought continually nearer into the direction of a tangent to the wheel, will give his muscular exertion an increasing effect on the wheel as he endeavours to prevent the pro-

 gressive

gressive spreading of his legs, till his belly falls on the wheel!

Man alone, from his erect position, and his facility of hanging or bearing discretionally by his hands on a fixed rail, seems capable of applying muscular power with advantage to the convex surface of a moving wheel.

I am sir, your obedient servant,

Westminster, Feb. 14, 1807. MECHANICUS junior.

XV. *Proceedings of Learned Societies.*

ROYAL SOCIETY OF LONDON.

JAN. 29, 1807. The right hon. the earl of Morton, vice-president, in the chair.—Continuation of Dr. Herschel's paper on the coloured concentric rings* seen through thin plates or lenses. The doctor detailed a great variety of experiments made with lenses of 120 feet focus down to those of the most common glasses. The colours of these rings seen through the lens of 120 feet were black and white; those through one of 40, were red; those through one of 14, were violet, &c. Thus these concentric rings, which through a glass of one focus appeared black, through another appeared blue, and so on throughout the whole series of the prismatic colours. The author drew no conclusions from these facts, nor did he attempt to classify them in any manner tending to elucidate the nature of the phænomena, or the peculiar influence of glasses of different densities on the transmissibility of light.

Feb. 5. Right hon. C. F. Greville, vice-president, in the chair.—The reading of the above paper was concluded. The doctor made numerous other experiments, all of which tended to establish the fact, that light could not have, as sir Isaac Newton supposed, *fits* of easy transmission or reflection; and that therefore this phænomenon of concentric rings must be ascribed to another cause, which he proposed to

* In our last Number, the words "circular rays" occur instead of "concentric rings."

investigate

investigate in a second part of this paper. It may not be improper to remark here, that many of the author's observations on Newton's theory of colours have been anticipated both by Dr. Bancroft and by an anonymous writer* on that subject. Perhaps it was a knowledge of this circumstance that induced him to mention so pointedly that most of his experiments were made several years ago.

Feb. 12. The right hon. the earl of Morton, vice-president, in the chair.—A paper, by E. Home, esq. containing observations on the stomachs of animals of the cetaceous genus. The late Mr. Hunter observed that this genus, contrary to what is common in other carnivorous animals, had stomachs composed of four cavities, or bags, through which the food passed before it was prepared to form chyle. Mr. Home, although he has examined, he says, several of these animals, and in the present instance has dissected a bottle-nosed porpoise, which had six of these bags constituting its stomach, has succeeded only in ascertaining the relative dimensions of these parts, without being able to assign any satisfactory cause for such an important difference of organical structure.

Feb. 19. The earl of Morton in the chair.—The introduction to an interesting paper on the bark of trees, by T. A. Knight, esq. was read. In this preliminary matter Mr. Knight expressed himself, after twenty years experience, in terms of great modesty and rational scepticism respecting our knowledge of the growth and importance of the bark of trees.

SOCIETY OF ANTIQUARIES.

Jan. 29, 1807. Craven Orde, esq. in the chair.—The reading of a curious and ingenious paper on the origin of the first race of Britons, by Mr. Greathead, commenced; in which the author took a view of the different nations supposed to have been the aborigines of the antient Britons, and pointed out their dissimilarity.

Feb. 5. Craven Orde, esq. in the chair.—A large stone ring, taken from the finger of Tippoo Saib, was exhibited, containing the following inscription graven on the stone in

* See Philosophical Magazine, vol. viii. p. 78.

Arabic: "Dominion to God; he is the only, the victorious." An old engraving of the gothic church of Milan, and the dome of the church at Pisa, were exhibited.

The reading of Mr. Greathead's dissertation on the aboriginal Britons was concluded. The author, from an extensive view of the facts, established the following conclusion: that the first inhabitants of Britain were neither Celts, Scandinavians, nor Gauls; but Cantabrians, originally and directly descended from aboriginal Spaniards. He traced the manners of the people of Cornwall and those on the opposite coast of Brittany, and also the particular district in England where he conceived the Cantabrians had originally settled, whence they migrated to Ireland: the latter island, he observed, was never visited by the Romans, and consequently its manners and language were unknown to them. The great similarity between the Irish and the modern Spaniards of Biscay, the descendants of the fierce *Cantabri*, tends considerably to confirm the author's plausible hypothesis.

Feb. 12. The earl of Leicester, president, in the chair.—Mr. Lysons read some extracts from the public records, particularly a letter from Richard III. to the lord chancellor, bishop of Lincoln, in which that monarch describes the character and conduct of Buckingham, and declares his determination of having him executed as a traitor; which he soon after effected. In this curious letter he required and received the great seal from the bishop, and kept it himself from the month of October till the middle of the following year, during which time he issued several orders as chancellor, and established many useful institutions; after which he delivered up the great seal, it appears, not to the same but to another bishop of Lincoln. This letter, accompanied by Mr. Lysons's remarks, tends to give us a much more favourable idea of Richard's character than is usually entertained.

Feb. 19. This society was occupied in choosing a secretary and member of its council in the place of the late Mr. Brand. There were three candidates; Mr. Carlisle, Mr. C. F. Dibdin, and Mr. Coxe: the former of whom was elected by a great majority.

FRENCH

FRENCH NATIONAL INSTITUTE.

[Continued from our last volume, p. 373.]

M. Thenard, professor in the College of France, has completely discovered in bile a saccharine matter the existence of which has been hitherto only suspected, and the property of which is to hold the oil of the bile in solution. The methods of analysis which he has employed have been remarked, by the committee charged with the examination of his labours, as singularly ingenious; in fact, it was extremely difficult completely to free this substance from those which disguised it.

M. Seguin, a corresponding member of the Institute, has made some researches on the nature of coffee; whence it results, that this grain is composed of albumen, oil, a particular substance which he has named the bitter principle, and a green matter which is merely a combination of the albumen with the bitter principle; that the proportions vary in the different kinds of coffee; that roasting increases the proportion of the bitter principle by destroying the albumen; that these two latter principles contain plenty of azote; and that the bitter principle is antiseptic. The oil of coffee is inodorous, congelable, and white like hog's lard.

M. Seguin afterwards examined if albumen was not to be found in other vegetables; and he discovered it, in short, in a great number, which he specifies. The most of them also contain, in certain proportions, a bitter principle, more or less similar to that of coffee.

This remarkable quantity of albumen being met with particularly in such vegetable juices as ferment and yield a spirituous liquor by themselves without yeast, such as the juice of raisins, gooseberries, &c. &c., M. Seguin was led to inquire if the albumen contributed any thing to this intestine commotive fermentation, hitherto so little known. He states, that having taken the albumen from these juices they are no longer capable of fermenting; and that having made albumen artificially, with the white of an egg and saccharine matter for instance, fermentation took place, when other circumstances were besides convenient for it; and

 there

there was always deposited a matter like yeast, which appeared to him to be nothing else than an altered albumen become almost insoluble, without losing, on that account, its fermenting action; whence he concludes that albumen, whether animal or vegetable, is the true ferment.

M. Seguin has further ascertained that albumen is found in three different degrees of insolubility and dispositions of becoming fibrous; that the more it is soluble the more energetic is its action; that the respective proportions of albumen and sugar in the different juices are what determines the vinous or acetic nature of the produce of the fermentation, it being so much the more spirituous the more sugar it contains; and lastly, that the most of the fermentable juices contain a bitter principle analogous to that of coffee, which goes for nothing in the fermentation, but which contributes to the taste and the preservation of the fermented liquor.

Tannin, that vegetable principle formerly discovered by M. Seguin, and the character of which is to form with gelatine an insoluble compound, has been recently examined by M. Bouillon Lagrange, professor in the Napoleon Lyceum.

He has found in it an affinity for the alkalis, for the earths, and metallic oxides, and the faculty of converting itself into gallic acid by absorbing oxygen.

The tannins, as they are extracted from the various vegetables, vary a little in their composition; and that which Mr. Hatchett, the English chemist, has discovered in caoutchouc is a little more oxygenated than the others.

An Italian chemist, M. Morichini, having discovered the fluoric acid in the enamel of the fossil grinders of the elephant, analysed that of the human teeth, and thought he discovered the same principle. M. Gay-Lussac has found it also both in the fresh and fossil ivory, and in the tusks of the boar.

Messrs. Fourcroy and Vauquelin have repeated these experiments, and have actually obtained this acid from tusks and teeth altered by their remaining in the earth; but not from fresh tusks or teeth, nor even from those which, although fossil, had not been altered.

M. Vau-

M. Vauquelin has this year made some experiments upon hair *.

The method of imitating the alum of Rome, discovered last year, has been so successful that immense quantities of it have been sold for true Roman alum.

We are indebted to Messrs. Clement and Desormes for this discovery; and it merely consists in calcining and re-crystallizing it, to take its superabundant acid. M. Curaudeau, however, asserts that it is still necessary to oxygenate to the maximum the little iron the alum generally contains.

But in a more recent memoir Messrs. Thenard and Roard have finished the investigation of this subject: a single millieme of iron influences the effect of alum in dyeing: every effort of the manufacturer ought therefore to be used to deprive it of this small quantity of iron. The oxygenation of the iron is one method, as it renders it insoluble in the acid; and the alums thus purified are equal in every respect to the alums of Rome.

Contagious miasma has been ably combated by the oxygenated muriatic acid gas. This preservative, for which we are indebted to M. Guyton, is very generally employed. M. Desgenettes ascertained its effects by some very careful experiments in the military hospital at Val-de-Grace; and it results, from the comparative tables he has sent us, that these fumigations not only prevent the communication of the disease, but appear to be of great efficacy in the cure.

M. Pinel has been equally successful in the Hospital of Salpetriere.

The public have recently been informed, through the medium of the journals, how successful this preservative has been in Spain, and of the presents which have been made by the king to those who have used it. We know also the honourable recompense given by our emperor to the principal author of the discovery.

From the journals also, and from the other extremity of our continent, we have been informed of the full success of the process, proposed by M. Berthollet, to preserve water

* See Phil. Mag. vol. xxv. p. 351.

sweet

sweet during long voyages, by charring the inside of the casks. Captain Krusenstern has honourably acknowledged how much navigation is indebted to the philosopher, who is a subject of a country at war with his own.

The sciences which tend to unveil to us the intimate nature of natural beings, have made still further advances.

A particular point in the anatomy of plants, the manner in which the seeds are fecundated, has been the object of the researches of M. Turpin.

This botanist thinks that the umbilical, or the part by which the grains adhered to the fruit, besides the passage which transmits the vessels which come from the trunk and which nourish the grain, also gives passage to other channels which descend from the pistil, shoot out opposite the small root of the embrion, and carry to it the fecundating principle by the stigma of the powder of the stamina. There is seen on all the grains a small aperture called *mycropila* by M. Turpin, and to which he attributes this function.

[To be continued.]

ROYAL ACADEMY OF SCIENCES OF BERLIN.

At the anniversary of the above Academy on the 7th of August last, the following distinguished foreigners were proclaimed members of the Institution: M. Cuvier, member of the French Institute; Sir Joseph Banks, president of the Royal Society of London; M. Goethe, privy counsellor to the duke of Weimar, and author of *Werter*; M. Zoega, agent for the king of Denmark at Rome, and author of several excellent works upon antiquities; and professor Hindeberg, of Leipsig.

The Academy at the same meeting awarded prizes to two memoirs upon the structure and functions of the lungs; the one by M. Reisseissen, a physician of Strasbourg; and the other by M. Soemmering, privy counsellor to the king of Bavaria. The class of mathematics of the Academy declared that they had received nothing satisfactory upon the problem relative to the variations in the obliquity of the ecliptic. The time has been therefore enlarged for giving in the memoirs on the subject, to two years longer. The Academy has proposed

proposed the following question in physics for the ensuing year: "Has electricity any direct influence upon the greater or less force of magnetism?—And this influence being proved by experiment, what are the modifications experienced from it by the magnetic force?"

ACADEMY OF GOTTINGEN.

At the meeting of the above Academy on the 12th of October 1806, professor Strohmeyer, resident member of the Academy, read a part of the results of extensive chemical researches upon the union of hydrogen with the metals. He particularly examined in this memoir the union of hydrogen and arsenic. He made several experiments upon the most striking phænomena presented by arsenical hydrogen gas. Professor Osiander afterwards presented to the museum of Gottingen a small phial filled with sand from the diamond mine of Bansor Massing in the Island of Borneo, which he had received from one of his countrymen, M. Haas, who returned from India in 1802. M. Haas served as chaplain to a Wirtemberg regiment in the pay of Holland, which had been sent to the Cape of Good Hope, and from thence to Java and Ceylon. When he undertook this voyage, George Forster, who then lived at Mentz, gave him various instructions, both verbally and in writing, upon the manner in which he ought to conduct himself, and particularly upon objects of natural history. According to the instructions of Forster, M. Haas endeavoured among other objects to procure some sand from the diamond mines in Borneo, hitherto inaccessible to Europeans. For this purpose he applied to one of his countrymen in the service of the Dutch in the Indies. This latter gentleman found means to obtain from the Sultan of Borneo a quantity of the sand of these mines, which he divided with M. Haas, who immediately sent some of it to the National Institute, and to a Spanish governor, Emmanuel D'Agota: the remainder, with the exception of a small part which he had concealed in a box of tea, was taken from him along with other things by the commander of a French privateer, who captured the vessel in which he sailed on his return to the Isle of France.

It

It was this small quantity which M. Haas, on his return to the Cape, sent to M. Osiander, his friend and countryman; who in his turn presented the greatest part of it to the museum of Gottingen, as a rarity worthy the attention of naturalists. This sand resembles that found in the other diamond mines of Golconda, Visapour, &c. and is of a reddish and ferruginous yellow.

XVI. *Intelligence and Miscellaneous Articles.*

MISCELLANEOUS.

A SUBSCRIPTION has been set on foot in the Swedish province of Smaland, where Linnæus was born, in order to erect a monument to this great botanist.

Several French engineers are at present busily employed in Switzerland, in laying down a grand topographical chart of that country.

"A machine, which in order to move itself and produce all its effect would have no occasion of any foreign agent, a machine which without the action of fire, air, or water, would contain in itself the inexhaustible principle of its own motion, would be a discovery useful to the arts and valuable to humanity: such is the machine of which M. Dodemant, professor of mathematics at Lyons, maintains that he is the inventor. Two commissaries have been sent to examinine this machine. These commissaries are Messrs. Cavron, chief engineer of the department; and Mollet, professor of physics, and member of the Lyonese Academy." *From Mag. Encycloped. June* 1806. *p.* 428.

By a French imperial decree, there has been established at Rouen, in Normandy, a school destined for teaching the art of modelling anatomical preparations in wax, under the direction of M. Laumonier. Six pupils sufficiently skilled in anatomical knowledge, and in the art of modelling, will be attached to this school, upon the nomination of the minister of of the interior. They are not to remain at Rouen longer than three years.

Messrs. Biot and Arrago left Paris for Spain, on the 2nd of September, in order to continue the measurement of the meridian of Messrs. Delambre and Mechain the length of the Balearic Islands.

SCIENTIFIC NOTICE.

Mr. Olinthus Gregory, A. M., of the Royal Military Academy, has now in the press a translation of the Abbé Haüy's valuable work, entitled *Traité Elementaire de Physique,* with notes historical, illustrative, and critical. The translation, which will make two handsome octavo volumes, will be published in a few weeks; and in conjunction with Mr. Gregory's Treatise on Astronomy, and his Treatise of Mechanics, (a new edition of which is just published,) will constitute a complete course of Natural Philosophy, including every important discovery of modern times.

GEOLOGY.

In the beginning of December 1806, as some labourers were digging clay in the brick-yard of Mr. Pool, at Bottesford, near Grantham, they discovered, nine feet below the surface, the head and horns of an animal of the bull kind, but of extraordinary dimensions. The horns, together with a piece of frontal bone, weigh 31 lbs. and measure from tip to tip 2 feet 1 inch; and at the greatest bridge of the horns the distance is 3 feet 2 inches. Each horn measures from skull to tip 2 feet 8 inches; and is at its base 1 foot 1½ inch. A single tooth weighs 2½ ounces. There was an immense cavity in the clay, supposed to have contained the body; and on each side was a very large piece of an oak tree, as black as ebony. Part of the horns, near the tip, are petrified. The parts found are at present in the possession of Mr. J. Wright, surgeon, of Bottesford.

LIST OF PATENTS FOR NEW INVENTIONS.

To William Hance, of Pooley-street, in the parish of Saint Clare, Southwark, and county of Surry, hatter; for his

his method of rendering water proof beaver and other hats. January 29.

To Benjamin Southcombe, of Brick-lane, in the parish of Saint Luke, in the county of Middlesex, tin-plate worker; for his method of making flexible or malleable metallic plates into convex or concave forms, or hollow shapes.—January 29.

To Richard Friend, of the Broadway Saint Thomas's, in the borough of Southwark and county of Surry, gun carriage maker; for his improvements in the making and working gun and carronade carriages.—January 29.

To Simon Orgill, of the town and county of the town of Nottingham, frame-smith; for his invention of certain stops for working bolt wheels affixed to the machine attached to the common warp lace frame, to give motion to the said machine; and also a rotatory spindle, projections and levers, to be affixed to the said frame itself, to give motion to the said frame, for the purpose of manufacturing by a more simple, certain, and expeditious method lace or net work of various figures and qualities, with silk, cotton, worsted, or other materials, produced from animal, vegetable, or mineral substances.—February 3.

To Richard Lorentz, of Great Portland-street, in the county of Middlesex, Esq. who, in consequence of communication made to him by foreigners residing abroad, is in possession of certain inventions of different machines or instruments, one of which will produce instantaneous light, and the other instantaneous fire.—February 5.

To James Essex, of the town of Northampton, woolstapler and grocer; for his methods of making or manufacturing dyed, botted, or felted wool into mats, rugs, carpets, &c. of various colours, figures, patterns, and sizes, for carriages, halls, parlours, hearths, and sundry other purposes.—February 5.

To James Spershott, of Shelton, in the county of Stafford, clay merchant; for his improvements in the manufacture of earthenware.—February 7.

To John Day, of Camberwell Green, in the parish of Saint Mary Lambeth, stone mason; for his engine for the

purpose

purpose of loading and unloading vessels; and also for raising large anchors and other immense weights to any height required.—February 12.

To our right trusty and right well beloved cousin Charles Earl Stanhope; for his improvements respecting the form, construction and manner of building and fitting out ships and vessels for the purpose of navigation, and especially for counteracting or diminishing the danger of that most mischievous invention for destroying ships and vessels, known by the name or appellation of Submarine Bombs, Carcasses, or Explosions.—February 16.

To James Winter, of Stoke under Hamdon, in the county of Somerset, glove manufacturer; for his machine for sewing and pointing leather gloves, with neatness and strength much superior to that which is effected by manual labour.—February 20.

To Andrew Kauffman, of the parish of Saint Leonard, Shoreditch, in the county of Middlesex, musical instrument maker; for his improvements in the construction of the flageolette, or English flute.—February 20.

To Archibald Thomson, of the parish of Saint John, in the city of Westminster and county of Middlesex, engineer; for his improvements (by the application of known principles) upon certain parts of mill spinning for spinning of wool or cotton.—February 20.

To Isaac Sanford, of the city of Gloucester, civil engineer, and Stephen Price, of Stroud, in the county of Gloucester, civil engineer; for their method to raise a nap or pile on woollen, cotton, and all other cloth, which may require a nap or pile, as a substitute for teasels or cards.—Feb. 20.

To Frederic Albert Winsor, of Pall Mall, in the county of Middlesex, gent.; for his oven stove furnace, or apparatus for the extracting of inflammable air or gas, and also oil, acetous and ammonial liquors from different kinds of fuel, for reducing such fuel into coke and charcoal, for completely purifying such inflammable air or gas of its odour during a state of combustion.—February 20.

METEORO-

METEOROLOGICAL TABLE,
BY MR. CAREY, OF THE STRAND,
For February 1807.

Days of the Month.	Thermometer. 8 o'Clock, Morning.	Noon.	11 o'Clock, Night.	Height of the Barom. Inches.	Degrees of Dryness by Leslie's Hygrometer.	Weather.
Jan. 27	42°	43°	40°	30·52	12	Fair
28	37	41	40	·56	9	Cloudy
29	40	41	35	·32	7	Cloudy
30	35	41	40	·02	10	Cloudy
31	38	43	35	29·62	10	Fair
Feb. 1	32	34	26	·60	7	Showers of snow
2	26	38	35	·29	5	Cloudy
3	31	39	35	·05	12	Fair
4	36	38	36	·26	0	Snow
5	37	42	35	·32	15	Fair
6	36	46	35	·46	15	Fair
7	35	43	37	·90	17	Fair
8	39	43	45	·65	0	Rain
9	46	52	44	·50	0	Rain
10	40	49	46	·82	27	Fair
11	48	56	50	·82	25	Fair
12	52	56	48	30·17	23	Cloudy
13	46	54	46	·10	24	Fair
14	46	53	45	·20	18	Fair
15	43	52	48	·07	15	Fair
16	49	53	46	29·85	10	Cloudy
17	40	46	38	·61	25	Cloudy
18	20	27	25	·65	0	Fair
19	25	33	32	30·14	10	Fair
20	34	46	40	29·96	15	Cloudy
21	39	47	42	·76	25	Cloudy
22	46	48	46	·67	0	Small rain
23	37	47	35	·85	24	Fair
24	30	46	46	·90	27	Fair.

N. B. The Barometer's height is taken at one o'clock.

XVII. *Description of Mr.* Ez. Walker's *new Optical Machine called the Phantasmascope.*

To Mr. Tilloch.

Sir,

Among the various amusements that the sciences afford us, none are more wonderful than those which we derive from optics. This science teaches us to distrust the evidence of our senses; for when we use optic glasses, instead of viewing real objects, we generally see nothing but phantoms.

The new optical machine, of which I now take the liberty to send you an account, is constructed to afford entertainment to those who derive pleasure from optical illusions. A person standing before this machine, sees a door opened; a phantom makes its appearance, coming towards him, and increasing in magnitude as it approaches. When it has advanced about three feet it appears of the greatest magnitude, but as it returns it becomes gradually contracted in its dimensions until it re-enters the machine; when it totally vanishes. This phantom appears in the air like a beautiful painting, and in such rich brilliancy of colouring, that it is by no means necessary to make the room dark; for, on the contrary, this aërial picture is seen rather in greater perfection when it is illuminated.

This machine, which may be called the *phantasmascope*, from the effects which it produces, is constructed in the following manner:

Plate III. represents a section of this machine.

ABCD, a wooden box, 36 inches by 21, and 22 deep.

EF, a concave mirror, 15 inches diameter, placed near the end BD.

AC, the other end, is divided into two parts at *m* by an horizontal bar, of which *m* is a section.

A *m*, a door that opens to the left hand.

n o, a board with a circular opening, 10 inches diameter, covered with plate glass on that side next the mirror.

 GHI,

G H I, a drawer, open at the end I, and covered at the top G *m* with tin plate. It is represented in the figure as drawn out about 16 inches.

a b, a moveable stage, 15 inches by 6, which slides freely upon the bottom of the drawer by means of a strong brass rod *c a*.

d x, a partition fixed to the stage *a b*, which is 15 inches long, and reaches nearly to the top of the drawer.

x, a circular aperture, 3 or 4 inches in diameter, made near the bottom of the partition, and at equal distances from each end of it.

z a, a screen $7\frac{1}{2}$ inches high by $4\frac{1}{2}$, covered with white paper on that side next the mirror. This screen prevents any light, reflected from the end of the drawer, from passing through the aperture *x*.

n p, part of the cover, fixed as represented in the figure, to prevent the inside of the machine from being seen by the observer.

When this machine is used, take a painting on glass in transparent colours, place it against the aperture *x* in the partition on that side next the mirror, and two short candles on the other side, between *z a* and *d x*. The glass must be perfectly opaque, except that part upon which the figure is painted; then the light which is transmitted through the painting and falls upon the mirror, is reflected into the air where the phantom is formed; but the phantom is much more beautiful than the painting, as the colouring receives a peculiar delicacy from the glasses.

When the painting is in the place represented in the figure, the phantom appears without the machine at *y*; but if the stage be drawn out to the end of the drawer G H, the phantom will appear within the machine at *r*, and very small. A very pleasing effect is also produced from a small painting on paper, or a coloured print put in the place of the painting on glass, with candles on the other side, near *b*.

Application

Application of the machine to represent the phases of the moon, primary planets, and some other phænomena in the heavens. This, I trust, will be easily understood from the following*

EXAMPLE.

To represent Jupiter and his satellites as they appear through a common telescope, take a piece of paper stained very black, about three inches square, near the middle of which cut a hole, perfectly circular, to represent the planet, and four small holes, in a line with the centre of the large one, for the satellites; but these must be cut out with a small punch, as it is difficult to make a circular hole with a sharp-pointed instrument. After this paper has been pasted upon a piece of glass, rough ground on one side, draw three or four lines across the planet with a black lead pencil to imitate the belts. From this simple contrivance the machine produces a very beautiful effect. The new moon represented this way is a striking resemblance of the real objects in the heavens: comets and fixed stars may also be represented by the same method.

The colour of Mars and of the moon, at rising or setting, may be imitated by covering the screen za with paper stained red, which will reflect a ruddy tint upon the object placed at x; and this tint may be increased or decreased by only altering the situations of the candles. I am, sir,

Your most humble servant,

EZ. WALKER.

Lynn,
Feb. 11, 1807.

XVIII. *A third Series of Experiments on an artificial Substance which possesses the principal characteristic Properties of Tannin; with some Remarks on Coal. By* CHARLES HATCHETT, *Esq. F.R.S.*

[Concluded from p. 76.]

§ V.

In my first paper I have remarked, that I suspected the tannin of the peat moors to have been produced during the

* These phænomena are represented much more exactly by this machine, than by any other that I am acquainted with.

 imperfect

imperfect carbonization of the original vegetable substances. Whether this has been the case, or whether the tannin has at times been afforded by heath and other vegetables growing upon or near the peat, still appears to me to be uncertain; but, whatever may be the origin, I have never yet been able to detect any tanning substance in peat, although I have examined a considerable number of varieties, some from Berkshire, and many from Lancashire, which were obligingly sent to me for this purpose by my friend John Walker, esq. F.R.S. Mr. Jameson has also made the same observation *, so that there cannot be any doubt (whatever the origin of the tanning matter may have been) that it has speedily been extracted and drained from the substances which at first contained it.

This effect is a natural consequence of the great facility with which tannin is dissolved by water, and extends even to the most solid vegetable bodies: I shall here give an example.

In the Philosophical Transactions for 1799, Dr. Correa de Serra has given an account of the submarine forest at Sutton, on the coast of Lincolnshire, where submerged vegetables are found in great abundance, including trees of different descriptions, especially birch, fir, and oak. At the time when I was engaged in those experiments on the Bovey coal, and other substances of a similar nature, which have been printed in the Philosophical Transactions for 1804, Sir Joseph Banks had the goodness to send me a piece of the oak, which was perfect in all of its vegetable characters, and did not appear to have suffered any change, excepting that it was harder, and of a darker colour, than recent oak wood. From some experiments which I then made, I found that after incineration it afforded potash, similar to the recent wood, and contrary to substances like the Bovey coal, which retain the vegetable external characters, although imperfectly converted into coal †.

In the course of my experiments on tannin I reduced

* An Outline of the Mineralogy of the Shetland Islands, &c. 8vo edition, p. 174.

† Phil. Trans. for 1804, p. 399.

about

about an ounce of this submerged oak into shavings, and digested them in water. A brown decoction was formed, which with muriate of tin afforded a pale brown precipitate; with acetite of lead, a precipitate of a deeper brown; with sulphate of iron, a copious brownish-black precipitate; but with solution of isinglass not any effect was produced.

The tannin of this oak wood had therefore either been separated by solution, or had been decomposed; so that the only substance which remained capable of being dissolved by water was the extractive matter. This last, in the present case, was most probably the original extractive matter of the oak; but in some other instances (such, for example, as that which was found in the alder leaves contained in the Iceland schistus*,) I am much inclined to believe that an extractive substance of a secondary formation, if I may be permitted to employ such a term, is produced during the process of carbonization. If a substance, therefore, so compact and solid as oak timber can by long submersion be deprived of its tannin, it naturally follows that the same effect must be more speedily produced by the action of water on the smaller vegetable bodies, which present an extensive surface; and also on porous and bibulous substances, such as peat.

But although peat, as I have already observed, does not contain any tannin, yet the imperfect carbonization which it has undergone renders it, like the roasted ligneous bodies, peculiarly susceptible of being converted into the artificial tanning substance when exposed to the action of nitric acid. It would be useless to enter into a detail of the different experiments which I have made upon it, as they were similar to those already related; and I shall therefore only here state, that when seven ounces of well dried peat had been twice moistened, and digested with diluted nitric acid, (to the amount of rather more than two ounces,) and subsequently dried, I obtained by water a solution of the artificial tanning substance, which when evaporated to dryness weighed two

* Phil. Trans. for 1804, p. 391.

 ounces.

ounces. I am convinced that much more might have been obtained from the residuum of the peat, had I thought proper to have repeated the operation; and I am also certain that less nitric acid would have been sufficient, had the process been conducted in close vessels, and with other œconomical precautions, which at that time were, for the sake of expedition and convenience, omitted.

§ VI.

It has been generally stated, even by modern chemists, that the acids act but little, if at all, upon resinous substances.

The contrary has, however, been proved, not only in the three papers upon the present subject, but also in some others which I have formerly had the honour to lay before this learned society.

In my experiments on lac, printed in the Phil. Trans. for 1804, p. 208, I have particularly endeavoured to show how powerfully the acetic acid acts upon resin, gluten, and some other substances; so that it may justly be regarded as a valuable agent in the chemical analysis of vegetable bodies. In this point of view, it is as a solvent to be the more highly appreciated, because it appears to dissolve the resins, &c. without affecting their respective qualities; and thus, by proper precipitants, these substances may be separated from it pure and unaltered.

I am induced, therefore, to consider acetic acid to be the true acid solvent of the resinous substances, as it dissolves them speedily, without producing any apparent subsequent change in their natural properties.

Sulphuric acid, also, almost immediately dissolves the resins, balsams, &c. and forms transparent brown or sometimes crimson solutions, the latter colour being most commonly characteristic of the balsams.

These solutions, however, are different from those made in the acetic acid, by not being permanent; for, from the moment when the solution is completed, progressive alterations appear to be produced in the body which is dissolved: thus

thus turpentine is almost immediately converted into resin, then into the third variety of the tanning substance, and lastly into coal.

Without being under the necessity of adducing other examples, we may therefore state sulphuric acid to be a solvent of the resinous substances, but which continues afterwards to act on their principles so as to decompose them, coal being the ultimate product.

Nitric acid, as I have shown in the course of these papers, and likewise on some former occasions, dissolves the resins, but the progress of its effects seems to be conversely that of sulphuric acid; in the latter case, solution precedes decomposition; but when nitric acid is employed, decomposition to a certain degree precedes solution; for it at first converts the resins into a pale orange-coloured brittle porous substance, then into a product which apparently possesses the intermediate characters of vegetable extractive matter and of resin; and lastly, this is converted into the first variety of the tanning substance, beyond which I have not been able to effect any change.

As coal, therefore, appears to be the ultimate effect produced by sulphuric acid upon the resinous bodies, so does the first variety of the tanning substance seem to be the terminating product afforded by the same when acted upon by nitric acid. This effect of nitric acid has been already amply discussed, neither does it appear necessary that I should here repeat the remarks which have been made on some of the simultaneous products, such as the vegetable acids; but, amongst the effects produced by sulphuric acid, the coal which is formed seems to merit some attention.

§ VII.

After the tanning substance and the other products had been obtained from the resins, balsams, &c. which have been mentioned in the beginning of this paper, the following proportions of coal remained *:

* The weight of the coal obtained from each of the above-mentioned substances was estimated after the complete separation of every other product, and after the moisture had been expelled by red heat in close vessels.

 Coal.

		Coal.
100 grains of	Copal	67 grains.
———	Mastich	66
———	Balsam of Peru	64
———	Elemi	63
———	Tacamahac	62
———	Guaiacum	58
———	Gum ammoniac	58
———	Amber	56
———	Olive oil	55
———	Balsam of Tolu	54
———	Asafœtida	51
———	Wax	50
———	Dragon's blood	48
———	Benzoin	48
———	Olibanum	44
———	Myrrh	40
———	Asphaltum	40
———	Gamboge	31
———	Elastic bitumen	31
———	Gum arabic	29
———	Liquorice	25
———	Manna	25
———	Tragacanth	22
———	Caoutchouc	12 *

The coal obtained from the resinous bodies by means of sulphuric acid, is in a much greater proportion than when equal quantities of those substances are exposed to simple distillation.

For, (as I have stated in my first paper,) 100 grains of common resin by the humid process afforded 43 of coal, which after a red heat still weighed 30 grains.

But the same quantity of resin by distillation only yielded 3-4ths of a grain of coal.

100 grains of mastich, by the first method, afforded 66 grains of coal.

* Caoutchouc and elastic bitumen were only superficially carbonized by the sulphuric acid, so that the proportion of coal above stated is considerably less than that which in reality might have been obtained from them.

100 grains

100 grains of the same mastich only gave $4\frac{1}{2}$ grains of coal when simply distilled.

And 100 grains of amber, when treated with sulphuric acid, yielded 56 grains of coal.

But from 100 grains of the same amber, when distilled, only $3\frac{1}{2}$ grains could be obtained.

Many other examples might be adduced, but these appear to be sufficient: and I must here observe, that the case is very different in respect to the gums; for the difference between the proportions of coal obtained from them by the humid and dry ways is not very considerable, although it is always the greatest in the former process when conducted with precaution. Moreover it is to be remarked, that, in either process, variations in the quantity of coal are produced by difference of temperature, by the figure and size of the vessels, and many other circumstances.

But it is not only in the proportion that there is so great a difference between the coal obtained from the resinous substances by the humid way or by fire, for the quality is also most commonly different; and this not only applies to resins, but also to ligneous matter.

The coal obtained by the humid process from many of the resins was shining, hard, and occasionally iridescent. Few of the coals obtained from the same bodies by fire, had any of these properties. The combustion of the former was slow, in the manner of some of the mineral coals; whilst, on the contrary, the latter were speedily consumed, like charcoal. This difference I was at first inclined to attribute to a small portion of the acid which might not have been completely separated, and I therefore purposely made some experiments, which convinced me that this was not the case.

Having remarked this difference in the coals afforded by the resins, I was desirous to make some comparative experiments on wood, and for this purpose I selected oak.

1. On 480 grains of oak sawdust I poured two ounces of sulphuric acid diluted with six ounces of water, and placed the matrass on a sand-bath, where it remained from the beginning of last June to the end of September. During this

time

time the sand-bath had very seldom been heated, but the vessel was occasionally shaken.

At the end of the period above mentioned, six ounces of boiling water were added, and, the whole being poured upon a filter was repeatedly washed, and was afterwards dried on a sand-bath in a heat not much exceeding 300°.

The sawdust appeared to be reduced to a granulated coal, partly pulverulent, and partly clotted: the whole weighed 210 grains.

105 grains of this coal were put into a platina crucible, and were exposed to a red heat under a muffle. At the same time, an equal quantity of charcoal, made from the same oak sawdust, was placed in another vessel by the side of the former.

The charcoal was speedily consumed, and left some brownish-white ashes, which, as usual, afforded alkali, with a trace of sulphate, which was probably sulphate of potash.

On the contrary, the coal formed by the humid way burned without flame, similar to the Kilkenny coal, and others which do not contain bitumen. It was very slowly consumed, like the mineral coals above mentioned, and left some pale red ashes, which weighed two grains. These did not yield the smallest vestige of alkali, and the only saline substance which could be obtained was a very small portion of sulphate of potash, which did not amount to more than 1-5th of a grain; and it is probable that, had the coal been more copiously washed, even this small portion of the neutral salt would not have been obtained.

2. At the time when the preceding experiment was begun, I also put 480 grains of the oak sawdust into another matrass, and, having added four ounces of common muriatic acid, the whole was suffered to remain during the period which has been mentioned.

At the end of the four months the remainder of the acid was for the greater part driven off by heat not exceeding 300°. The sawdust then had the appearance of a brownish-black mass, on which about a pint of boiling distilled water was poured; the whole was decanted into a filter, was repeatedly

peatedly washed, and was afterwards dried without heat. The sawdust then appeared, as I have observed, brownish-black, and was pulverulent. It burned with some flame, emitted still a slight vegetable odour, and was reduced to ashes much sooner than the coal formed by sulphuric acid, but not so speedily as the oak charcoal. The ashes had an ochraceous appearance, and were almost devoid of any saline substance, excepting a very slight trace of muriate of potash.

These two experiments therefore prove,

1st, That wood may by sulphuric acid be converted into a coal which in its properties is very different from charcoal, although prepared from the same sort of wood; and that the coal thus formed by the action of sulphuric acid resembles by its mode of burning, and by not affording any alkali when reduced to ashes, those mineral coals which are devoid of bitumen.

2dly, That wood may also be converted into a sort of coal by muriatic acid; but in this case some of the vegetable characters remain, although, like the former, not any alkali can be obtained from the ashes.

§ VIII.

Four different solutions have been proposed respecting that difficult problem in the natural history of minerals, *the origin and formation of coal.*

The first is, that pit coal is an earth or stone chiefly of the argillaceous genus, penetrated and impregnated with bitumen.

But Mr. Kirwan very justly remarks, that the insufficiency of this solution is demonstrated by Kilkenny and other coals which are devoid of bitumen, and also that the quantity of earthy or stony matter in the most bituminous coals bears no proportion to the weight of them *.

The second and most prevailing opinion is, that mineral coal is of vegetable origin; that the vegetable bodies have, subsequent to their being buried under vast strata of earth, been mineralized by some unknown process, of which sul-

* Geological Essays, p. 316.

phuric

phuric acid has probably been the principal agent, and that by means of this acid the oils of the different species of wood have been converted into bitumen, and a coaly substance has been formed.

The third opinion is that of Arduino, who conceives coal to be entirely of a marine formation, and to have originated from the fat and unctuous matter of the numerous tribes of animals that inhabit the ocean.

And the fourth is Mr. Kirwan's opinion, who considers coal and bitumen to have been derived from the primordial chaotic fluid *.

The limits of this paper will not permit me to enter into the various arguments and facts which have been adduced in the support of these different opinions; but the second, or that which regards the vegetable substances as the principal origin of coal, seems by much the most probable, because it is corroborated by the greater number of geological as well as by many experimental results. Most of the former have, however, been stated in different works, and I shall therefore only notice a few of the latter which have occurred in the course of my experiments.

The observations of Dr. Correa de Serra on the wood of the submarine forest at Sutton, on the coast of Lincolnshire, together with many similar accounts which have been published in the Philosophical Transactions and other works, demonstrate, in the most satisfactory manner, that whether vegetables are totally or partially buried under the waves or under the earth, they are not merely by such means converted even into the most imperfect sort of coal †. Some process,

* Geological Essays, p. 327.

† In my paper "On the Change of some of the proximate Principles of Vegetables into Bitumen" I have quoted the remarks of Bergman, Von Troil, and others, on the compressed state of the trunks of the trees which have been converted into surturbrand, Bovey coal, and similar substances. The same observation has been also made by Dr. Correa de Serra respecting the timber of the submarine forest at Sutton; and this is the more remarkable, as the submerged vegetables at Sutton do not exhibit any appearance of carbonization.

Dr. Correa says, "In general the trunks, branches, and roots of the decayed trees were considerably flattened; which is a phænomenon observed in process, therefore, independent of these circumstances must have taken place, in order that the vegetable substances, such as ligneous matter, resin, oil, &c. should become coal and bitumen.

In a former paper I have endeavoured to show that these changes are progressive, and, having noticed the perfect state of the submerged wood at Sutton and other places, I next described the qualities of the different kinds of Bovey coal, which exhibit a series of gradual changes from bodies which retain the vegetable structure and texture, although imperfectly carbonized, to others in which almost the complete characters of the common mineral or pit coal are absolutely established.

From the alder leaves in the schistus from Iceland I obtained extractive vegetable matter; and although this was not afforded by the varieties of Bovey coal, yet these, as well as the alder leaves, and also a coal like that of Bovey, found in Sussex, at Newick Park, (an estate belonging to sir Elijah Impey,) and also the surturbrand of Iceland, yielded some resin, which at Bovey is likewise found in distinct masses, intermixed with the strata of coal, and combined with asphaltum, in the proportion of about 41 parts of the latter with 55 of resin *.

Now, exclusive of the other vegetable characters which are so evident in many of the varieties of Bovey coal, of the Sussex coal, of surturbrand, &c. &c. the presence of resin must be regarded as a strong fact; for this substance has always been attributed to the organized bodies, particularly to those of the vegetable kingdom, and I do not know of any instance, previous to my own experiments, in which resin had been discovered as constituting part of any of the different species and varieties of coal.

From the external vegetable characters possessed by the Bovey coal, the Sussex coal, the surturbrand, and many

in the surturbrand or fossil wood of Iceland, and which Scheuchzer remarked also in the fossil wood found in the neighbourhood of the lake of Thun, in Switzerland." Phil. Trans. 1799, p. 147.

* Observations on the Change of some of the proximate Principles of Vegetables into Bitumen. Phil. Trans. 1804, p. 405.

 others,

others, together with the resin, (allowed to be exclusively a vegetable substance, or at least one which only appertains to the organized natural bodies,) there cannot be any doubt that such coals have been formed from wood and other substances belonging to the vegetable kingdom.

But some mineralogists attempt to draw a line of separation between the coals above mentioned and the others, which therefore they call the true mineral coals.

This opinion may in some degree be refuted even from the specimens afforded by the Bovey coal pits, where, as I have observed, a regular gradation may be seen from wood which is but very imperfectly carbonized, to the substance called stone coal, which in every respect appears to be most nearly if not absolutely similar to the common pit coals *.

It may however be objected, that such a transition is peculiar to this and similar places, and that the pit coal found in other situations where nothing resembling the Bovey coal can be discovered is in reality of a different nature.

But this objection, I think, may be answered by the results of those experiments on pit coal, Cannel coal, and asphaltum, which I have related in the third section of this paper; for, when these were subjected to the action of nitric acic not too long continued, it was found that the acid first dissolved the principal part of the carbonaceous matter, and if then the process was stopped, there remained a substance in a proportion corresponding to that of the bitumen either in pit coal, or principally forming the Cannel coal and asphaltum, which, although not absolutely in the state of resin, was however in a state intermediate between it and the extractive matter.

Moreover I have stated, that, under similar circumstances, a substance possessing in a great measure the same properties, may be obtained by the known vegetable resins by the action of nitric acid.

When, therefore, these facts are added to that of the natural mixture of resin and asphaltum which is found with the Bovey coal, we to all appearance have almost positive proof that the pit coals are of vegetable origin.

* Phil. Trans. 1804, p. 308.

True

True it is, indeed, that bitumen has never been formed, by any artificial process hitherto devised, from the resins or other vegetable substances. I have myself attempted it in various ways without success; for although I occasionally obtained products which resembled it somewhat in odour when burned, and other properties, yet the effects of alcohol or water always proved these products not to be bitumen.

But synthesis of natural products, although required in strict chemical demonstration, is (as we have but too often occasion to know) seldom to be attained, especially when operations are performed on bodies whose component parts are liable to an infinite series of variations in their proportions, qualities, and mode of combination.

Considering, therefore, that bitumen and resin afford, by certain operations, similar products; that resin and bitumen are found blended together by nature; and that this mixed substance accompanies a species of coal which in many parts still exhibits its vegetable origin, whilst in others it passes into pit coal, we may with the greatest probability conclude that bitumen is a modification of the resinous and oily parts of vegetables, produced by some process of nature, which has operated by slow and gradual means on immense masses, so that, even if we were acquainted with the process, we should scarcely be able to imitate its effects, from the want of time, and deficiency in the bulk of materials.

But although bitumen cannot at present be artificially formed from the resinous and other vegetable substances by any of the known chemical processes, yet there is every reason to believe that the agent employed by nature in the formation of coal and bitumen has been either muriatic or sulphuric acid; and when it is considered that common salt is never found in coal mines except when in the vicinity of salt springs, whilst on the contrary, pyrites, sulphate of iron, and alum, most commonly are present *; these facts, together with the sulphureous odour emitted by most of the mineral coals when burned, appear strongly to evince the agency of the latter. That this has been the case, seems

* Kirwan's Geological Essays, p. 324.

also

also to be corroborated by the great resemblance which (as has been previously stated) the coals formed artificially from many vegetable substances bear to the mineral coals, especially as the similarity is not confined to external characters, but extends to other properties.

By the action of sulphuric acid on vegetable bodies, a much greater portion of their carbon is converted into coal than when the same are subjected to the effects of fire.

Several examples respecting the resins have been mentioned in the seventh section of this paper; and the result of the experiment made upon oak perfectly accords with them.

M. Proust, in the course of some comparative experiments on the proportions of charcoal afforded by different kinds of wood, obtained 20 per cent. from green oak, and 19 per cent from heart of oak *.

But by sulphuric acid, from 480 grains of oak I obtained 210 grains, or about 45 per cent. of coal, which burned not like the charcoal obtained from the same wood, but like many of the mineral coals; and this was also observed in the combustion of the greater part of the coals obtained, by the humid way, from resinous substances.

The experiment on oak, also, appears to refute another objection to the vegetable origin of pit coal, namely, the total absence of the alkalis, which, on the contrary, are so constantly obtained from the ligneous parts of vegetables by combustion †. But I have shown, that when these bodies are carbonized in the humid way either by muriatic or by sulphuric acid, not any alkali can be obtained from the ashes of coals so formed; and this seems also to be a further proof that the humid way has been employed in the operations of nature to convert the above-mentioned substances into pit coal; for, supposing fire to have been the agent, it does not appear easy to conceive how the alkali could have been destroyed or separated ‡.

Every

* Journal de Physique 1799, tom. xlviii. p. 469.

† Kirwan's Geological Essays, p. 320.

‡ Some have attempetd to account for the absence of alkali in the Bovey coal and common pit coal, by supposing that the vegetable bodies (from which these have

Every circumstance seems, therefore, to support the opinion of those who consider the pit coals as having been formed, in the humid way, principally from vegetable bodies, and most probably by the agency of sulphuric acid; and allowing that animal substances may also have contributed to the production of coal, yet this would not militate against the above-mentioned opinion, as the effects produced upon them by that acid would in all the essential points be perfectly similar*.

An

have been formed) were previously deprived of alkali by simple lixiviation during their immersion in water. But in page 127 of this paper I have shown that the submerged oak of Sutton, although deprived of its tannin, still retained its potash, which certainly would not have been the case if the latter, like the former, could have been separated from the wood by mere solution. When wood is reduced to ashes the alkali becomes completely denuded by the destruction of the woody fibre, and consequently may be immediately taken up by water; but when wood is converted into coal in the humid way by means of an acid, then it seems to me that two effects take place; for the intimate combination of the alkali with the woody fibre becomes in a great measure destroyed by the carbonization of the latter, whilst a simultaneous action arises in the affinity between the acid and the alkali; so that if coal has been formed by such means, the alkali must have been separated from the wood in the state of a dissolved neutral salt.

* From the nature of the experiments which have been related in this paper, I have unavoidably been induced to notice concisely the different opinions on the formation of coal by the humid way; but I did not intend to have mentioned any of those which have been brought forward in favour of the immediate or indirect action of fire, as I only wished to express my sentiments respecting the most probable of the former opinions.

Since, however, this paper was written, and partly read before the Royal Society, I have been favoured by sir James Hall with a copy of his paper, entitled "Account of a Series of Experiments showing the Effects of Compression in modifying the Action of Heat;" and I am fully of opinion that the scientific world has not for a long time received any communication of more importance, or in which more accuracy, ability, and perseverance have been displayed. The effects which sir James Hall has produced on carbonate of lime by heat acting under compression, certainly remove a great, and at one time apparently insurmountable, obstacle to the Huttonian or Plutonian theory; and if they do not solve the grand geological problem, they must, even in an insulated point of view, be allowed to have opened a new and unexplored field of research in chemistry as well as in geology.

In the eighth section of this valuable paper the author has given an account of some experiments made on leather, horn, and fir sawdust, from which he obtained coal which burned with flame, and which apparently resembled some of the mineral coals. In one case, also, he obtained a substance which in

An inquiry into the nature and formation of coal was my first object when I discovered the artificial tanning substance, and, considering the importance of the latter, it will not appear surprising that it should immediately have engaged the principal part of my attention.

In addition to the experiments which have been related in the three papers upon this subject, I intended to have decomposed the different varieties, to have compared their gases and other products with those of the natural substance called tannin, and especially to have endeavoured to discover more œconomical methods of obtaining the artificial product; for, exclusive of speculative science, this appears to be an object of consequence, not only respecting that useful and valuable branch of manufacture to which it immediately relates, but also as the means of preventing, or at least of diminishing, the premature destruction of timber in a country, where, on account of its population, as well as on account of its maritime position, every œconomy in such an article should be most rigidly observed.

But, for the present, I intend to relinquish this subject to such as may consider it worthy of attention; whilst, as I have already stated, I entertain very sanguine expectations that eventually it will prove œconomically useful; and should any be inclined to pursue the inquiry, I would recommend particular attention to those processes which relate to the roasted vegetable substances, and to peat.

Almost any refuse vegetable matter, such as twigs, dead leaves, &c. will serve for the former; whilst the latter, as I have shown, does not require to be roasted, and in many, especially the northern counties, peat is found in such abun-

in external characters appeared somewhat similar to the mixture of asphaltum and resin found at Bovey, to which I have given the name of Resin-asphaltum. These experiments sir James Hall intends to resume, and it is my earnest wish that he would do so; for although I am strongly inclined to believe that the mineral coals have generally, if not always, been formed by some humid process, yet it is impossible to foresee the results which may be obtained from animal and vegetable bodies subjected to the effects of heat modified by compression, as the principles of these bodies may be acted upon, and may be made to re-act on each other, under circumstances which until now have not been imagined.

dance,

dance, that but a small proportional quantity is consumed in the only useful way to which it has hitherto been applied, namely, fuel.

Before I conclude this paper I shall also observe, that the experiments which have been described must be regarded only as a mere sketch of that which may be performed; whilst the facts which have been ascertained respecting the resins, balsams, gum resins, and gums, serve to prove that much may be expected from regular chemical examinations of these bodies. But such investigations, in order that science may truly be promoted, should be strictly regular: that is, they should not be taken up in a desultory manner, but these substances should be comparatively and systematically examined with all the accuracy which can be employed in the present state of chemical knowledge; for, as this knowledge concerning the composition of organized bodies is confessedly very imperfect, I am persuaded, that, like others of the sciences, chemistry will be less liable to error when guided by comparative experiments and comparative analyses.

XIX. *On Atmospheric Phænomena: particularly the Formation of Clouds; their Permanence; their Precipitation in Rain, Snow, and Hail; and the consequent Rise of the Barometer. By Mr.* CORNELIUS VARLEY *.

I BELIEVE few will contend that any of the hypotheses which have yet been offered respecting atmospheric phænomena are perfectly satisfactory. I shall therefore be deemed the less presumptuous in offering the present hints, in the hope that they may prove useful to meteorologists, and assist in forming a more correct theory on this intricate subject than we are yet possessed of. The remarks which I offer are founded on actual observations, which any person may easily verify, and on the known and admitted laws of electricity. The inferences which I have drawn from the latter, I have, for brevity's sake, in some instances blended with the observa-

* Communicated by the Author.

tions to which I apply them. How far any of them are correct, lies not with me to determine. Should I only have succeeded so far as to help any other person to do more justice to the subject, my end will be fully gained.

Observation I. When a thunder storm is gathering, small specks of cloud may be observed, which increase rapidly in size; and round about, in every clear part of the sky, others may be seen forming, which all keep uniting till a very large cloud is formed, which is shown by the event to be well charged with electricity; for sparks are soon after discharged to the earth, the cloud collapses, drops of water are formed by the approach and union of the moist particles, and a heavy shower of rain falls from the cloud. But as it is well known that bodies charged with electricity never part with the whole at one shock, so only a portion of the cloud is thus thrown down, proportioned to the quantity of electricity previously given off. Other clouds still keep joining the large one, another spark is emitted, and a second torrent of rain follows.

II. In fine weather, when the wind was easterly, I have observed an effect quite the reverse of the foregoing,—large clouds coming before the wind from about two miles distance, which were constantly breaking in pieces and dissolving in the air, so as to disappear entirely before the wind could bring them over my head. I have also been under clouds that were thus gradually dissolved without being followed by any thing like rain; and when the clouds touch the mountains I have seen them break and dissolve quickest.

III. When this kind of weather had continued some days, and all clouds had disappeared, the sky was very pale, owing to a mist in the air, which so obscured the distant mountains that little more than their outline could be distinguished. This proves that the air does not hold the water of the dissipated clouds, or the vapours raised simply by heat, in solution; for if so it would be perfectly transparent. (It is well known by astronomers, that in frosty weather the air is clearest; which is owing to the complete absence of all vapours raised by heat only.) When clouds again appeared, first the

sky

sky round them, and then all over, became quite bright, and distant objects more distinct.

IV. From this time the same wind lasted about a fortnight. On the first evening I observed that no dew fell; on the second I perceived a little; on the third more; which increased every evening till at length it became so thick, that as soon as the sun was set it obscured the ground; and the following mornings were very foggy. During these fourteen days the sky became daily more misty, as in Observation III. From this I inferred, that the sun during the day raised a greater quantity of vapour than the quantity of electricity present in the atmosphere could support in the night and raise up to the clouds; the electricity having been gradually taken up from the earth to form clouds during the preceding fine weather; and being thus carried away, in the end there was so little left, that a considerable part of the vapour raised in the day fell down in the night, and continued till the succeeding sun raised them again.

From these observations I draw the following inferences:

1st, That no cloud can be formed, or exist, without electricity.

2d, That no cloud can rain till it parts with some of its electricity.

3d, That in fine weather the earth must be giving electricity to the atmosphere by means of vapour, and in stormy weather the atmosphere must be giving electricity to the earth by means of vapour, rain, or lightning.

4th, That in fine weather the clouds are separating, and in stormy weather uniting.

5th, That electricity is the suspending power in clouds.

6th, That dry air is a conductor of heat, but a non-conductor of electricity.

7th, That water can exist permanently in four states, and temporarily in one. Two of these are effected by electricity, and three without it. The first electrical state is that of cloud, which is so much charged as to become lighter than air at the surface of the earth; the second is a complete saturation of water with, or solution of water in, the electric fluid, which produces a transparent and elastic fluid light

 enough

enough to float above the highest clouds. The first of the three other states is ice; the second is liquid; the third, which is quite temporary, is vapour; for, as soon as the supply of heat by which it is raised from the earth is withdrawn, it condenses, and returns again to the state of water.

When the sun raises vapour and there is no electricity in it, as soon as he sets the water begins to fall down in dew: if there is a little electric fluid with it, it falls very slowly, in the form of fog: if there is more, it remains pendent in the air a little above the earth, and cannot fall: if there is a greater quantity, it rises up to form compact clouds: if more highly charged, it will take the highest station: and if a still larger quantity of electricity be present, it will be dissolved by the redundant electricity, and form aqueous atmosphere, as in Observation II. If this opinion be well founded, it will follow that the atmosphere is composed of air at the surface of the earth, but in the higher regions, above the clouds, partly of water highly rarefied by electricity. It is well known that bodies charged with the same electricity repel each other; and therefore I infer that each particle of water has an atmosphere of electricity round it, which totally prevents its touching any other particle, and thus renders any assemblage of them light enough to float in such an elevated part of the atmosphere. This agrees with Observation I., and seems, in some measure, proved by it; for how otherwise can it be accounted for, that out of a transparent atmosphere such immense clouds should be formed as those which accompany thunder storms?

Each particle of water that rises from the earth to form a cloud, or the aqueous part of the atmosphere, mounts a little way only by the help of the sun, but attains its highest elevation in consequence of that charge of electricity which at first repelled it from the earth remaining undiminished; which renders it light enough to float in the air. If this charge is moderate, it forms cloud; if it is strong, it forms a portion of the atmosphere, and attains a suitable elevation. From this may be inferred the cause of the rise and fall of the barometer; for, in fine weather, the electric state of the earth and air being the same, they are constantly repelling

 each

each other, and, with the temporary help of the sun, rapidly increasing the quantity of the clouds and enlarging the bulk of the aqueous part of the atmosphere. Though this increase of the atmosphere, by the combination of electricity and water, can make but little difference in the whole, yet as long as it operates the atmosphere must be getting higher in that place, and at any rate more dense, and so must press more heavily on the surface of the earth than under different circumstances:—hence the rise of the barometer. When it rises rapidly, the evaporation by means of electricity may be inferred to be going on very fast.

Agreeably to this, after long-continued hot weather, people in general expect lightning; but this would not follow if there were not an extra quantity in the air. This expectation is founded on experience, but a natural cause may be assigned for the effect; for, when no discharge of electricity has been effected by the descent of rain for a long time, the accumulation by the constant daily ascent of vapour, loaded with electricity, must at last become so great in the upper regions that an effort of nature to restore the equilibrium may with certainty be expected to follow. When a change in the direction of the wind brings an atmosphere from a place where the sun has raised more vapour than there is electricity to support, the air will become damp enough to form a slow conductor; then the barometer will begin to sink, and stormy weather will follow; for the clouds, being thus robbed of a portion of their electricity, will condense, and fall into the lowest station where the atmosphere balances them, which is generally about the height of a thousand feet. The reason why they do not fall lower is, that at this degree of descent the particles are sufficiently condensed to unite and form rain, which then falls to the ground, so that we continue to see only the part of the cloud that still remains uncondensed. But this is not the only cause that prevents them from descending lower; for sometimes this fall of rain from the clouds does not yet take place, owing to the highly electrified vapour beginning to give off to the clouds as large a supply as can be carried off by so imperfect a conductor. The vapour then descends into a lower region, where it loses its transparency and presents the appearance of a general mist, covering the sky, and forming itself into small clouds, which keep augmenting and joining the larger clouds in the lowest station, till sufficiently increased to allow the electricity to strike to the distance of the earth; when it begins to lighten, and the cloud is precipitated in rain. But so sudden a condensation and discharge must be accompanied with the formation of an extensive vacuum, and an instantaneous collapsing of the surrounding atmosphere; a cause perfectly sufficient to account for the noise of the accompanying thunder; for, if the discharge of a large gun merely by the impulse of the gas generated by the explosion of the gunpowder, striking against the atmosphere into which it is thrown, can produce so loud a report, what proportion can so diminutive an effort be made to bear with the large scale on which Nature performs her processes?

The fall of so large a mass of water as was before suspended in the atmosphere must, undeniably, leave its gravity minus the weight of that mass. Accordingly the barometer sinks immediately, and sinks even to a lower station than it can maintain; which shows, that though the atmosphere collapsed to destroy the vacuum where the discharge took place, still there is a want of atmosphere in that region, which is gradually supplied from the neighbourhood,—(one of the causes of winds.) As the cause of diminution of volume in the atmosphere ceases, the barometer rises again; and when it has entirely ceased to operate, the barometer reaches some intermediate point between its highest and lowest level.

That electricity is the principal suspending cause of clouds, may be inferred from another circumstance. Clouds exist permanent in regions of so low a temperature that water could never reach them without being frozen; or, if we suppose a loss of heat to have taken place after the ascent of the vapour, how comes it then to be suspended, instead of descending in snow? This shows that there is a great difference between cloud and vapour: the former being held in its divided state by electricity may perhaps be denominated electrified

electrified vapour; the latter being so held by caloric only might be called calorified vapour—in speaking of the difference between clouds properly so called, and those exhalations which return to the earth in the form of dew.

It will follow as a consequence from what has been advanced, that when a cloud by any means loses its electricity in an atmosphere below the freezing point, then snow will be produced; for the vapours will be frozen in the act of uniting: and for a similar reason it will follow, that particles of moisture united into rain, and passing through a cold region in their descent to the earth, will come down in the form of hail.

The influence which I ascribe to electricity in the production of all the phænomena before recited, agrees also perfectly with the well known fact, that rains are more abundant and frequent in mountainous than in flat countries. Indeed, if the remarks I have presumed to offer are correct, this becomes so self-evident that more need not be added on the subject.

XX. *Extract from the Account of the Proceedings of the Society of Arts, Sciences, and Belles Lettres, of Bourdeaux, for the Year* 1805. *Drawn up by Messrs.* LEUPOLD *and* DUTROUILH, *Secretaries* *.

M. DUCOM has given the society a new method of determining the latitude at sea by two altitudes: it is founded upon this, that the time which we deduce from an observation made at the moment the sun passes by the prime vertical is exact, whatever may be the error which affects the latitude by account, which is requisite to be used in most of the methods now followed †. By this first observation, and the exact time which we deduce from it, we regulate the watch; and at any other time of the day a new altitude, with this exact time being known by the preceding operation, will give the true latitude.

* Extracted from Millin's *Magazin Encyclopédique* for March 1806, p. 150.

† This idea is contained in a memoir of M. le Marquis de Verdun, printed at Brest.

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The commissioners charged by the society with the examination of this method proposed by M. Ducom (Messrs. Lescan, Thibaut, and Leupold,) have compared it with those most practised at sea, and particularly with Douves's method. This last has been discussed at great length in a memoir by M. Mendoza, inserted in the *Connoissance des Temps* for 1793; but the author of this memoir only employs the differential formulæ in the discussion of the errors which might affect the elements of the calculation, which formulæ always suppose the errors to be extremely small. Much care and attention in making the observations, and a sufficient knowledge of the instruments made use of, reduce the errors in the altitudes, in the interval marked by the watch and in the declination, so as to be effectually very small: but it is not the same with errors which affect the latitude by account, which in certain circumstances may be considerable. As to the useful researches of M. Mendoza in his memoir, and to which we must refer in the cases before cited, the commissioners have added the examination of the influence which a considerable error in latitude might occasion.

They have given in their report a formula which expresses the error of the result given by Douves's method, in powers of the error which affects the latitude by account. In using this formula it will be necessary to take so many more terms of the series, according as the error in latitude is greater.

Among other consequences which this formula presents, it shows that Douves's method will always give an error which will be in a contrary sense to that which affects the latitude by account, and that this error increases rapidly as the latitude of the place of observation is greater, since the successive powers of the tangent of the latitude enter into his method.

It appears from the reports made by the above gentlemen that the method proposed by M. Ducom will give the latitude very exactly, whatever may be the error in the latitude by account, when, as the method requires, one of the two altitudes shall have been taken exactly at the passage by the prime vertical, or very near it.

This method has one inconvenience, that it is not always practicable:

practicable: it cannot be done when the latitude and declination are of a contrary denomination; neither can it about the equinoxes, because the sun passes the prime vertical then in the horizon, or very near it.

The time when the second altitude is taken, which the author of the memoir leaves to the observer's pleasure, has not appeared indifferent to the commissioners with regard to the greater accuracy of the result: they have engaged to turn their attention to the examination of the most favourable time for taking the second altitude *.

When circumstances will permit the proposed method to be practised, it will be preferable to that of Douves, which, according to the formula given in the report, for an error at all considerable in the latitude by account, gives a result strongly erroneous.

M. Leupold has been occupied in a memoir, which he read to the society, *upon the generation of surfaces of the second order*. All of them may result from one common generation, which is executed by a curve of the second kind, variable in its dimensions, moved in such a manner that its plane may always remain parallel to itself. The equations which point out this circumstance give the law of the motion of the generatrix. This curve will be an ellipsis for surfaces having a centre, and a parabola for surfaces having no centre. In the case where each of the points of the generating curve has a right line for its direction, the surface may be engendered by a straight line moved in space. The analytical condition for this to happen indicates the hyperboloid with only one *nappe*, the hyperbolic paraboloid, and the parabolic cylinder. The common generatrix to all these surfaces may become a circle, except with regard to the hyperbolic paraboloid and the parabolic cylinder, for which the analysis used in this memoir shows that the generatrix can never be a circular curve.

This memoir is terminated by some general considerations upon the relation between elimination and the genera-

* In a note M. Ducom establishes, that the most favourable time to take the second altitude is when the sun is near the meridian: he is occupied in determining the minimum of the interval between the two observations.

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tion of surfaces, and by an essay upon the general equation for surfaces of different orders which may be engendered by a right line.

XXI. *On the Mineral Waters of Lipetzk, in the Province of Tambow, in Russia*.*

THE numerous arrivals of the sick at Lipetzk, and the rumours concerning the efficacy of its mineral waters, at last induced the Russian government to have their medical properties ascertained by chemical experiments and analysis.

The waters of Lipetzk were known in the reign of Peter the Great. This monarch, while inspecting the manufactories of that town, was the first who took notice of their healing nature; they were however, upon the decline of the manufactures, neglected, and not in any repute till within the last three years. Invalids resort to them from all parts of the empire, and the arrivals during the last year (1803) were extremely numerous.

The town and the fountains are pleasantly situated. In consequence of the general abundance of provisions in the province of Tambow all the necessaries of life are extremely cheap; and the only difficulty that occurs, is to find lodgings and a suitable accommodation.

According to the analysis made by a gentleman of the faculty, Mr. Skell, commissioned for that purpose by the college, one pound of the mineral water of Lipetzk contains:

Carbonate of iron (*ferrum carbonicum*) -	$\frac{20}{10}$ grains.
Carbonate of lime (*terra calcarea carbonica*)	$\frac{24}{20}$
Muriate of magnesia (*magnesia muriatica*)	$\frac{16}{50}$
Sulphate of lime (*calx sulphurica*) -	$\frac{6}{48}$
Sulphate of soda (*soda sulphurica*) -	$\frac{46}{100}$
Muriate of soda (*soda muriatica*) -	$\frac{215}{200}$
Bitumen - - - - -	$\frac{7}{100}$

The uncertainty whether this water contains any gases, and what they are, induced the minister of the interior to

* From the *Journal of St. Petersburg* for the year 1804.

send

send Dr. Albing for the purpose of investigating its component parts, and ascertaining in what diseases particularly it is capable of affording relief.

From the observations made, it appears that the water of Lipetzk has some analogy to that of Pyrmont; but differs in having less of the carbonic acid and sulphate of lime, and more of iron.

The water of Lipetzk, consequently, in comparison with that of Pyrmont, has less of the irritating quality, with regard to the carbonic acid; less of the dissolving, with regard to salts; and more of the strengthening, with regard to iron.

Taking into consideration this composition, it may be generally asserted, that the water of Lipetzk, on one hand, stimulates, gives vigour, increases the elasticity of the muscular fibres and the activity of the organs, lessens the poorness of blood, and imparts more colour to it; while on the other it liquefies tenacious, slimy, and condensed fluids, removes obstructions in the canals, qualifies the sharpness of humours, and destroys worms.

Not far from the first fountain, near the bridge, is another of equal extent, possessing the same qualities: it is not yet enclosed, but merely defended by a wooden fence on one side.

These waters, like the rest that are known in Europe, are used internally and externally.

The course of taking them in general is from ten to twenty days. On the first day one glass is taken, which contains about six ounces of the water: the quantity is increased by one ounce till the number of glasses will amount to six. After dinner three glasses are commonly taken, and, upon the average estimate of the whole quantity, an invalid drinks four pounds and a half a day, and sometimes more.

The diet depends entirely on the judgment of physicians. Formerly all sorts of fruits, tea, coffee, and milk, were forbidden; but, with regard to the latter, experience proves the restriction to be erroneous: the water diluted with milk has been known frequently to increase its effect, and impart double vigour to the nerves.

The best time for the use of them are the months of June, July,

July, and August: in autumn and spring, on account of the humidity of the atmosphere, they can be of no service. A previous preparation is absolutely necessary.

In slight diseases, especially when a previous preparation has been made, two or three weeks are commonly sufficient for obtaining relief; but in old and rooted cases, four and six weeks are required; and sometimes it is necessary to repeat the application the ensuing year.

Morning is by far the best time for taking the water; and the warmer the weather, the earlier this should be done. The water may be used after breakfast and in the evening; but those who take it regularly in the morning, receive more relief in three weeks than others in six.

The measure and quantity taken ought to be proportionate to the nature and constitution of the patient. In general, the stomach should not be overloaded; and the interval between one glass and another, containing from 12 to 17 table spoonsfull, should not be less than 15 or 20 minutes.

At the commencement of the course the following symptoms are observed: head-ache, oppression at the stomach, loss of appetite, disturbed sleep, &c. according to the different constitutions of patients. These changes, however, more or less affect every one, on account of the new and uncommon irritation in the system. In the course of time these symptoms disappear by degrees, and the patient feels his appetite increase.

With weak, irritable, and delicate constitutions, such symptoms happen even some time after, when the quantity comes to be increased to five, six, or seven glasses a day: but in this case the daily allowance is either decreased or totally laid aside, and then renewed again, according to the habit of the constitution, when the symptoms disappear. Some, during the course, are subject to the flux; in which case they must leave off till it is stopped.

In cases of pain and weakness in the stomach, these waters are particularly efficacious. In those diseases which are incident to the female sex, on account of their tender constitution, hysterics for example, their effect is excellent.

A great many, whose health for several years had been assailed

assailed by chronic and other similar diseases, have found relief, and sometimes a complete cure, from these waters.

They possess also the virtue of counteracting costiveness, and dispersing the phlegm accumulating in the stomach; their operation is not mechanical, but extends to the very source and principle of disease: by means of their relaxing quality, in a slight degree, they stimulate inertness and weakness, restore to the organs their former activity, and prevent the return of the disease. They are particularly useful in cases of worms and hypochondria.

In those chronical diseases of the breast, and in declines, which, although they do not proceed from ulceration of the lungs, are no less afflicting and fatal, these waters, especially when they are accompanied with proper nourishing and strengthening remedies, often give relief, and sometimes effect a complete cure.

This salutary effect of Lipetzk waters, situated in the very heart of the populous part of Russia, must considerably increase their value; more so, as the government has taken upon itself to provide every thing that can make the abode of invalids at Lipetzk agreeable and convenient.

Industry, attracted there by its own interest, facilitates the views of the government; and Lipetzk, famed for its waters, in no distant time will be known all over Europe.

XXII. *On the Caucasian Mineral Waters* *.

Mr. Skatelowitch, inspector of a medical institution in Astracan, reported to the faculty, in 1797, some extraordinary effects of the cold spring of water discovered in some of the Caucasian mountains, 35 versts † from the fortress of Constantinohor, towards the north-west. The spring is situated in a kind of pit, between two rivers of fresh water, issuing from several crevices in the rocks: it foams, throws up its sprays in various directions, and then, by a hollow

* From the *Journal of St. Petersburg* for the year 1804.

† A verst is about three quarters of an English mile.

channel,

channel, discharges itself into one of the rivers, by which it is surrounded in the form of a semicircle.

In the year 1798, Dr. Leventz, and Mr. Herner, a chemist, were sent by the government to ascertain the nature of the above-mentioned spring; and the result proved it to be, in reality, possessed of medical virtue. Professor Pallas, in his Travels, published at Leipzich, has given a short account of this spring.

In 1801, Mr. Simpson, a chemist, presented to the college an account of a warm spring discovered in the chain of the Caucasian mountains, five versts north-east from the fortress of Constantinohor, and 40 from the cold spring. It runs straight towards the west, down the steep declivity of a chalky, shelly, and curiously-coloured mountain, falls from the height of 44 yards, divides itself into small rivulets, and entirely disappears at the foot of the mountain.

In the same year, in consequence of another report, from the general Obriezkow, concerning the Caucasian mineral waters, the government resolved to send thither some intelligent men, for the purpose of describing their situation, ascertaining their nature, and investigating their virtue and properties, and transmitting an account thereof; that, if the result proved favourable, there might be established proper, secure, and convenient habitations for those who come to receive the benefit of them.

In consequence of this, the next year (1802), in March, Drs. Hordinsky and Krushevitch, and Mr. Skwentzon, a chemist, were sent by the college to the Caucasian mountains.

Mr. Skwentzon, on his arrival there, endeavoured to find out the nature of the two springs by a chemical process; and, having ascertained the quantity of volatile parts, he boiled next about 700 pounds of the water, for the purpose of discovering their solid and permanent parts, investigated them minutely, and upon his return produced a comparative table of the compositions of the Caucasian with other mineral waters.

Meanwhile doctors Hordinsky and Krushevitch spent the whole summer in the use and application of these waters, and

and in making practical experiments on different individuals of both sexes. Having observed their various effects, in various diseases, on different constitutions, they successfully acquitted themselves of the task imposed upon them, and produced their accounts, from which the following particulars are extracted:

The temperature of the hot spring, during the warmest parts of summer, is, in the evening, from 35 to 37 degrees, according to Reaumur's thermometer. The quantity discharged in three minutes and fifteen seconds is 3580 pounds, and its weight is equal to that of distilled water brought to the strength of a mineral water. It has a smell of sulphur, and contains the gases of sulphuric and carbonic acid: after the evaporation of 300 pounds, till the vessel was quite dry, there remained 12 ounces 7 drachms and 35 grains of solid matter. The water of this spring is good for curing eruptions of the skin, intermittent agues, scorbutic, chronical, and venereal diseases, dropsy, and long standing rheumatism.

The cold spring, according to the same thermometer, has at all times 10 degrees of temperature. The weight of its water to that of distilled water is in the proportion of 50 to 30. It is very transparent, has a sharp acrid taste, and a smell of carbonic acid, which enters into its composition: after the evaporation of 400 pounds, by boiling, there remained 9 ounces and 1½ drachm of solid matter. The effect of this water, whether drunk, or only applied externally, is very beneficial in chronical rheumatisms, in cases of general debility occasioned by venereal excesses, in hemorrhoids, king's evil, ring-worms, palsy, internal obstructions, and in all diseases where it is necessary to stimulate and strengthen the action of the vitals.

It may be safely affirmed that these waters are equal to some of the most celebrated in Europe, and to some are superior.

As the warm spring flows from a great height, and many of the patients cannot, therefore, ascend the steep declivity; and as the two bathing-places at the top of the hill, one covered and the other open, are not sufficient for the ac-

 commodation

commodation of the great numbers of sick, and there is no conveniency to construct additional accommodation; the government resolved to have the water conveyed down, by means of pipes, into bathing reservoirs, at the foot of the mountain, formed separately for each of the sexes.

The cold spring, on account of its low situation, is often inundated in rainy seasons, and choked up with mud from the adjacent river, which swelling out, in summer time, beyond its banks, the bottom was filled with a quantity of chalky stones or substances, which, dissolving in the carbonic acid of the water, impeded probably its salutary effects. The government, in consequence of this, ordered the fountain to be cleared, and the well enclosed with a high wall made of stone, to prevent thereby dirt and common water from running into it.

For the purpose of bathing there are to be built several covered and separate baths, and also a covered gallery for the conveniency of walking in bad weather.

Near both these springs are established temporary infirmaries, under the direction of medical men, and the inspection of a commissioner, for the preservation of the general order and accommodation.

For the security of visitors there are patrols of Cossacs stationed along the Caucasian line.

For the greater benefit of the sick there is an experienced physician, with an assistant, whose duty it is to observe the effects of these waters, and collect all such information, from actual experience, as may make, in time, a useful and instructive book, to serve as a guide, both to the patient and physician, in every thing that concerns these waters.

The benefit of these waters is so great, that the government spares no expenses to bring them into such a state that they may rival the most celebrated mineral springs of Europe.

The following is a comparative table of the composition of the Caucasian and that of other mineral waters in Europe:

[To face page 130.

...ess. *The Numbers between the Lines denote Grains. Apothecary's Weight.*

	si.	Salis amari.	Salis communis.	Magnesiæ salitæ.	Calcis salitæ.	Terræ aluminosæ.	Terræ siliceæ.	Extract. resinos.
	ate ne.	Sulphate of magnesia.	Muriate of soda.	Muriate of magnesia.	Muriate of lime.	Aluminous earth.	Silex.	Resinous extract.
Th								
Co	$\frac{2}{5}$	$66\frac{6}{19}$	$156\frac{7}{13}$	$1\frac{1}{2}$	—	—	—	$\frac{1}{4}$
Sh	$\frac{4}{5}$	$27\frac{7}{19}$	$27\frac{23}{26}$	$2\frac{33}{41}$	—	—	—	$\frac{1}{4}$
Ha		—	—	—	—	$13\frac{12}{67}$	—	—
Th		—	—	—	—	$29\frac{17}{27}$	—	—
Th	$\frac{3}{5}$	$109\frac{1}{2}$	$24\frac{2}{5}$	$26\frac{4}{5}$	—	—	—	$1\frac{4}{5}$
Th	2	—	$30\frac{10}{21}$	—	—	—	—	—
Th	$\frac{6}{7}$	$26\frac{6}{7}$	$96\frac{4}{7}$	$217\frac{1}{7}$	—	—	—	—
W		—	990	$106\frac{1}{4}$	—	—	—	$3\frac{3}{4}$
Ber		—	$105\frac{5}{11}$	—	—	—	—	—
Car	$\frac{5}{7}$	$81\frac{27}{133}$	$384\frac{21}{57}$	—	—	—	—	—
Cu	$\frac{77}{18}$	—	$337\frac{7}{9}$	—	$6\frac{2}{3}$	—	—	—
Bili		—	$3\frac{7}{11}$	—	—	—	—	—
Car		—	$28\frac{4}{57}$	—	—	—	$16\frac{48}{57}$	$11\frac{23}{47}$
Ehe		—	$71\frac{1}{9}$	—	—	—	—	—
Dri		—	$105\frac{2}{11}$	—	—	—	—	—
Bili	$\frac{3}{5}$	57	$4\frac{3}{5}$	18	$1\frac{1}{5}$	1	—	$2\frac{3}{5}$
Zei		—	$34\frac{14}{19}$	—	—	—	$15\frac{55}{57}$	$12\frac{26}{57}$
	$\frac{1}{11}$	$3120\frac{9}{11}$	—	$79\frac{1}{11}$	—	—	—	—

A Table shewing the Component Parts of the Mineral Waters analysed by a Chemical Process. The Numbers between the Lines denote Grains. The given Quantity of Water is Twenty Pounds, according to Apothecary's Weight.

Names of the Springs.	Acidi carbonici / Carbonic acid in cubic inches	Gas hepatic / Sulphurised hydrogen ditto	Calcis aeratæ / Carbonate of lime	Magnesiæ aeratæ / Carbonate of magnesia	Ferri aerati / Carbonate of iron	Sodæ / Soda	Sal mirabilis Glauberi / Sulphate of soda	Gypsum / Sulphate of lime	Sal amarum / Sulphate of magnesia	Salis communis / Muriate of soda	Magnesiæ salitæ / Muriate of magnesia	Calcis salitæ / Muriate of lime	Terræ aluminosæ / Aluminous earth	Terræ siliceæ / Silex	Extract. resinos. / [illegible] extract
The warm spring of Constantinohor	106[illegible]	80	99¾	17	—	—	101[illegible]	31[illegible]	66[illegible]	156[illegible]	1½	—	—	—	[illegible]
Cold ditto - - - - -	550	—	87	12[illegible]	2[illegible]	—	53[illegible]	41[illegible]	27[illegible]	27[illegible]	2[illegible]	—	—	—	[illegible]
Shwolner well - - -	346[illegible]	—	77[illegible]	—	2[illegible]	31[illegible]	—	—	—	—	—	—	13[illegible]	—	—
Hambacher spring - - -	426[illegible]	—	74[illegible]	—	3[illegible]	12[illegible]	—	—	—	—	—	—	29[illegible]	—	—
The waters of Pyrmont (at one-half of the quantity) - - -	600	—	69¾	67[illegible]	21[illegible]	—	57[illegible]	173[illegible]	109[illegible]	24[illegible]	26[illegible]	—	—	—	1[illegible]
The acid water of Mauritz, in Switzerland - - - -	557¼	—	68[illegible]	17[illegible]	—	—	60[illegible]	—	—	30[illegible]	—	—	—	—	—
Those of Shinthnacher - -	not ascertained	182[illegible]	40	34[illegible]	28[illegible]	—	—	70[illegible]	26[illegible]	96[illegible]	217[illegible]	—	—	—	—
Those of Maynbergh - -	160	—	146[illegible]	22[illegible]	2[illegible]	—	60	320	—	990	106¼	—	—	—	3[illegible]
Warm Aacher water, in the dukedom of Ulich - - -	—	2	98[illegible]	—	—	251[illegible]	—	—	—	105[illegible]	—	—	—	—	—
Bergh acid well - - -	326[illegible]	65[illegible]	160	—	31[illegible]	—	—	105[illegible]	81[illegible]	384[illegible]	—	—	—	—	—
Canstadt water, in Wirtemberg	266[illegible]	—	191[illegible]	—	10	—	170[illegible]	146[illegible]	—	337[illegible]	—	6[illegible]	—	—	—
Cudovar water, in the county of Glatz - - - - -	great deal	—	200	240	11[illegible]	30[illegible]	—	—	—	3[illegible]	—	—	—	—	—
Bilintz acid spring, in Bohemia -	673[illegible]	—	82[illegible]	67[illegible]	—	522[illegible]	89[illegible]	—	—	28[illegible]	—	—	—	16[illegible]	11[illegible]
Carlsbad well - - - -	1	—	97[illegible]	97[illegible]	—	204[illegible]	888[illegible]	—	—	71[illegible]	—	—	—	—	—
Eher's acid well, in Bohemia -	338[illegible]	—	27[illegible]	—	14[illegible]	170[illegible]	1000	—	—	105[illegible]	—	—	—	—	—
Driburgh well, in Paderborna -	560	—	137[illegible]	4[illegible]	26½	—	233[illegible]	213[illegible]	57	4[illegible]	18	1½	1	—	2
Bilintz large acid well - -	980	—	65[illegible]	49[illegible]	—	610[illegible]	91[illegible]	—	—	34[illegible]	—	—	—	15[illegible]	12[illegible]
Zeisholtz bitter water, in Bohemia	11[illegible]	—	16[illegible]	15[illegible]	—	—	—	69[illegible]	3120[illegible]	—	79[illegible]	—	—	—	—

XXIII. *Experiments upon the various Species of Cinchona.* *By M.* Vauquelin.

[Concluded from p. 53.]

Phænomena presented on a closer Analysis of the Maceration and Decoction of some Kinds of Cinchona, which precipitate neither the Infusion of Tan nor Emetic.

These kinds of cinchona communicate to cold water a red colour, often of a yellowish, and sometimes of a brownish cast. The water thus saturated with the soluble part of these cinchonas becomes frothy upon agitation, like beer yeast; it has then a bitter taste, with more or less astringency, according to the kind.

Left to subside in a close or open vessel, provided it is not full, this cinchona water becomes speedily mouldy, and is covered with a greenish pellicle.

Some of them redden very sensibly turnsole tincture; which indicates the presence of a free acid.

Alcohol mixed with these infusions of cinchona, in the proportion of two parts to one, precipitates from it a grayish matter, which becomes black upon drying; the liquor is then clearer, and of a purer red: this phænomenon announces the presence of a mucous matter.

A small quantity of caustic alkali forms, in such of these waters as are acid, a red precipitate inclining to violet; but a greater quantity of this re-agent redissolves the matter, and gives the liquor more intenseness of colour.

Submitted to evaporation they become deeper in colour, and deposit upon cooling, after having been concentrated, a very bitter brown substance, which is easily dissolved in alcohol, particularly with the assistance of heat, and which water precipitates from it, if the solution is sufficiently concentrated. Water itself redissolves this matter, although it abandons it on evaporation; but it requires a far greater quantity than when it is accompanied with the other principles of cinchonas: this seems to prove that these same principles favour the solution in water.

 If

If we allow the infusions of cinchona to cool several times before reducing them to dryness, they deposit upon each cooling a matter similar to that of which we have spoken. It was formerly thought that this substance became insoluble on its combination with oxygen; but this effect seems to be owing to the insufficiency of the water.

It is this resinous kind of matter which gives to cinchonas and their infusions the bitter taste they possess; for, if we separate the deposits as they are formed, and afterwards dilute the concentrated matter with the same quantity of water, the liquor has no longer any thing like the same degree of bitterness. Nevertheless, the whole of this substance is not separated from the water by this means; the other principles of cinchona always retain a tolerably large quantity of it in solution.

But if, after having performed the various operations in the manner I have described, we treat with alcohol the infusions of cinchona reduced into the form of soft extract, and separate the greatest part of the resinous-formed matter, there remains nothing but a viscous substance of a brown colour, which has hardly any bitter taste, which is completely soluble in water, and does not precipitate on cooling.

These experiments teach us, that in the infusions of these kinds of cinchona there are at least two very distinct substances; the one bitter and astringent, soluble in alcohol, little soluble in water; the other, on the contrary, absolutely insoluble in alcohol, very soluble in water, having a sweet and mucilaginous taste.

These substances being without doubt those which act the most efficaciously in maladies where cinchona is employed, I think it right to explain their properties in detail: I shall commence with that which is soluble in alcohol.

1. This substance, in the dry state, has a brownish red colour and an extremely bitter taste. 2. Cold water only dissolves a part of it; the rest remains in the form of reddish flakes; but if we heat the mixture the latter dissolve also, and we obtain a clear liquor of a very deep red, which becomes turbid on cooling, but deposits very little.

What is remarkable in the manner in which this substance

stance acts with water is, that if only a small quantity of this fluid is employed, it is entirely dissolved, and furnishes a clear liquor; if more water is afterwards added it becomes turbid, and latterly becomes clear again upon the addition of a still greater quantity of this fluid.

It would seem, according to this, that there is in it another body, which, when it is concentrated, favours its solution; and that this body afterwards loses this property upon being diluted in water.

It is this matter which, by separating itself, makes turbid such infusions of cinchona as are prepared by heat, as well as the macerations evaporated to a certain degree. This is what has been designated by chemists under the name of resin of cinchona: its solution in water becomes mouldy in a few days, and forms a fungus like a solution of gum; which proves that it is not a true resin, as this last never grows mouldy.

The aqueous solution of this substance recently prepared, and a little concentrated, presented the following effects with the different agents mentioned:

1. With ammonia it coagulates into a thick whitish matter, which becomes brown in the air, and hardens considerably a short time afterwards; but it becomes soft when heated, and assumes the ductility and dirty lustre of turpentine wrought through the hands.

2. It produces nearly the same phænomena with the alkaline carbonates.

3. The ordinary acids produce no sensible change upon it; the oxymuriatic acid makes it yellow, without producing any precipitate; but if we afterwards mix ammonia with it, there is a grayish white precipitate formed, which is light and flaky.

4. The solution of animal gelatine does not precipitate it at all; the infusion of these kinds of cinchona, however, precipitates the solution of animal glue: the principle which produces this effect must therefore be altered during the evaporation.

5. The muriate of iron, or any other ferruginous salt, pro-

duces in it a deep green colour, and soon afterwards a precipitate of the same shade.

6. Emetic, or antimoniated tartrite of potash, forms no precipitate in it. This substance, therefore, is not the same as that which precipitates this metallic salt, in the infusions of certain kinds of cinchona.

7. Lastly, it reddens very sensibly turnsole tincture.

The acidity of this substance, and the precipitation produced by the alkalis in its concentrated solution, made me suppose that it was indebted for a part of its solubility to the presence of the free acid which accompanies it: this seems to me to be founded upon its having been once separated by an alkali, washed and dried, and therefore not longer soluble in water, except in a very small proportion.

In order to acquire a greater degree of certainty upon this substance, I put some of it into water acidulated by different acids, and I saw that in fact it dissolved with facility, and that its solutions resumed a bitter taste, similar to that which it had before having been precipitated by the alkalis.

I remarked that this substance retained, on being precipitated, a portion of the alkalis employed for this purpose; at least, the following experiment seems to prove it. After having precipitated it from its aqueous solution by ammonia, and washed it in a great quantity of water, I mixed with it some caustic potash, which immediately developed an extremely sensible ammoniacal smell, which it did not produce before having been precipitated by this alkali.

It is therefore evident that this substance is combined with a portion of ammonia, which serves to precipitate it from its solution; at least, that the acid which accompanies it naturally, only forms with this alkali an insoluble salt, and mixes with the resinous matter; which seems very little probable.

It would seem, according to these properties, that this substance sometimes performs the part of an acid and sometimes that of an alkali, since it unites with those two kinds of substances by neutralizing a part of their properties.

If, after having precipitated this matter by the alkalis, we we add an excess of these re-agents, it is redissolved, and the liquor which results from it has a reddish brown colour.

The solubility of this substance in alcohol singularly increases on the application of heat. When this solvent is saturated with it, it has a reddish brown colour and an extremely bitter taste. The addition of water precipitates from it abundantly a precipitate of a fine red colour, slightly inclining to pink. This alcoholic solution, exposed to the air in an open vessel, crystallizes in needles in the manner of a salt.

The alcoholic solution, thus precipitated by water, retains a portion of the matter, which preserves to it a pink colour and a sensibly bitter taste. It deposits this substance, in the form of scales, of a reddish brown colour, by spontaneous evaporation.

The principle of cinchona insoluble in alcohol, dissolved in water, filtered and abandoned to a spontaneous evaporation in a warm place, thickens like a kind of syrup, and crystallizes in the form of laminæ, sometimes hexaëdral, sometimes rhomboidal, and sometimes square, and slightly coloured of a reddish brown: there always remains a portion of thick liquor, which never crystallizes completely, and which must be separated from it by decantation.

By successive solutions and crystallizations this salt may be obtained white and pure: I shall explain its properties a little lower down. As to the substance which does not crystallize, and which remains in the form of a mother water, it presented to me all the characters of a mucilaginous matter, in which there always remains a small quantity of the salt I have mentioned, and which it is impossible to separate from it by crystallization.

Action of the Acids upon the Residues of Cinchona exhausted by successive Washings.

The cinchonas in question, exhausted by water, still furnish something to the acids. They act almost nearly in the same manner, *i. e.* their effect is confined to a simple solution, without producing any sensible change in the nature of the principles of cinchonas.

I ought

I ought to say, however, that if cinchona be reduced to a fine powder, and repeatedly exposed to the action of alcohol assisted by heat, there remains little for the acids to do. The substance extracted from cinchona by the acids is, to all appearances, of the same nature as that which is dissolved in alcohol; as I shall soon explain.

The nitric acid acquires by this combination a colour inclining to red, sometimes orange: but these shades vary much in intensity, according to the concentration of the acid; they change to the yellow so much the more as the acid is more concentrated. The nitric acid by this combination loses much of its acidity, at least the taste seems to announce this: it is true that this acid dissolves at the same time a certain quantity of lime, which the oxalate of ammonia demonstrates, and this substance contributes its share in neutralizing it.

If we pour into this nitric solution saturated carbonate of potash, a precipitate of a fine red colour is formed; but if we employ the common carbonate, and an excess of it is added, the colour of the precipitate changes to violet, purple, or blue. Thus the alkalis have the property of changing into blue the colour of these kinds of cinchonas, which is red in its nature.

The metallic solutions form there also precipitates variously coloured, and more or less considerable as the nitric acid contains more or less vegetable matter; but, on saturating the excess of acid, the metallic salts then produce very abundant precipitates, and the liquor is discoloured.

1. The solution of muriate of tin occasions a red or flesh-coloured precipitate.

2. That of sulphate of iron, a grayish precipitate.

3. That of copper, a chestnut-brown precipitate.

4. The sulphate of titanium, assisted by a little carbonate of soda, formed in the nitric solution of cinchona an orange red precipitate, analogous in its shade to that which gall-nuts produce in the solutions of this metal.

5. Alum causes no change in the acid solution of cin-

chona; but with the assistance of a little alkali, alumine carries off with it the colouring part, and the liquor loses its colour.

In the countries which produce these cinchonas a very fine and durable chestnut red colour may be extracted from their barks for dyeing cotton and wool: this colour changes to pink with soap and water.

Action of the Sulphuric and Muriatic Acids upon the Residues of Cinchona.

These acids diluted in water dissolve the resin-formed matter of these cinchonas, and saturate themselves with it, like the nitric acid. The colour they acquire by this combination inclines less to the yellow than that of the nitric acid; it is always of a more decided red.

The precipitates which the alkaline carbonates form in these solutions are also of a pure red; and an excess of these alkaline salts causes the precipitate to pass to a more decided blue colour.

The residues of cinchona seem to contain a great quantity of lime; at least, the sulphuric acid in which they are infused furnishes, upon spontaneous evaporation, plenty of sulphate of lime.

According to the action of the acids upon the resinous matter of these species of cinchona, if we could one day demonstrate that this substance is the only one in cinchona which has a febrifuge property, it will be evident that the medicine might derive from this bark many more advantages in the cure of intermittent and ataxic fevers, by uniting with it the acids or wine. In fact, as we have seen above, water only extracts from cinchona, particularly when it is not bruised, a very small quantity of resinous matter, of which even the greatest part is precipitated upon cooling. But by this method it is certain, that from a great quantity of cinchona we can extract but a very small part of the febrifuge principle, which, being divided among a great quantity of water, does not, of course, produce the same effect it would do if more concentrated.

For

For a long time it has been known that the essential salt of cinchona has not in fevers an action proportioned to that of the quantity of cinchona in powder from which it has been extracted; which proves that there remains in the refuse something useful in the cure of fevers.

In my opinion I think that, to the present moment, a method has been pursued for the preparation of the essential salt of cinchona, quite the reverse of the proper process. When an infusion of cinchona is made, it is evaporated to a certain degree and cooled, in order to deposit a precipitate; the resinous deposit, which had been formed while cooling, is then separated: this is repeated until the liquor is no longer turbid, and has only a pale yellow colour: it is then dried upon plates placed in ovens. By performing the operation in this manner, a very small quantity of resinous matter only remains in the water, with a gum and a salt with a base of lime, the efficacy of which in the cure of fevers is very doubtful.

Comparative Examination of the Resin of these Cinchonas with the other known Vegetable Substances.

Does there exist in the vegetable kingdom any immediate principle to which we may refer the latter? Should we class it among the resins, as hitherto done? It is true, that formerly chemists and apothecaries united together under this genus so many species of substances, that we might still class the one in question among them, if we did not narrowly reflect upon some of its peculiar properties; but upon applying the name of resin to such substances as truly deserve it, those of cinchona and of many other vegetables ought to be separated from the resins properly so called.

If the resinous matter of these cinchonas resembles the resins by its solubility in alcohol, it is different from it by its solubility in water, in the acids, the alkalis, and particularly by its property of precipitating the metallic salts, and of attaching itself firmly to cloths. I think, therefore, that we ought to regard this substance as a particular vegetable principle, of which chemists have not yet known the properties.

properties. This principle is not identically the same in all cinchonas; it differs in those which precipitate the infusion of tan and emetic, and in those which precipitate glue only.

It is probable that it is a very analogous principle which most commonly gives vegetables their bitter taste.

The Properties of Cinchona resumed.

1. We may divide the different species of cinchonas into three sections, relative to their chemical properties.

In the first we comprise all those which precipitate tannin, and do not precipitate animal gelatine.

In the second we include the cinchonas which precipitate animal gelatine and do not precipitate tannin.

In the third we class those which precipitate at the same time tannin, animal gelatine, and emetic.

2. We may conjecture, with every appearance of probability, that every vegetable substance which does not possess at least one of the properties above indicated will not be a febrifuge; and it is probable, also, that the more of these properties is possessed by cinchona and other vegetable substances, the more remarkable will their febrifuge properties be.

3. The property of precipitating tannin not being common to all the cinchonas, it is not from that exclusively they derive their febrifuge virtue, since there are several of them which do not precipitate it, and which yet cure fevers.

4. It would seem, however, that the principle which precipitates the infusion of oak bark and gall-nuts is a febrifuge; because in general it is acknowledged in medicine that the kinds which produce this effect are best.

5. On the other hand, the cinchonas which do not precipitate the infusion of tan nor gall-nuts being febrifuge, it may be concluded that the principle in virtue of which these precipitations were formed is not the only one in cinchonas which cures fever.

6. The principle which precipitates the infusion of tan and gall-nuts, is of a brown colour and of a bitter taste: it is less soluble in water than in alcohol: it also precipitates emetic, but not glue. It has some analogies with the resinous bodies, although it furnishes ammonia on distillation.

7. It

7. It seems that it is to the tannin of oak bark and of gall-nuts that this principle joins, in order to form the precipitates which it occasions in the infusion of these substances: nevertheless, this principle existing in some species of cinchonas which precipitate glue at the same time, it remains doubtful if it truly unites to the tannin of the infusion of oak bark, or that the principle of the other kinds of cinchona which precipitate glue is true tannin.

8. But it must necessarily happen that the one or other of these suppositions is true, since the infusions of these two kinds of cinchonas mutually precipitate each other.

9. The principle which in some kinds of cinchonas precipitates glue, has a bitter and astringent taste: it is more soluble in water than that which in other kinds precipitates the infusion of tan: it is also soluble in alcohol, and does not precipitate emetic.

10. It would seem that the substance which precipitates infusion of tan is the same which decomposes emetic.

Thus from all these doubts there remains much more to do before we can exactly ascertain the effective principle or principles of cinchonas in the cure of fevers. It is to be hoped, that through time, and in consequence of assiduous labour, we shall be able to resolve this important question.

Analysis of the Salt of Cinchona.

M. Deschamps junior, apothecary at Lyons, is the first who, to my knowledge, announced the presence of a particular salt in cinchona, which ought not to be confounded with the essential salt of cinchona, which contains at the same time both resin and mucilage; but M. Deschamps having only described some physical properties of this salt, I thought it right to analyse it, in order to ascertain the nature and proportions of its principles. In another place I have explained how this salt of cinchona may be obtained, and what processes ought to be employed in order to purify it: I shall therefore now confine myself to a simple detail of its properties.

1. This salt is white; it crystallizes in square laminæ, sometimes

sometimes rhomboidal, or with the solid angles truncated: these laminæ are also often united in groups.

2. It has hardly any taste, and is flexible under the teeth.

3. It requires about five parts of water, at 10 degrees, in order to dissolve it.

4. It swells, when heated, nearly like tartar, of which it has the smell; it leaves a grayish residue, which dissolves in the acids with effervescence, and which is only a mixture of carbonate of lime and charcoal.

5. Its solution does not alter turnsole tincture; and it is entirely insoluble in alcohol.

6. The fixed alkalis, both caustic and carbonated, decompose it, and precipitate from it pure or carbonated lime.

7. Ammonia does not produce the decomposition of it; which proves that this acid has a stronger affinity for lime.

8. The sulphuric and oxalic acids form, with its solution a little concentrated, two precipitates, which are in the one case sulphate of lime, and in the other an oxalate with the same base.

9. It causes no apparent alteration in the solution of acetate of lead, nor in that of nitrate of silver.

10. Concentrated sulphuric acid, poured upon this salt reduced to powder, blackens it slightly; but there are no pungent vapours liberated from it, as from the acetates.

11. What is remarkable is, that the infusion of tan and of some kinds of cinchonas, that of Santa-Fè for instance, produces a flaky yellow precipitate in the solution of this salt. The various phænomena caused by these experiments announcing that this salt is formed of a vegetable acid and lime, in order to decompose it and have the acid isolated I made use of oxalic acid, which, as we know, is that which renders lime most insoluble by its combination with it.

I proceeded in the following manner:—I dissolved, in the necessary quantity of water, 100 parts of this salt; I afterwards poured into the liquor, at different times, until there was no more precipitate formed, a solution of oxalic acid, the weight of which was known to me: it required 22 parts of oxalic acid to precipitate all the lime, and yet I only found 27 parts of dry precipitate.

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This proves that the oxalic acid employed contained about half its weight of the water of crystallization, and that the salt of cinchona only contains a small quantity of lime; because in 27 parts of oxalate of lime there is more than 15 parts of this earth.

After having thus separated the lime from this salt by the oxalic acid, I allowed the liquor to evaporate spontaneously in the air: it was reduced to the form of a very thick syrup, without giving any sign of crystallization for more than eight days; but having stirred it with a piece of glass, in order to extract a part of it, which I intended to submit to a trial, I was astonished to find, some minutes afterwards, that the liquor was crystallized into a hard mass, formed of a great quantity of divergent laminæ from several very distinct centres of crystallization.

It was of a slight brown colour; its taste was extremely acid and a little bitter, because the salt of cinchona I employed had not been perfectly purified.

I shall, however, detail the properties which I recognised in this acid: I cannot give long details upon this subject, because I had only a very small quantity of salt of cinchona at my command; I think, however, I examined it sufficiently to be convinced that it is a peculiar acid hitherto unknown.

In its state of crystallization it has a very acid and a bitterish taste, as I have said above.

It is perfectly well preserved in the open air; and it is neither deliquescent nor efflorescent.

Placed upon live coals, it melts very quickly, boils up, becomes black, exhales pungent white vapours, and leaves but a very slight charry residue.

It forms, with the alkalis and the earths, soluble and crystallizable salts.

It does not precipitate the nitrates of silver, mercury, or lead, as most of the other vegetable acids do.

It can no longer be doubted that this acid is quite new to us: on reflecting on the specific characters of the other vegetable acids known, we shall find that not one of them unites all the properties of the above.

In

In fact, oxalic acid forms a salt insoluble with lime, and, besides, decomposes the combination of this earth with the acid of cinchona.

The citric and tartareous acids also form an insoluble combination with lime, and decompose the acetate of lead.

The malic acid does not crystallize, and precipitates the acetate of lead.

The benzoic acid is not very soluble in cold water, and volatilizes without decomposition.

The gallic acid is also very little soluble in cold water, and blackens the solution of iron.

It has some similarity to the acetous acid by the solubility of its combinations; but the acetous acid does not crystallize, and volatilizes without undergoing any alteration.

I shall not mention the camphoric, suberic, and succinic acids, because they have no analogy with the one in question.

We must conclude, therefore, that this acid is truly different from all those which are known; and we ought to give the name of *kinic acid* to it, from the word cinchona, until we are able to give it a better.

It is to this acid, united with lime, that the physicians of Lyons, according to M. Deschamps, have attributed the febrifuge virtues of cinchona; they maintain that no intermittent fever can resist two doses of this salt, of 36 grains each.

If this assertion were proved, we could easily conceive how a drachm of this salt could cure an intermittent fever, because this quantity represents at least five or six ounces of common gray cinchona.

I would not directly deny the result thus announced by learned and respectable men; but I think myself warranted in starting some doubts on the subject. In the first place, before it deserves implicit confidence, the experiment ought to be repeated a great number of times, and the success ought to be constant; for it often happens that effects are attributed to medicines, which belong to nature alone. In medicine, more than in any other branch of philosophy, it is

 difficult

difficult to unravel with certitude the causes which operate to perform an alteration in the state of health or disease.

On the one hand, physicians have learned, by a long experience, that infusions and extracts of cinchona, prepared after the Garaye process, do not produce in any degree, in fevers, effects proportioned to the quantities of cinchona from which they have been made; and yet these preparations contain the salt in question.

We know also that alcoholic tinctures of cinchona, in which the salt of M. Deschamps does not exist, since it is insoluble in this menstruum, nevertheless cure intermittent fevers.

There are, besides, cinchonas which contain infinitely small quantities of this salt only; and there are vegetables which do not contain it at all, and yet they cure fevers. It is not without reason, therefore, that I offer my doubts on this subject; and if it has sometimes happened that this salt has cured fevers, we may suppose that it was not perfectly freed from the bitter principle which it forcibly retains.

To conclude: it is very desirable that physicians should occupy themselves with ascertaining this question by means of actual experiments: if results are obtained similar to those of the Lyons physicians, it will be a discovery of great importance to mankind.

XXIV. *On reclaiming Waste Lands.* *By Mr.* John Wagstaffe *.

GENTLEMEN, Norwich, June 27, 1801.

As your influence for the inclosure of waste land is confessed, and, I conceive, extending within the scope of your society, and it should now seem on the eve of a parliamentary encouragement, I ask leave to recite an experiment I made on a portion of land of as obvious sterility as perhaps any present waste within the western counties.

This was an acclivity which had not been cultivated within memory;

* From *Letters and Papers of the Bath Agricultural Society*, vol. x.

memory; and at the foot of it a various tract, gravelly and moory, broken into hollow spaces, in which waters rested during the summer months, which waters were covered with most of the aquatic plants native to stagnant pools. My predecessor in possession of those watery wastes, during a summer drought fed their interstices with sheep, which became diseased, and many of them rotten.

The mode I pursued was, as much as might be, to extract the weeds, roots, and sediment; lay them in heaps as a preparation of manure measurably to replace and fertilize the barren sands and gravel, brought from the heights to fill up these hollows. I then opened ditches, raised their sides with sand and gravel, and on them planted large cuttings of poplars and willows. The ditching drained the soil, and the materials from the heights raised this swamp to the proper condition of meadow. The upland I inclosed with thorns on a willow ley*, and within the banks inlaid them with seedling trees and forest; divers of the former have been taken down for use, and some of the aquatic cuttings are grown to a timber measure; while the several subdivisions, meadow and upland, have been cultivated, and borne every species of grain and herbage, confessedly upon an equality with the long-tillaged circumjacent fields. By a process thus pursued, of which I have presumed to adduce this example, the numerous millions of waste acres which yet disfigure our nation, may, and will become, the seasons favouring, under your and your compatriots' encouragement, a widely-extended garden, replete with every useful production congenial to our climate; and the boundary of its fields fenced with faster-thriving trees, and more abundant in number than the present large tracts of forest produce, provide for generations yet to come an increase of those necessary timbers that have given this island an intercourse with the inhabitants of every maritime clime, and an acknowledged superiority in the commercial world, which probably it would not have obtained but from the indigenous growth of these not sufficiently valued timbers. Although your ex-

* A willow fence in this situation has the appearance of improbability, but it is yet improving.

tended encouragements have much increased them by multiplied plantations, yet their growth may be indefinitely enlarged by an encouragement for their acorn seed to be placed in every raised bank, or their seedlings planted in every new-formed hedge-row; which most efficaciously might be enforced by parliament as a conditional obligation on all to whom they are assigned, under the statute of a national inclosure. But as every seminary of oaks must be referable to a distant posterity, it becomes worthy of every present planter in the interior of his hedge-rows to have large cuttings of poplar * and willow †, and an intermixture with young trees of the resinous tribe. Those I have already known may be taken down as timber during the life of the planter, and as early as the inlays are grown to afford shelter and shade to the herd and the flock that occasionally feed within their inclosures. I may just add, the fall of the autumnal leaf with the manure of the depasturing cattle may continue the fertility of these fields without extraneous aid; and, where not readily procurable, I may further add, that in the latter end of the autumn of 1799 I procured turves from different wastes, reserved them on a gravel walk, and thereon dibbled wheat, almost every grain of which succeeded, branched into divers stems, which severally bore a full and perfect grain. In the autumn of 1800 ‡ I repeated

* Of poplars, the *Nigra*, *Alba*, and *Hybridum*; this latter hath not, I conceive, found its way into any systematical arrangement of plants, and in course has not received any specific character. The name assigned it is on the opinion of a gentleman well acquainted with botanic distinction, who conceives it to be a variety, perhaps of the two former. I may speak from an enlarging experience, that it is a handsome and fast growing tree, multiplies itself distinctly from its roots, while its cuttings take with nearly equal facility as the two former.

† *Pentandria* (laurel-leaved), *Amygdalina* (almond leaf), *Alba* (common gray leaf). These three species I know, or presume, on the progress the first has already made, that they will severally grow to a timber bulk. The prospective diversity of contrasted foliage can perhaps be not better exemplified than in the vivid green of the laurel willow and the hoary leaf of the white poplar.

‡ There is an average of four large ears to every grain dibbled, now in full flower, which conveys an expectation of more than an hundred fold increase, the actual increase of the preceding year. These turves or flags have received no aid from the manure, or any artificial watering.

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the trial, which at this instant is as promising as the other proved. The early spring of this year, 1801, I practised the same mode with tares, pease, oats, and barley, which severally are promising. I bring forward these experiments to show, that generally every waste may be rendered productive by the first simple operation of the plough, and thereby supersede the long process pursued by many; call forth to the earliest production the unprofitable wastes of the kingdom; and hence, as far as human foresight can discover, prevent such a sensible scarcity as most of our provinces have recently felt. And again, under the blessing of Providence, witness a competency for ourselves, and a surplus for other nations; and thence be commercially beneficial to a large portion of mankind.

I am, with sincere regard,
Your respectful friend,
JOHN WAGSTAFFE.

To the Society.

XXV. *On the Advantages of the Use of Oxen and Neat Cattle in Husbandry.* *By Lord* SOMERVILLE*.

SIR, London, Dec. 8, 1804.

YOU will have the goodness to express to the Bath Society my regret that I cannot attend its anniversary meeting, as was my intention.

On the subject of my claim to the premium for a change of sheep stock, &c. I have only to observe, that it was made at a period the most unfavourable to stock, when distress for keep of all sorts was greater than I have ever known; and that whether the premium be adjudged or not to me, I shall ever consider the favourable reception it met from the committee to which it was referred, the able essays which it produced, and the recommendation which this committee, numerously attended, has unanimously given to this general meeting that it should be awarded, together with the proofs since produced, as decisive on this important question.

* From *Letters and Papers of the Bath Agricultural Society*, vol. x.

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The return of my year's labour with oxen was made out for the year 1803, because, the year 1804 not being expired, to have made it without the amendment, since resolved on, would have been a palpable error. I now comply with the repeated and earnest wishes of the society, in presenting this statement for its inspection.

Unprepared as I was, it would have been impossible to have done it with that degree of accuracy which I shall adhere to in any statement of serious import to the public; but the rules which govern the proceedings of the Bath Society allowing me time to examine my own books, and to obtain replies to certain needful questions, I have great pleasure in stating that the following report is now presented to the society in substance, I trust, correct. In that part of the statement which reduces the halling and carting of manure to be equal to a given number of acres ploughed, I have profited by the kind assistance of Mr. Paul and Mr. Gordon Grey.

No land ploughed with horses, save part of one acre, as a trial.

	No. of Acres.
Forty-four acres of ley ground broke up -	44
Fifty ditto of spring corn, two earths, scarified and dragged, equal to 1½ earth more -	170
Sixty ditto of turnips, at three earths, cultivated, or scarified and dragged, equal to 1½ earth - - - -	271
Twenty-two ditto pease, at one earth, and broadcast dragged, part of it drilled - -	26
Fifty-seven acres of wheat, 32 acres on one earth, once dragged, and twenty-five of heavier land, twice ploughed and twice dragged -	123
Twenty-nine ditto of ley ground, broke up to December 1st - - - -	29
Three ditto of beans, seven ditto winter vetches, two ditto potatoes, cultivating, dragging, &c.	17
Carried forwards	680

Lime

Brought over	680
Lime carried and "butted"* over the land, 160 butts, equal to two acres work, being a large proportion of 1920 hogsheads, or 9600 bushels of lime	120 Halling. 125 Butting*
Twenty-five acres of the turnip land dunged, equal to - - - - -	$30\frac{1}{2}$
Total	$955\frac{1}{2}$

Hay harvest, corn harvest, corn to market, halling of timber, &c. &c. not easily calculated, but still to be allowed for, probably amounting to Allowing for three-year-old steers ninety acres, and eight half days work of two two-year-old bulls, worked occasionally with the steers for the purpose of keeping them quiet; allowing also as above, the hay harvest, &c. not brought to account; it will appear that the labour of the twelve oxen throughout the year will amount to, if not exceed, one thousand acres.

The average amount of our labour is two acres of ley ground per day, and fallowing and stirring more than two acres; but the second cross ploughing, or earth, somewhat less. Our teams consist of four oxen, a man, and a boy, to each double-furrow plough, and to each four-wheel waggon. Our ploughing in general very deep, and our fields small, not exceeding $4\frac{1}{2}$ acres each on the average. These two circumstances are to be duly considered as adding materially to the labour. The working stock consists of sixteen steers and oxen, two bulls, and three light horses, viz. six five-year-old oxen, six four-year-old steers, and four three-year-old ditto. They are fresh growing stock, and are regularly turned out to graze, after the barley sowing, at six years old. The whole object aimed at is to carry on our course of crops on the most speedy and vigorous system, but without injury to the growth of the stock.

It is evident that my labour, severe as it long has been, cannot be found to injure the health or growth of the stock:

* Butting. The lime being mixed with the foreheads or headlands round the hedges of the field, is from thence carried in implements called butts, bodily over the land,—a laborious but good management.

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the exhibition of my oxen annually, within ten months grazing from the time they are turned out of work, will fully exemplify this important fact. This was in great part my object in establishing the Barbican cattle show; and, if I may be allowed to say so, the effect already produced, more especially in countries where oxen were held in disrepute as animals of labour, has exceeded my most sanguine expectations. That our crops are worked-in so expeditiously as to amaze those who contend for horse labour only, cannot be denied; in proof of which, fifty-seven acres of wheat were this autumn ploughed, sown, and manured in a complete manner, according to the usage of the country, within three weeks, although the weather was unfavourable, and the land worked close and heavy. The last nine acres were ploughed, sown, dragged, and harrowed, in one day. In obedience to the wishes of the society, I present them with this statement; but I wave all claim to a premium. If, however, in the ordinary course of business, any man in this kingdom shall be found to have done more at a less cost, I shall consider myself as having trespassed unworthily on the notice of this society. It is fitting to add, that in twenty years labour I have not lost one ox or steer, or ever broke a yoke or pair by sickness, death, or accident. And I may further add, that so far from incurring any loss of value from working cattle after their full growth, as is supposed to be the case with horses, amounting to 25 per cent. or more, my own experience, and the concurring opinion of the committee sent to examine our stock in the month of June last, warrant me in declaring, that working cattle, from three to six years of age, do actually gain at the rate of 20 per cent. yearly; the loss in my own case, in twenty years, being nothing!

The premium now in question, having distinctly waved my claim to it, will probably be awarded to Mr. Billingsley; and it gives me sincere pleasure that it should be bestowed on him. He has been a most strenuous and successful advocate for the labour of oxen, and is well aware of its extreme importance. Mr. Billingsley has accomplished a measure hitherto untried, namely, to set out his ploughing by the acre, and to apply one team of oxen, full grown, with two

two to assist, in all eight oxen, to constant plough-labour, every day in the year that it was possible for them to work. I consider the attempt of such consequence to the landed interest, so momentous an illustration of the powers of these superior animals in labour, that I beg leave here to offer him my sincere thanks; and I have the honour to be,

With all respect to the Society, &c. &c.

To the Secretary. SOMERVILLE.

XXVI. *Practical Statement on the former Subject, with Claim of Premium.* *By* JOHN BILLINGSLEY, *Esq.**

THE claimant states, that his servant Esau Green has on a farm of eight hundred acres, the soil of which is of a middling texture, ploughed and harrowed, with a team of six oxen and a double-furrow plough, the following acres of land, *statute-measure*, between the 1st day of January and the 1st of December, 1804, viz.

Acres.
56 of oat stubble.
62 of turnips for oats.
68 of ley.
68 of ley cross-ploughed for a fallow.
100 of fallow, for the purpose of being cleaned after a slovenly tenant.
19 of vetches.
12 of vetches folded off, and sown with wheat.

385 acres ploughed in eleven months.

56 of oat stubble.
62 of turnip sown to oats.
14 of ley.
80 of fallow.
48 of cross-ploughed ley.
19 of vetches.
12 of wheat.

291 acres harrowed in the same eleven months.

* From *Letters and Papers of the Bath Agricultural Society*, vol. x.

The

The claimant further states, that no possible error can have crept into this statement. No other team being employed in the tillage of this farm, and the ploughman being paid by *the acre*. Nor can any doubt arise respecting the size of the acres, as it is well known that lands newly inclosed are set out *statute*-measure.

The oxen employed were home-bred, of the long-horned race, and were purchased last year of one of the claimant's tenants, at the price of 14*l.* each. Four of them were six years old, and four four years old.

Though eight oxen were kept, six only were worked at a time. The other two were changed as occasion required, at the will of the ploughman. These oxen are in no respect injured by their labour, and are now in good working order.

The ploughman and driver were paid 1*s.* 4*d.* per acre for ploughing, and 6*d.* per acre for harrowing; and in this was included all necessary attendance on cattle at all times and seasons.

The depth of ploughing from 3 to 5 inches.
The breadth of ditto from 7 to 10 inches.

As the harrowing was all performed with six oxen, drawing very heavy and long-tined harrows, (provincially called drags) and in many fields two bouts in a place, it will not be unfair to estimate *two* harrowings as equal to *one* ploughing; and in proof of this comparison it may be observed, that the double plough will turn two acres and a half in eight hours, which are half as much as six oxen can harrow in the same time.

Presuming that no solid objection can be brought to the foregoing statement, it may be satisfactory to the society to see the debtor and creditor side of the account, methodically arranged, so as to ascertain the cost both of the ploughing and harrowing per acre, statute-measure.

DEBTOR.

Eight Working Oxen, from Jan. 1st to Dec. 1st, 1804.

	£.	s.	d.
To 24 lb. of hay per week, consumed between Jan. 1 and May 12, when they were turned to grass, at 2*l.* 10*s.* - - - -	47	10	0

To

	£.	s.	d.
Brought over - -	47	10	0
To 24 weeks' keep at grass, at 3*s*. each ox -	28	16	0
To 6 tons of hay, between Oct. 1 and Dec. 1, when at grass - - - - -	15	0	0
To repair of yokes and bows - - -	0	18	0
To wear of plough and dressing shares, mending chains, &c. - - - - - -	4	13	6
To cash paid Esau Green for ploughing 385 acres in eleven months, at 1*s*. 4*d*. - -	25	13	4
To cash for harrowing 291 acres, at 6*d*. -	7	5	6
	£129	16	4

N. B. This price per acre includes driver and attendance.

CREDITOR.

By 385 acres ploughed, at 4*s*. 10¼*d*. - -	93	8	10
By 291 acres harrowed, at 2*s*. 6*d*. - -	36	7	6
	£129	16	4

If this had been lett by hire, it would not have been taken by any neighbouring farmer at less than 8*s*. per acre ploughing, and 4*s*. per acre harrowing.

If the harrowing of *two* acres be admitted as equal to ploughing *one*, it follows that the work done by these oxen, (caparisoned in the old-fashioned way with yokes and bows) is equal to the ploughing of 530 acres in eleven months, or 578 acres in a year.

It may naturally be supposed, that on so elevated and exposed a hill as that of Mendip many interruptions to tillage work must occur in the course of a year, notwithstanding which the man's earnings (driver included) amount to 14*s*. per week nearly; to which must be added sundry work in the time of harvest, (after his day's work at ploughing) and other occasional labour, amounting to the average of 2*s*. per week, constituting altogether the receipt of 13*s*. per week for himself, and 3*s*. per week for his boy.

In conducting this experiment the claimant has sedulously guarded his mind against all bias and partiality, being desirous of getting at the truth by the most accurate investigation: and he has no doubt that the statement of work performed under the direction of a noble lord (the rival candidate for this premium) will lead to the same conclusions, and rescue this most useful animal from that degraded state of inferiority in which he has unjustly been classed.

At midsummer last the claimant had not the most distant idea of starting as a candidate; and since that time he has in no way whatever stimulated the ploughman to *extraordinary* exertion.

In letting his tillage labour by contract he has not departed from the uniform practice of twenty-five years. A practice originating from an idea, that the best method of making servants laborious and honest is to make it their interest to be so.

Encouraging, however, as these facts must be to the use of oxen in this department of husbandry, he does not venture to say that they will answer in all countries, or on all soils.

On all light sandy soils, such as Norfolk, Suffolk, &c. single ploughs of different constructions, drawn by two horses without a driver, may in cheapness of execution nearly approach the double-furrow drawn by four oxen. But on all level soils unincumbered with stones, and where good pasture may be found for *summer*, and good hay for *winter* keeping, oxen with the double-plough may in his opinion be considered as justly entitled to a preference.

JOHN BILLINGSLEY.

Bath, Dec. 6th, 1804.

XXVII. *Notices respecting New Books.*

Observations collected during a Journey through Part of Sweden during the Year 1799. *By* JOHN GEORGE ECK *jun. Published at Leipzig,* 8*vo.*

SWEDEN is far from being so well known as it ought to be; the observations of intelligent and impartial travellers on that country will therefore be read with interest. The small work

work of M. Eck, from which we are now about to give some extracts, is the fruit of a two months' stay which the author made in Scania, one of the finest provinces in Sweden. M. Sjæborg, of Lund, is at present occupied in writing a statistical, geographical and historical description of it; and to his pen we are already indebted for an excellent description of the province of Blekingia, published at Lund in 1792 and 1793, in two vols. 8vo.

There is no country in which persons can travel so expeditiously, or at so little expense, as in Sweden. Although there are no post horses similar to those established in the other countries of Europe, a royal ordinance regulates the terms on which the peasants and the inhabitants of the towns are obliged to let out for hire the necessary horses for travelling, and the price of this accommodation is extremely moderate. Persons travelling may also be accommodated with a small four-wheeled country carriage; but it is not at all convenient, and travellers had much better bring their own equipage. The horses are small and slender, but they run with great swiftness; the roads are good; the carriages are often driven by young boys of ten years of age, and sometimes by young girls; these children, however, always drive with great care: according to the last regulation, which is dated in 1765, every traveller has a right to require that they shall drive him a Swedish mile in an hour, which is nearly equal to three leagues. In every inn there is a register, where every traveller may inscribe whether he has been well or ill driven, the place to and from which he travels. In the inns in the country, scarcely any thing else than spirits, and some milk, or bread and beer, is to be found. M. Eck therefore advises travellers to bring provisions along with them.

Scania is fourteen Swedish miles long and eleven broad. It contains about 90 square miles, and 219,830 inhabitants, being a proportion of 2,442 for every square Swedish mile.

The climate of Scania, and of Blekingia in its neighbourhood, is milder than the rest of Sweden. In spring the nightingale visits these countries, and the stork builds her nest there; which cannot be said of the more northern districts.

stricts. Scania resembles Fionia and Seland much, and the same fruits are cultivated in each province.

Fishing, and the rearing of cattle and bees are considerable branches of the industry of the inhabitants of this country; and the animals here are generally of a stronger make than in the rest of Sweden. Plenty of corn also is cultivated here; which has given it the appellation of the granary of Sweden. A great quantity of this corn is sold for the supply of the interior of the kingdom. Hops and tobacco are also cultivated in abundance. The higher parts of the province furnish a good deal of wood, which would not, however, be sufficient for the wants of the inhabitants, if they had not coals also.

The lovers of mineralogy, and, indeed, travellers of every description, will find useful information on that subject in a work entitled, "Guide to the Quarries and Mines of Sweden, by Engestrœm; Stockholm, 1796, in 8vo." This work has a very fine chart attached to it.

There are in Scamia 9 cities, 203 parishes, 398 churches, 153 privileged domains, 13 of which belong to the crown, 51 large and 89 small domains belonging to nobles, and 6,426 *hemman* or peasants' farms.

The agriculturists of Scania are not so active as those of Germany; there is even a Swedish proverb on this subject: *Han ær hastig som en Tysk*, i. e. He is as active as a German. This indolent slowness, particularly that of the domestics, often plagues strangers much.

The peasants of Scania are generally either very rich or very poor; but they do very little to better their condition. The men and women are almost all of a tall and fine shape, and of a healthy complexion. Among the peasants of this province, those are the poorest who cultivate the estates of the nobles; but they are not slaves, as some authors have asserted, for they may quit their masters when they please. The immense number of crows with which they are infested hinder them from cultivating their lands so carefully as they would otherwise do. Baron Maklier has driven all the crows from his estates, which are very considerable; he has divided them into *hemmans* or farms, which he lets for a certain

tain number of years at a stipulated rent. The advantage of this arrangement has been already felt by the proprietor, and baron Maklieri's example will soon be imitated by all the other great proprietors.

The nobles and several persons of distinction have established beautiful and useful gardens and orchards; but the peasants have not been able as yet to imitate them; every one is afraid of being the first to have a garden, in case of being robbed by his neighbours who have not similar plantations.

Lund is a very antient city; it was formerly much more celebrated and important than it is at present. M. Eck gives some curious details upon the history of this city. When Charles X. passed through Lund in 1658, the learned bishop Winstrup solicited his majesty to establish an university there. The king granted his request; but it was not until the reign of Charles XI., his son, that the project was executed. The inauguration took place on the 28th January 1668, being the king's birth-day, and it was named after its founder, *Academia Carolina Gothorum*. The celebrated Samuel Puffendorf was called there from Heidelberg in order to teach the law of nature and nations, and contributed not a little to the splendour of this new university.

Some curious and satisfactory details upon the state of the sciences and learning in these countries at a remote period will be found in the fourth part of the "*Konigl.* Vitterhets, Historie och Antiquitats Handlingar." Stockholm, 1795, in 8vo.

It is said that a school was established at Lund in 1085. Notwithstanding the rarity of books at that period, and although, in 1317, ten marks of fine silver were paid for a missal, the cathedral of Lund established a library so early as 1124. Scania may boast of being the country of the learned *Saxo Grammaticus*, whose real name was *Lang*, celebrated in the thirteenth century for the elegance of his Latin style.

The antient residence of the archbishop is at present the seat of the university. On the south side there is in a court an agreeable promenade, the alleys of which are formed by indigenous trees; it is called Lundagord, and is much frequented

quented on Sundays by the inhabitants. To the north of the edifice is the botanical garden, which was established in 1753, in which are a hot-house and an anatomical theatre. The whole is surrounded with a very high stone wall.

Behind the botanical garden are the orchard and plantation belonging to the academy, which is called Paradies Lycka; containing all sorts of trees, not only indigenous, but foreign, which they endeavour to naturalize in Sweden. This plantation, as well as the Lundagord, is the work of that respectable old man Eric Gustavus Ludbeck, professor of natural history at Lund, and knight of the order of Wasa, whose house is in front. From the year 1755 to 1782, 16000 feet of the trees of this plantation have been annually distributed gratis.

The centre of the college contains the library and the cabinet of natural history. The latter has been lately enriched by the acquisition of a collection of minerals found in Russia by M. Norberg, counsellor of the mines at Stockholm. There is here preserved a piece of Descartes's skull, which was placed here by the learned bishop of Lund, Celsius. It came into his possession in the following manner: When the body of this celebrated philosopher was about to be transported from Sweden to France, an officer of the city guards of Stockholm, thinking to render a signal service to his country, possessed himself of the skull, and substituted another which he placed in the coffin. After the officer's death, the philosopher's skull passed as an object of curiosity through the hands of several persons, and was divided; the counsellor of state Stiernman, father-in-law to bishop Celsius, acquired one of these pieces, which the latter gave to the university of Lund.

The library possesses a very numerous collection of Greek and Roman medals, and is particularly rich in works of natural history. There is here preserved a very fine manuscript Virgil, of the seventh or eighth century, upon vellum, with large initial letters in gold; a magnificent manuscript of the Koran; an edition of Julius Cæsar in folio, 1469, with initials in gold; a Livy of 1470, and similarly executed; the work of St. Augustine, "De Civitate Dei," a Venice edition, 1470, fol.; "Petr. de Crescentiis de Agricultura,"

Argentor.

Argentor. 1486, fol.; "Missale Lundense," which archbishop Birger caused to be executed at Paris in 1514, in fol.; the rubrics and the initial letters are in red, and the character is Gothic. This missal is very rare, and it is asserted that throughout all Sweden there is only a second copy of it. There is also the work of count Erich Dalberg, entitled *Suecia Antiqua et Hodierna*, published in three volumes in fol. about 1700, although the year is not mentioned. This work, which contains accurate and well executed engravings of the cities, public buildings, and other curious objects in the kingdom, was executed at the expenses of Charles XI. and XII.

The library is disposed into spacious halls, adorned with busts of professors of Lund, and several portraits of chancellors of the university, some of which are extremely well painted.

The upper part of the academical building contains a cabinet of natural history and an observatory. The latter is placed on a circular tower, and at the top of it is a platform surrounded by an iron balustrade. This observatory is situated in 55° 42′ 13″ latitude, and 30° 57′ 0″ longitude. It would be desirable if the instruments were better and in greater number. From the top of this tower there is a very fine view; the eye takes in the whole city; it is surrounded with fine meadows and rich corn-fields; and in its interior it contains a great number of gardens, so that the *tout ensemble* resembles a large and fine garden. When the sky is clear, the towers of Copenhagen may be easily seen beyond the sea. On the first floor there is a large and a small hall, in which the academical sittings are held; and where the public discourses are pronounced, the theses disputed, and where the professors deliver such of their lectures as are public and gratuitous. Nigh this place is the hall in which the senate of the academy assembles, which is here called the consistory, and which is composed of all the professors and of a syndic. There are here some good portraits, and among others that of Charles XII. This heroic prince lived at Lund in the interval between his return from Pultowa by Stralsund in 1716, and his irruption into Norway in the summer of 1718.

During

During his stay at Lund, Charles manifested a predilection for every thing relating to the sciences. He attended the lectures of the professors; and one day, when he found them all collected in the library, he testified a desire of instantly hearing some public thesis disputed. No person was prepared for such a proposition; Jean Jacques Dœbeln, however, professor of medicine, pronounced extempore an elegant Latin address to the king, and gave this thesis as a subject for discussion: *Objecta movent sensus, non tam ratione quantitatis, quam qualitatis.* Quensel, professor of mathematics, undertook to attack him.

Although this subject is a very abstract one, the king, in spite of his vivacity, lent every possible attention to the academical disputation he had thus provoked. As a mark of his esteem for professor Dœbeln, he conferred upon him the dignity of nobility, and increased his salaries.

The chemical laboratory, the concert-room appropriated to the musical exercises of the students, and the hall where the public sales of books take place, are in a separate building in front of the entrance to the cathedral. In another building there is an armoury, which, in winter, is made use of for balls and assemblies.

The number of students is 150. Every three years the faculty of philosophy creates forty masters of arts. The examinations of this faculty, and of that of jurisprudence, take place in public, and minutes are drawn up of the questions and answers. The faculty of philosophy has three ways of expressing their opinion upon the degree of talents possessed by the candidates, and the following are the terms made use of: *laudatur, approbatur, admittitur.*

One of the first public functionaries of the state is always chosen as chancellor of the university. The academical senate names him, and the king confirms the nomination. The bishop of Scania and Blekingen is always vice-chancellor. This university has sixteen professors, thirteen *aggrégés* or adjuncts, and fourteen masters of arts, who give lectures, and are called *docentes* or *magistri legentes.* The salaries of the professors are paid in coin, and they are tolerably large; some of them are, besides, titulars of good livings, which

which considerably increases their incomes without adding to their labours, as they are entitled to fulfil their clerical duties by a chaplain, to whom they allot only a small part of the emoluments. When a professorship becomes vacant, the consistory or senatus academicus proposes three candidates, out of whom the king chooses one.

There are two printing-houses at Lund, that of the university belongs to M. Berling. M. Anders Lidbeck, son of the botanical professor of this university, publishes a weekly journal entitled "Nytt och Gammal," i. e. "Modern and Antient Times." The short distance between Lund and Copenhagen enables the learned men of this university to have a greater facility of communication between Denmark and Germany than their philosophical brethren of Upsal and Abo. Thirty years ago a literary society was established under the name of the Physiographical Society; it has published several useful works, which evince the solidity of the acquirements of its members.

Professor Retzius possesses a fine cabinet of natural history; there is a very fine collection of seeds in it. The cabinet of M. Flormann, adjunct of the faculty of medicine, is particularly interesting from the great number of preparations it contains relative to veterinary medicine; and M. Fremling, professor of speculative philosophy, has a very fine mineralogical cabinet, plenty of rare medals, and an extensive library.

The cathedral is the grandest building in the small city of Lund; it is the only remains of its antient splendour. This mass of stones, which seems to have been heaped up by the hands of giants, in order to brave eternity, has been from the earliest periods regarded as one of the wonders of Sweden. Swenon, king of Denmark, began the building of this edifice in 1012; but the time when it was finished is unknown. It was consecrated in 1145 by archbishop Eskild. It is the largest church in all Sweden, and it is said that it a good deal resembles the cathedral of Spires. Before the Reformation, there were at least fifty altars in different chapels, all richly endowed. It is of the form of a cross, and, according to vulgar tradition, its two towers represent the two female saints who clung by the feet of our Saviour. The whole edifice is 135 ells and a half long*, 50 broad, and 48 ells and three-fourths high. It is built of large hewn stones, with the exception of the upper part of the towers and some chapels, which are brick.

Divine service is at present performed in the nave, or the western part of the church. We there see considerable fragments of a large old clock, which indicated the hours, months, and days, sun-rise and sun-set, &c. The altar is of white marble; the pulpit is of white and black marble; both are ornamented with bas-reliefs carefully wrought.

The choir, or the eastern part of the cathedral, is a little higher than the nave, and is used in order to celebrate the academical promotions, as well as the installation of the new rector of the university, which takes place on the 28th of January every year, being St. Charles's day.

During M. Eck's stay at Lund, the act of promotion of the masters of arts was celebrated; it only takes place every three years, with much solemnity, mingled with many absurdities.

In the choir there is an enormous brass candelabrum, surmounted by a small statue of St. Laurence; there is also a curious altar of the middle age, adorned with figures in relief, which represent several subjects in sacred history. Before this altar there is a pavement different from that of the rest of the church. It is said that this formerly served as an asylum for criminals. Under the choir there is a subterranean church called *Krafts Kirka*, which was formerly appropriated for the religious assemblies of the German population. In this vast vaulted hall we remark the following objects:

1. Two pillars, on one of which there is sculptured the figure of a giant, and on the other those of his wife and child. According to popular tradition his name is Finn. It is added, that it was he who built this church, at the request of St. Laurence, who consecrated it to the Holy Virgin; that afterwards this giant and his wife wanted to demolish the church; but, in order to punish them, they were

* The Paris ell is 3 feet 7 inches and 8 lines.

converted

converted into stone along with their child. We may easily see that the meaning of this tradition is, that this church was built by the Pagans, who, discontented at the introduction of a new religion, afterwards attempted to destroy it. 2. A well, the water of which passes as the best in the whole city. Upon one side of it is sculptured an enormous louse in the act of devouring a sheep. 3. The tomb of the learned bishop Bærge, adorned with his statue, in his archiepiscopal robes. This prelate died in 1519; his father was only a sacristan. In the sacristy, the curious are shown the shift of Margaret the heroic queen of Sweden, and popular opinion attributes a great virtue to it, in order to facilitate difficult labours. We know, by authentic documents, that king Christian I. requested it from the chapter of the cathedral for this purpose.

When king Adolphus Frederick and queen Louisa Ulrica visited the cathedral of Lund in 1754, this princess testified that it would give her pleasure to see published an historical description of this remarkable edifice. This induced the learned professor Sommelius to compose a copious dissertation upon this church, which he dedicated to the queen*, and in which he has given a description of all the inscriptions, monuments, &c. which are there.

The exterior of the cathedral presents an imposing coup d'œil, which results from its great simplicity. It is to be regretted that the houses are too close together, which at night is felt extremely inconvenient. The abominable custom still subsists of burying in the churches, and it is done very carelessly, the graves being of no great depth.

For a long time Lund has been improving; the number of well built houses, however, and of a solid construction, does not amount to more than twenty. The rest are built of

* The following is the title of this work: Disputatio historica de Templo. Cathedrali Lundensi, quam auxiliante Deo, consensu ampliss. Fac. Philos Acad. Carol. ad publicum eruditorum examen d. xvi. cal. sextil. anni MDCCLV. deferunt Gustav. Sommelius in ling. orient. docens et Coll. Sch. Lund. et Isaac. Liefery, Lundensis, in 4to. The chaplain M. Pere Savarin published at Lund, in 1795, an extract in the Swedish language of this very diffuse dissertation; and this extract will be sufficient for such travellers as wish to visit this church to advantage.

 wood.

wood. The most of them are only one story high. This city has in general more the appearance of a large village; it is badly paved, and in some places the pavement is entirely wanting: thus the least rain renders the streets almost impassable, and most of the professors are obliged to keep a carriage. To most of the houses are attached gardens, in which fine fruit-trees are cultivated. The inhabitants in general are fond of agricultural pursuits. The neighbourhood of the city abounds in fine tobacco plantations, and within these forty years past the produce has amounted to 160,000 pounds weight. In 1730, a coal-pit was opened near Lund, but some years ago the digging of it ceased.

From Lund M. Eck proceeded to Malmoe, one of the richest cities in Sweden, and the commerce of which is very flourishing. The houses are better built than those of the other cities in Scania; the number of its inhabitants is 8000. On the king's birth-day, the order of Knut (or Canute) holds a solemn assembly in a fine saloon in the town-hall, which is adorned with several portraits of kings who were members of this association. In antient times there were several similar orders or associations; the latter, however, is the last that now exists. It was founded in honour of Knut IV., who was massacred by the peasants in the eleventh century. The kings and princes of the kingdom have always been members of this fraternity. In its hall of assembling two silver vases of an extraordinary size are preserved, (out of which the members drink at their annual repasts,) and a grand silver pigeon, which is suspended by a strong silver chain from the neck of the newly admitted members. The same fraternity has also a grand bell in the tower of the cathedral, which is sounded at the death of every member. An eulogium is also pronounced upon those who merit the distinction. Each new member makes choice of a sister, to whom as well as to himself the distinguishing mark of the order is granted, viz. a small silver pigeon suspended from the neck by a blue ribbon. The members, however, wear it only at their assemblies, and on the king's birth-day. A very learned Danish lawyer, professor Hofod Ancker, has written a work upon this order of Knut.

There

There are in the city of Malmoe several manufactories, among others, one of tobacco, where it is cut by a machine worked by horses, and a cloth manufactory, which is very extensive and remarkable; it is upon the footing of the English manufactories. Near the city there are fine gardens and beautiful fields.

Between Malmoe and Lund, near the road, is seen a large family *tumulus*, open towards the north. In the inside there is a space of two ells and a half high, three ells broad, and five long. To the left of this place there is a small chamber, four ells long, and about an ell and a half high. There was nothing found except a large irons word, which is at present preserved in the cabinet of the university of Lund, with several similar antiquities. Nearer Malmoe there are several fine *tumuli*, but they have not yet been opened. Plenty of them are to be found throughout all Scania and Seeland, and they have a pleasing effect.

In the reign of Charles XI. the study of the antiquities of Sweden occupied much of the public attention; since that period they have been a little neglected. M. Tham, intendant of the court, at present devotes himself with a most praise-worthy zeal to researches upon the monuments of his country; he has collected several upon his estate in West Gothland, and has published a description and engravings of them in a work, of which he is preparing a continuation *.

The island of Ilween, situated between the coasts of Sweden and those of Denmark, is celebrated in the History of Sciences from the circumstance of the Danish king Frederick II., the grand protector of the sciences, and particularly mathematics and astronomy, having conferred it as a fief † upon the celebrated astronomer Tycho Brahe, by a solemn act, dated 15th May 1576.

On the 8th of August, in the same year, the first foundations were laid of the magnificent observatory of Uranienborg, and on the 14th of December following Tycho Brahe

* Gœthiska Monumenta samlade och beskifne af Pehr Tham, Hof Intendant; i.e. "Monuments of Gothland, collected and described by Pehr Tham, Intendant of the Court," Stockholm 1794, in 4to.

† This island was ceded to Sweden by the peace of Rothschild in 1658.

made

made the first astronomical observations in this island. In the library of the university of Copenhagen are still preserved the sheets containing the astronomical observations made at Uranienborg from 1576 to 1597. The retired and tranquil situation of this remarkable island renders it extremely favourable to the study of the mathematical sciences. Tycho lived for these studies alone; he there invented and executed new instruments, formed some excellent pupils, and, by the care which he bestowed on the sick islanders, (whom he supplied with such medicines as resulted from his extensive chemical inquiries,) has deserved the admiration of all Europe, as much as from his discoveries in astronomy.

The greatest scholars, princes and kings, visited this great man in his retreat, kept up communications with him, and profited by his advice. In 1577, the university of Copenhagen unanimously voted him their chief; but his occupations at Uranienborg did not admit of his accepting of this testimony of the esteem of his learned countrymen. King Frederick II. did not content himself with granting him large appointments; he made him considerable presents, and conferred on him the order of the Elephant. The favours heaped upon Tycho Brahe, in consequence of his merit attracted some envy; and, after the death of Frederick in 1588, his enemies succeeded in oppressing him more and more, so that at last they only left him the island of Ilween, which brought him in no more than 200 crowns. This succession of ill usage drove him from his ungrateful country, and in the month of June 1597 he set out for Italy. After having remained some time at Rostock, and in some other places, the emperor Rodolph II., that great amateur and protector of the arts and sciences, invited him to Prague, and showered upon him the most striking testimonies of his esteem. He conversed with him in Latin; made him a present of 2000 golden florins; assigned him an annual pension of 3000 golden florins; fitted up for him a house at Prague, and a chateau at Benach, some leagues from that city, that he might give himself up to his astronomical and chemical labours; and finally gave him the promise of a fief,

fief, with the reversion to his family, that he might have no uneasiness on this point. The emperor studied the works of Brahe with the greatest zeal, and often consulted with him on political subjects also. Death, however, prematurely carried him off in 1601, in the 55th year of his age, and frustrated the hopes which had been entertained from the labours to which he had attached himself. In the church of Prague there is a beautiful monument erected to him, with an honourable inscription.

At present there are very few traces to be found in the isle of Ilween of the observatory formerly occupied by Brahe: the present inhabitants are occupied entirely in fishing and agriculture. Several *tumuli* of the antient days of paganism are to be found here.

Helsingborg, an antient city, and formerly a considerable one, has not yet recovered from the ruinous consequences of the several sieges which it sustained in the wars between Denmark and Sweden; it has only about 1200 inhabitants. In summer this city is lively enough, on account of the strangers who come to drink the waters of Ramlœsa, situated half a league beyond it; the proximity of Copenhagen produces a great crowd of the inhabitants of that city here on Sundays and holidays. M. Eck there met with a good company of Swedish comedians, who had established their theatre in a barn, and who played several original pieces and some imitations of Kotzebue, Iffland, Schræder and Yunger, &c. Upon this occasion, M. Eck says a few words upon the dramatic literature of Sweden, which has within these few years suffered a sensible loss in consequence of the premature death of *Lidner*, author of a Medea and several other poems, which evince his genius. There is another Swedish dramatic chef-d'œuvre by another living author, Leopold; it is entitled Oden eller Asarnes Utwandring: "Odes, or Emigration of the Asarnes." M. Adlerbeth, a respectable old man, and counsellor to the chancery, has published several dramatic works, which are distinguished by a purity and dignity of language. *Kenell*, who has been dead some years, was the author of several good pieces; and within these few years, a young man, Charles Lindegreen, has

has entered into the career of the drama under favourable auspices. Alten has given several translations of foreign pieces. It may be said in general that within the latter half of the 18th century, and particularly since the reign of Gustavus III., the belles lettres, and particularly poetry, have been cultivated in Sweden with much success: the example of this last monarch, who is himself celebrated as a poet and an orator*, has had necessarily a most salutary influence upon the fate of letters. By establishing the Swedish Academy, composed of eighteen members, his principal object was the cultivation of the Swedish language, and to favour poetry and eloquence.

Among the best poets of Sweden now dead, M. Eck mentions Nordenflycht, Kellegrew, Lidner, Creutz, Kexell, Bellman, and Oelf; and among living poets, Adlerbeth and Leopold; the latter is also author of several very fine lyrical compositions, and of an agreeable collection of erotic poems. Count Gyllenborg, a respectable old nobleman, some years ago published a much esteemed heroic poem, entitled *Toget œfver Belt*; "Expedition of Charles X. beyond the Belt;" some satirical poems, in which he has taken Boileau as his model; and several lyrical poems, which will secure him an honourable place among the best poets of our times †. The marshal of the empire, count Oxenstierna, is the author of a happy imitation of the Georgics of Virgil, entitled *Skœdorne*, or "The Harvest." Francis Franzen has written several lyrical pieces, in which he has drawn the picture of a country life and simplicity of manners. Eckeberg is the author of several good satires; and Bagge ‡ published, at the age of eighteen,

* Several of his speeches, delivered before the states of the kingdom and in the senate, have been translated into Latin by the learned Italian Dominicus Michilessi, who was so much esteemed by Frederic II. of Prussia, on account of his genius. This translation, published at Berlin in 1772, in 8vo. was dedicated to Pope Clement XIV., and in the dedication Michelessi calls Gustavus III. eloquentissimum regem.

† There exists a choice collection of his poetry, and of his friend the late count Creutz, under the title of "Vitterhets Arbeten af Creutz och Gyllenborg," Stockholm 1795, in 8vo.

‡ M. Bagge studied at Upsal in 1799. M. Eckeberg was then a *magister docens* of that university; M. Franzen is adjunct professor of eloquence at Abo;

eighteen, his "Essays of a Young Man," which contain several pieces which the poet Leopold praises highly, and which show a true poetical talent. The wife of the assessor Lenguen, at Stockholm, a woman of much genius, has published several lighter poems, which are much esteemed.

M. Eck finishes his work by some observations upon the paper and metal currency circulated in Sweden, and some remarks on the analogy between the Swedish and Danish languages.

XXVIII. *Letter from Mr.* Keith *in reply to the Anonymous Reviewer of Mr.* Bonnycastle's *Trigonometry.*

[Having no personal knowledge of either Mr. Keith or Mr. Bonnycastle, I cannot be suspected of partiality to either. I have endeavoured to show my impartiality by inserting Mr. Keith's first letter on the review of Mr. Bonnycastle's work, and the answer of the reviewer; but as it would not be proper to devote the pages of the Philosophical Magazine to a lengthened dispute, I hope Mr. Keith will not be offended at my suppressing the introductory part of his letter, and confining the following extract to that part on which he principally founds his charge of plagiarism.—A. T.]

To Mr. Tilloch.

........"Let this reviewer point out *a single example* in any of *my* works, that can be found in similar works of Mr. Bonnycastle, (and I am aware he can do it in two or three instances) I am prepared to refer, without hesitation, to the original work, of prior date to any of Mr. Bonnycastle's works, whence it was extracted.—In the mean time I will furnish him with a few examples which Mr. Bonnycastle has copied from my work; and when he has

Abo; the rest live at Stockholm: Messrs. Gyllenborg, Oxenstierna, Leopold, Adlerbeth, and Franzen, are members of the academy.

has found them in any other treatise, prior to the publication of mine in 1801, I will *publicly retract the whole that I have written on Mr. Bonnycastle's work.*

Keith's Trigonometry.			*Bonnycastle's Trigonometry.*		
Example	4th,	page 237	Example	2d,	page 209
———	3d,	— 242	———	2d,	— 213
———	9th,	— 243	———	3d,	— 213
———	4th,	— 246	———	2d,	— 217
———	6th,	— 246	———	3d,	— 217
———	4th,	— 260	———	2d,	226-227
———	6th,	— 261	———	3d,	— 227
———	3d,	— 264	———	2d,	— 228
———	4th,	— 265	———	3d,	— 229
———	2d,	— 266	———	2d,	— 231
———	4th,	— 268 &c.	———	3d,	— 232 &c.

"I am, sir,

"Your most obedient servant,

"THOMAS KEITH."

No. 18, Norfolk-street,
Fitzroy-square,
March 11th, 1807.

XXIX. *Mode of Heating Rooms by Steam. By Mr.* NEIL SNODGRASS, *of Johnstone, Renfrewshire*.*

SIR,

THE undersigned memorialist, having several years since invented, and successfully put in practice, a method of heating rooms, which he flatters himself will be found to fulfil the conditions for reward required by the society, begs leave to propose himself as a candidate for the honour of such reward.

NEIL SNODGRASS.

Johnstone, Feb. 18, 1805.
To C. Taylor, M. D.

* From *Transactions of the Society of Arts,* &c. vol. xxiv.—The society's gold medal, or forty guineas, was voted to Mr. Snodgrass for this communication.

Reference

Reference to the Engravings of Mr. Snodgrass's Method of Heating Rooms by Steam.

The proposed mode of heating rooms will, perhaps, be most distinctly explained by a brief history of the first ideas of the memorialist on the subject; of his attempts to put them into practice; and of the successive improvements which have been suggested to him by experience.

In April 1798 he was engaged by G. Macintosh and David Dale, esqrs. to manage a cotton mill near Dornoch, in the county of Sutherland. He remained in Glasgow for six months after this, superintending the construction of machinery for the mill. During this period he was led to consider of a cheap method of heating the mill, as he had learnt that fuel was extremely scarce and dear in the county in which the mill was situated. It was evident that none of the methods which he had seen practised could be applied but at an enormous expense; and his experience had pointed out to him important defects and inconveniences in them all. Having observed a mode of drying muslins by wrapping them round hollow metal cylinders, filled with steam, practised at the bleach-fields near Glasgow, it occurred to him, that, by means of a proper apparatus, steam might be applied to heat a cotton mill, or any other large manufactory. It was evident that this not only would be an œconomical mode of producing heat in large works, so far as fuel was concerned, but that it would prevent the danger of fire, to which such works, when heated in the usual manner, are much exposed. He communicated his notions to a number of cotton spinners and others, from whose suggestions he expected assistance. But he met with nothing but discouragement; the project being every where treated lightly, or pronounced to be impracticable. Strongly impressed, however, with the advantages of the plan, the memorialist persevered in his resolution to make trial of it, and ordered tin pipes to be made for the purpose. These he erected in the mill in May 1799. When filled with steam they at once produced the necessary degree of heat; but the pipes, having been damaged in the carriage, proved not sufficiently strong.

strong. Indeed, the memorialist was immediately sensible that their position was unfavourable. With a view to some conveniences in point of room, they had been carried up diagonally in one end of the mill, whence the upper sides of the pipes became sooner heated than the lower; which caused an unequal expansion. The water arising from the steam condensed in the pipes in its return to the boiler, and also obstructed the steam in its ascent. In order to remedy these defects, the pipes were altered, and erected in a perpendicular position, and certain tubes were connected with them to carry off the water arising from condensation. The whole apparatus, as it stood after this alteration, is represented by the drawing, fig. 1.

This drawing presents a view of an inner gable, which is at one extremity of the preparation and spinning-rooms of the mill. On the other side of this gable there is a space of 17 feet, enclosed by an outer gable, and containing the water-wheel, the staircase, and small rooms for the accommodation of the work. In this space the furnace and boiler are placed on the ground. The boiler cannot be shown here, as it lies behind the gable exhibited; nor is it of any consequence, as there is nothing peculiar in it. It may be of any convenient form. The feeding apparatus, &c. are in every respect the same as in the boiler of a common steam-engine. A circular copper boiler, two feet diameter by two feet deep, containing 30 gallons of water, with a large copper head as a reservoir for the steam, was found to answer in the present instance. The steam is conveyed from the boiler through the gable, by the copper pipe B, into the tin pipe C, C. From C it passes into the centres of the perpendicular pipes E, E, E, by the small bent copper tubes D, D, D. The pipes E, E, E, are connected under the garret floor by the tubes F, F, for the more easy circulation of the steam. The middle pipe, E, is carried through the garret floor, and communicates with a lying pipe, 36 feet in length (the end of which is seen at G), for heating the garret. At the further extremity of the pipe G, there is a valve falling inwards to prevent a vacuum being formed on the cooling of the apparatus; the consequence of which would be the

crushing

crushing of the pipes by the pressure of the atmosphere. Similar valves, K, K, are placed near the top of the perpendicular pipes E, E; and from the middle one E, the small pipe passes through the roof, and is furnished with a valve at I, opening outwards, to suffer the air to escape while the pipes are filling with steam, or the steam itself to escape when the charge is too high.

The water condensed in the perpendicular pipes E, E, E, trickles down their sides into the three funnels L, L, L, the necks of which may either pass through or round the pipe C, into the copper tube M, M, which also receives the water condensed in C, C, by means of the short tubes N, N. The pipe C, C, is itself so much inclined as to cause the water to run along it to the tubes N, N, and the pipe G in the garret has an inclination of 18 inches in its length, to bring the water condensed in it back to the middle pipe E. The tube M, M, carries back the water through the gable to the boiler, which stands five feet lower than this tube. It is material to return the water to the boiler, as, being nearly at a boiling heat, a considerable expense of fuel is thereby saved.

The large pipes are ten inches in diameter, and are made of the second kind of tinned iron plates. The dimensions of the smaller tubes are seen by their comparative size in the drawing, and perhaps they might be varied without inconvenience.

The apparatus erected as here described, has been found sufficiently strong, and has required no material repairs since the first alterations were made. The leading object in the instance under consideration being to save fuel, in order to derive as much heat as possible from a given quantity of fuel, the flue from the furnace, which heats the boiler, is conveyed into common stone pipes placed in the gable. These are erected so as to prevent any danger of fire, in the manner shown in the drawing, fig. 2. The steam with this auxiliary communicates a heat of about 70° to the mill, the rooms of which are 50 feet long, 32½ feet wide, and 8½ feet high, except the lower story and garret; the former of which is 11, and the latter 7 feet high. The rooms warmed in this

 manner

manner are much more wholesome and agreeable than those heated by the best constructed stoves, being perfectly free from vapour or contaminated air.

By various experiments it appears that the expense of fuel is scarcely one-half of what is necessary to produce the same degree of heat with the best constructed stoves. The memorialist was the better able to make the comparison, since he had previously had five years experience of cotton mills on what was, at that time, reckoned the most approved plan.

After having ascertained these results, the memorialist, in 1800, drew a plan similar to that now presented to the society, and sent it to Glasgow to his employers, who were very doubtful of the success of the scheme. They immediately published the discovery in the Glasgow newspapers, inviting cotton spinners, and others interested, to inspect the plan. In consequence of this public intimation of the method having been successfully practised, a number of cotton spinners turned their attention to it, and adopted it with various modifications, according to the convenience of their mills, or their notions of improvement.

The memorialist afforded to every person who desired it, all the information on the subject which he possessed. His general recommendations were to detach the condensed water, in returning it to the boiler, as much as possible from the steam; and where tin pipes, or others of similar strength, were used, to secure them carefully with safety valves.

There are obvious defects in the application of the principle, as practised in the instance described above. Of some of these the memorialist was perfectly aware at the time of the first construction of the apparatus, though it was out of his power to remedy them; and he has thought it proper to give a detail of the first successful experiment exactly as it took place.

From the pipes being all in one end of the house, the heat was unequally diffused, and a considerable time elapsed, after their being first heated, before it reached the other end of the rooms. But, as the mill had barely room enough for the

the spinning machinery, it was impossible to erect the pipes in any other situation, or to convey them along the rooms, so as to produce a more equal distribution of heat. This, however, can be so easily effected, when there are no obstacles, such as have been mentioned, that it is scarcely necessary to enter into any detail of the means. It may be barely mentioned that the memorialist has fitted up the apparatus in two cotton mills, which are now under his management, belonging to George Houston, esq. and Co. of Johnstone, in a manner which completely distributes the heat. In one of these mills, consisting of six stories, a lying pipe of cast iron, 5 inches in diameter, is carried along the middle of the lower story, about two feet from the ceiling, with a small declivity to carry off the water. This pipe heats the story in which it is placed. Tin pipes, 7½ inches diameter, communicating with this lying pipe, are carried up perpendicularly through all the floors to the top of the house at the distance of seven feet from each other, and form a line of heated columns in the middle of each room.—The same general plan has been followed in the other mill. But there are several irregularities in the building, which require a little variation of the contrivances for diffusing the heat to every quarter. Some of the rooms having been added since the first erection of the mill, are connected with the main body of the building awkwardly. Into these the steam is carried by lying pipes, slightly inclined, and communicating with the principal apparatus. The steam may afterwards be distributed by other pipes in any way that is thought convenient. The memorialist has found no difficulty in conveying, by such means, the steam necessary to produce the degree of heat required in every variety of situation.

In the former of the last-mentioned mills, the perpendicular pipes are connected under the ceiling of the garret by a pipe 2½ inches diameter, slightly inclined, the extremities of which pass through the walls of the house, and are provided with valves opening outwards. A connecting pipe, with similar valves, is placed under the ceiling of the third story. These are intended for the more easy circulation of the steam: but the memorialist found, from experience, that with all these aids, the filling of the perpendicular pipes with steam was attended with some difficulty. The steam, when first thrown in, passes up the perpendicular pipe nearest to the boiler, and, being specifically lighter than air, occupies the upper part of the apparatus, compressing the air in the lower part of the rest of the pipes. The resistance of the air will thus for a long time prevent the pipes from being completely heated: but this difficulty is easily obviated by having a valve or valves opening outwards, at the lowest part of the apparatus, through which the air, when compressed by the steam, is suffered to escape. In the mill just mentioned, the lying cast iron pipe in the first story is carried through the gables of the mill, and furnished with valves for the egress of the air. It is unnecessary to repeat, that the same valves serve for the discharge of the air in heating the apparatus, and of the steam itself, when its expansive force becomes too great. In both mills each of the perpendicular pipes is provided with a valve, to prevent a vacuum; and in the second mill the lying pipes for carrying the steam into the detached rooms have each two valves, one opening inwards, and the other outwards.

Certificates of five other mills being heated in a similar manner, by the direction of the memorialist, are presented to the society.

The application of the principle to buildings already constructed, it is presumed, will be sufficiently obvious from the foregoing details. In new manufactories, where the mode of heating may be made a part of the original plan, a more convenient apparatus may be introduced. This will be best explained by a description of the drawing, fig. 2., which gives a section of a cotton-mill constructed in a manner which the memorialist would adopt, were he to apply the steam apparatus to a new building, or any other that would permit such an apparatus from its regular constructions. In an old mill in this place, an apparatus is now erecting by the advice of the memorialist, conformable to this plan, which is likely to be generally adopted in new cotton mills.

The furnace for the boiler is shown at *a*. The flue of the

furnace

furnace conveys the smoke into the cast iron stove pipes, 1, 2, 3, 4. These pipes are placed in a space in the gable, entirely inclosed with brick, except at the small apertures, 5, 6, 7, 8. A current of air is admitted below at 9, and thrown into the rooms by those openings, after being heated by contact with the pipes. This part of the plan is adopted with a view to prevent, as much as possible, any of the heat, produced by the fuel used, from being thrown away. It may be omitted where any danger of fire is apprehended from it, and the smoke may be carried off in any way that is considered absolutely secure. So far, however, as the memorialist is able to judge, there seems to be little or no danger of fire from a stove of this construction. The greatest inconvenience of a common stove is, that the cockle or metal furnace is liable to crack from the intensity of the heat. By the continuity of the metal from the fire-place, an intense heat is also conducted along the pipes, which exposes them to the same accident. Here the smoke being previously conveyed through a brick flue, can never communicate to the pipes a degree of heat sufficient to crack them. In like manner the pipes, having no communication with the rooms but by the small apertures, cannot come in contact with any combustible substance; and from being surrounded with air, which is constantly changing, can impart only a very moderate degree of heat to the walls. The iron supporters of the pipes may be imbedded in some substance which is a bad conductor of heat, as furnace ashes and lime, &c. The emission of heated air into the rooms may be regulated by valves. As the pipes are not exposed to cracking, there is no risk of their throwing smoke or vapour into the rooms.

The boiler *b*, *b*, is six feet long, three and a half broad, and three feet deep. As there is nothing peculiar in the feeding apparatus, it is omitted. The boiler may be placed in any convenient situation. Where a steam engine is used for other purposes, the steam may be taken from its boiler. The pipe *c*, *c*, conveys the steam from the boiler to the first perpendicular pipe *d*, *d*, *d*. There is an expanding joint at *e*, stuffed, to make it steam tight. The steam ascending in the first pipe *d*, *d*, *d*, enters the horizontal pipe *f*, *f*, *f*, *f*, (which is slightly inclined) expelling the air, which partly escapes by the valve *g*, and is partly forced into the other pipes. The valve *g* being considerably loaded, forces the accumulating steam down into the rest of the pipes *d*, *d*, *d*. The air in these pipes recedes before the steam, and is forced through the tubes *h*, *h*, *h*, into the pipe *m*, *m*, *m*, whence it escapes at the valve *i*, and the syphon *k*. The water, condensed in the whole of the pipes, passes also through the tubes *h*, *h*, *h*, *h*, into the pipe *m*, *m*, *m*, which has such a declivity as to discharge the water at the syphon *k*, into the hot well *n*, whence it is pumped back into the boiler.

The whole of the pipes are of cast iron, except *m*, *m*, *m*, which is of copper. The perpendicular pipes serve as pillars for supporting the beams of the house, by means of the projecting pieces *o*, *o*, *o*, which may be raised or lowered at pleasure by the wedges *p*, *p*, *p*. The pipes are sunk in the beams about an inch, and are made fast to them by the iron straps *q*, *q*. Those in the lower story rest on the stones *s*, *s*, *s*, *s*, and are made tight at the junction with stuffing. The pipe in each story supports the one in the story above by a stuffed joint as shown at *r*. The pipes in the lower story are seven inches in diameter; those in the higher six inches; those in the other two are of intermediate diameters. The thickness of the metal is three-eighths of an inch. The lower pipes are made larger than the upper, in order to expose a greater heated surface in the lower rooms, because the steam being thrown from above into all the pipes, except the first, would otherwise become incapable of imparting an equal heat as it descends.

There is no necessity for valves opening inwards in this apparatus, the pipes being strong enough to resist the pressure of the atmosphere.

The cotton mill is 60 feet long, 33 wide, and four stories high, the upper being a garret story. In the engraving five parts out of nine in the length of the building are only shown. The apparatus will heat the rooms to 85° in the coldest season. It is evident that, by increasing the size, or the number of the pipes, and the supply of steam, any degree of heat up to 212° may be easily produced. It may even

even be carried beyond that point by an apparatus strong enough to compress the steam: this, however, can seldom be wanted. At first it was objected to this construction, that the expansion of the pipes, when heated, might damage the building: but experience has proved, that the expansion occasioned by the heat of steam is quite insensible.

The memorialist thinks it would be improper, in addressing so intelligent a body as the Society of Arts, &c. to expatiate on the various œconomical purposes to which the principle, which he has been able but imperfectly to unfold, may be applied. In abler hands it may be found susceptible of improvement, which he cannot anticipate.

NEIL SNODGRASS.

XXX. *Proceedings of Learned Societies.*

ROYAL SOCIETY OF LONDON.

FEB. 26. The right honourable the earl of Morton, vice-president, in the chair.—Continuation of Mr. Knight's paper on the bark of trees. This philosopher, after many experiments and observations during several years, has come to the following conclusion: that there is a juice in trees distinct from that which is elaborated by the leaves or conveyed by the alburnum; that this juice gradually exudes, and, like all vegetable matter, naturally assumes a regular form, which at first resembles a honey-comb, and afterwards unites itself with the alburnum to form vessels fit to convey the true sap either from the roots to the leaves, or from the leaves to the roots, and in this manner is finally incorporated with the wood of the tree. The author was led to this conclusion chiefly from having observed that the bark of grafted trees gradually unites and forms an uniform mass, and that bark on the trunks of trees is speedily regenerated where the leaves are, perhaps, at a distance of nearly 200 feet. The theories of Malpighi and Hales he considered very inadequate to the explanation of these phænomena.

March 5. Earl of Morton in the chair.—A paper by Mr. Rigo was read, containing a proposal for a new compensation pendulum. The failure of all former attempts to construct pendulums not subject to the changes occasioned by temperature, induced the author to make some experiments with various metals, in the course of which he discovered, that of all the modes of compensation, that of triangles was the best, and accordingly he constructed one of triangles, two sides of which were composed of small steel bars, and the base of brass or zinc, which expands two times more than steel, and hence the expansion of the sides was duly counteracted by the expansion of the base. In this manner, he alleged, pendulums might be constructed of two, three, or more series of triangles, that would continue the same length throughout all climates and seasons. The same idea, the author acknowledged, had occurred to others.

March 12. The Right Honourable Sir J. Banks, Bart., President, having recovered from his indisposition, resumed the chair.—A paper by Dr. Wollaston, "On Fairy Rings," was read. Those deep green circles of coarse grass seen in humid meadows and pasture-ground have occupied the attention of several philosophers, in order to be enabled to give a satisfactory physical explanation of their origin, progress, and final termination. Dr. Wollaston having observed that fungi were always found on the exterior border of these rings, thence inferred, that they originated in the exhausted state of the soil, which could only nourish agarics, instead of more perfect vegetables. It yet remains, however, to be decided whether this circumstance be an effect or a cause of the phænomena in question.

March 19. The President in the chair.—A part of an interesting paper, by captain Flinders, (containing also some corrections of his former one) on the dip of the magnetic needle, was read. The captain detailed a great number of observations, made at different times, on the variations of the needle according to the direction of the ship's head in different latitudes.—The society then adjourned, on account of the holidays, till the 9th of April.

FRENCH NATIONAL INSTITUTE.

[Continued from p. 90.]

The researches of M. Cuvier upon the fossil grinders of elephants having led him to examine some fresh grinders, and the opportunity he had within these few years of dissecting two elephants, almost adult, having admitted of his examining in detail the manner in which the teeth of these animals grow, he drew from these examples some conclusions on dentition in general. We may consider the anatomy of large animals as a kind of natural microscope, which assists better in seeing the anatomy of others.

M. Cuvier was led to confirm the doctrine of John Hunter, at least so far as regards the substance called *osseous*. It has no vessels, and is not formed by intus-susception like true bones, but a successive transudation of layers produced by the pulpy nucleus of the tooth, and which are glued the one over the other. The enamel is deposited above by the membrane which envelops the young tooth, and is there fixed by a kind of crystallization: lastly, a third substance, proper to certain herbivorous animals, is deposited after the enamel, but by the same membrane, which changes its nature at a certain epoch.

These two last points had also been observed upon smaller teeth by R. Blake, an Irish anatomist.

This thin substance had been originally discovered by M. Tenon, who named it *cortical osseux*, but who regards it as formed by the ossification of the capsular membrane.

This respectable anatomist has continued to communicate to us his grand work upon teeth; and this year he has given us a description of those of the cachalot and crocodile. The teeth of the former have no enamel, but only the osseous cortex. The one may be easily distinguished from the other, because the enamel is much harder, and is entirely dissolved in the acids, without leaving any gelatinous parenchyme. The tusks of the elephant, and the grinders of the bear and of the dugoug, have no other envelope.

As M. Cuvier, in speaking of the teeth of elephants, had related several observations recently made, both by himself and Messrs. Everard, Home, Corse, and R. Blake, naturalists

ralists or anatomists in England, upon the manner in which these teeth are shed and replaced, M. Tenon has presented to the class the work he has edited upon the same subject for more than twenty-five years, which contains a great part of these observations.

Distinctly acknowledging the priority legitimately due to this excellent anatomist, the class regret that he has so long deprived the public of his discoveries, and have earnestly entreated him to publish them.

M. Tenon is on the point of publishing another work upon the eye and its diseases. He has made several new remarks upon the parts which surround this organ: he has found, for instance, some tendinous lumps which tie the straight muscles to the anterior edges of the orbit, and serve them for a kind of returning pulley, and hinder them from compressing the eye-ball; he has developed a membranous tunic which surrounds the eye-ball, attaches it to the two angles of the orbit by two kinds of wings, passes into the pupils, and is there reflected behind the tarsi; and lastly, gives a passage to the tendons of the muscles. Other anatomists confound this tunic with the cellaconté: he discovered small ligaments which join the extremities of the tarsi to the orbit; he has examined the effect of the various chemical substances upon the crystallines: lastly, he has established a new opinion upon the agents which transmit to the iris the action of the retina, and by which the impressions received by the latter dilate or contract the other. M. Tenon searches for these agents in the ciliary processes, the tongues of which are prolonged behind the iris, and the tails of them touch the retina.

This indefatigable anatomist has also given us some account of the malconformation commonly called *hare-lip.* He has found it sometimes proceeding from a rent of one of the two maxillary bones, sometimes from a rent in both; and he attributes the cause of it to a disproportionate dilatation of the tongue. Sometimes he found the palate divided behind, and it was then a too rapid increase of the brain which produced the evil. Children born without a tongue, or such as had lost it early by the small-pox, had,

on

on the contrary, the palate narrow, and its cavities filled up.

Experience has taught M. Tenon that it is dangerous to perform any operation for the hare-lip at the time when the teeth are cutting.

The class has witnessed with great satisfaction a valuable method of teaching certain branches of anatomy, in the pieces of artificial anatomy prepared for the School of Medicine by M. Laumonier, of Rouen. There is reason to believe that the account given by the School of Medicine of this new process will contribute to the erection of an establishment where this art will be practised as successfully as it is in Italy: in the exactitude of the details, and in the truth of the imitation, M. Laumonier exceeds the Italian school.

The class has directed that these artificial anatomical preparations should be confined to the representation of such singular or monstrous conformations which rarely occur.

M. Laumonier has presented to the class one of the most singular monstrosities which has been ever observed in the human species, and a conformation which, perhaps, approaches more closely than any yet known to a perfect hermaphroditism. A woman had, besides all the organs of her sex, two testicles, well formed, concealed in the folds of the great labia, and the vasa deferentia of which end in the bottom of the matrix.

M. Pictet, correspondent and professor of physics at Geneva, has sent to us a drawing of a monstrous colt, born at Locre, in the county of Neufchatel: it had cloven hoofs, representing claws; its head was larger and shaggier than usual. The peasants killed it from superstition; and they attributed its malconformation to a fright which the mother had received from two bears that were once shut up in the same stable with her.

A young physician, M. Duvernoy, has presented to the class a memoir upon the *hymen*, where he has shown that this singular membrane, hitherto generally regarded as peculiar to the human species, is also to be found in every animal.

The same author has published the three subsequent volumes

lumes of "Lectures on comparative Anatomy, by M. Cuvier;" and thus terminated a work in which anatomy and physiology are considered in the most general manner.

M. Dumas, correspondent and professor at Montpelier, has not yet finished his "Grand Physiology," announced by us some time ago; and he has been obliged to give a new edition of that which he had already published.

M. Barthey, correspondent and professor also of Montpelier, has reproduced his celebrated work upon "The Elements of the Science of Man;" which is likely to produce a happy revolution in physiology.

The natural but premature desire of referring to the general laws of physics and chemistry the phænomena of living bodies, had suggested to the physiologists of the 17th and of one-half of the 18th century, a crowd of hypotheses equally gratuitous as they are complicated, and which were very far from conducting them to their object.

Some men of genius, disgusted with this way of contradictory suppositions, thought of applying to living bodies the method so usefully employed in physical astronomy since the days of Newton.

That great man discovered that the movement of the stars, so complicated in appearance, was regulated according to certain laws which he succeeded in ascertaining; in a word, universal gravitation: and admitting, once for all, in our calculations, this general fact, rigorously defined and appreciated, without examining the cause of it, we may effectually succeed in explaining every phænomenon with precision, and foretel the time and place of each with even more exactitude than we could have done by the longest continued observations.

This rejection of the inquiry into first causes, in order to attach ourselves merely to an exact determination of secondary causes, or the immediate elements of motion, has thus been a fortunate and productive idea.

Physiologists, therefore, have done right in imitating it, and much is due to M. Barthes for having invited them to it from his own success.

But now that the utility of this method is no longer contested,

tested, some reflections upon the precision necessary to obtain from it all that may be expected, will not, perhaps, be out of place.

The astronomers ought to be imitated in every particular, who do not content themselves with vaguely attributing the celestial phænomena to *attraction*, but they analyse these phænomena, showing and distinguishing the parts of the attractions of each of the various bodies, and determining the measure and the laws of their action; they explain, by means of a rigorous calculation and precise observations, that these laws are in fact constantly the same, and belong to no arbitrary supposition.

There is really no meaning in saying simply that living bodies have a vital principle, and in attributing to this principle every thing we cannot explain by other means. To think that we have said something useful, when we say vaguely, that sensibility and contractibility are effects of the vital principle, in our opinion is both deceiving ourselves and others by an expression devoid of meaning.

In order legitimately to compare the employment of the attraction with that of universal gravitation, it would be necessary to analyse separately every phænomenon of life; to determine the share which the ordinary laws of physics and chemistry have in them; and afterwards to compare the elements of the phænomena which these two sciences could not have furnished, to those which would have remained after the analysis of the other phænomena; to see if all these unknown elements, extracted, if we may be allowed the expression, each one separately from the various phænomena, have any thing common among them; lastly, to ascertain the laws to which we are to attribute their common principle, if we find that it exists, since, on combining it with those of the ordinary sciences, it gives a rational explanation of all the phænomena observed, and enables us to foretell with some exactitude the phænomena which would happen in new circumstances. It is then only that physiology may flatter itself with possessing a particular principle, as well as astronomy; it is then only that we shall be permitted logically to employ the *vital principle* in reasonings and calculations,

tions, as a general fact, the primitive cause of which we may dispense with ascertaining, until new discoveries shall give a well grounded hope of ascertaining it.

But we ought to know, that we cannot attain this object but by bringing to perfection the anatomy and chemistry of organized bodies, by incessantly comparing their results with the observation of these bodies, as well in the state of health as disease, by applying, in short, this method to all the classes of these bodies, whatever be the complication of their organs and the extent of their faculties.

The works which daily appear upon the medical and physiological sciences, show how necessary it is to collect these principles, and the present state of science admits of great improvements being made in the particular branches to which I have above alluded.

XXXI. *Intelligence and Miscellaneous Articles.*

BALLOONS.

On the 24th of this month (March) an experiment was made at Woolwich, in the presence of several military officers and engineers, with a species of balloons intended to carry dispatches from one post to another when the wind serves. The dispatches are fastened to a string attached to the balloon. By means of a match joined to the string it takes fire at any calculated time; and the dispatches falling to the ground are picked up by sentinels watching for them at some distant post.

METEOROLOGY.

An immense ball of fire was observed at Glasgow on Friday night, the 6th of March, 15 minutes before 10 o'clock, directing its course (seemingly) from south-east to north-west, with a very long streaming tail, and, towards the end, of a sparkling appearance.

LIST OF PATENTS FOR NEW INVENTIONS.

To John Falconer Atlee, of Wandsworth, in the county of Surrey, distiller; for his improved apparatus to be used in fermenting liquors. March 7.

To

To John Maberly, of Bedford-row, in the county of Middlesex, gentleman; for his method of making and constructing tents, poles, and other machinery, so as to expel and carry off noxious and contaminated air by a readier and more effectual ventilation than can be accomplished by the tents in common use. March 7.

To Elizabeth Bell, of Blackheath, in the county of Kent, spinster; for certain improvements in an artificial method of sweeping chimneys, and an improvement in the preparing and manufacturing pieces used for the constructing the chimneys invented by her, so as to render the said pieces capable of being better joined together, and more advantageously used for conveying smoke, water, and other fluids or bodies in a divided or pulverulent state in any required direction; and also for certain methods, machinery, and apparatus, useful or necessary for manufacturing such pieces, and applicable for the purpose of forming various other articles of pottery. March 7.

To John Houlditch, of Long Acre, in the county of Middlesex, coach-maker; for improvements in the construction of four-wheeled carriages of different descriptions. March 7.

To Henry Charles Christian Newman Clerk, rector of St. John's Capisterre, in the island of St. Christopher; for a machine applicable to mills in general and to various other purposes, but more particularly adapted to the cattle mills employed for expressing the juice of the sugar-cane, by greatly augmenting their power and execution with fewer cattle, and by increasing the number of the revolutions of the spindle and rollers in the proportion of ten to one of the present mills, or even more if required, by means of a ring, made either of hard wood or cast iron, round the mill, and by an entirely new construction of the axis in peritrochis, the lever, and a lantern-wheel or pinion, the spindles or teeth of which turn a cog-wheel on the spindle of the mill; which axis in peritrochis, lever, and lantern-wheel or pinion, are also constructed so as to revolve together with two distinct motions; that is to say, a rotatory one round their own axis, and a progressive circumvolutionary one on the ring, constantly acting upon and impelling the cog-wheel and spindle with their separate and united forces. March 7.

METEORO-

METEOROLOGICAL TABLE,
By Mr. Carey, of the Strand,
For March 1807.

Days of the Month.	Thermometer. 8 o'Clock, Morning.	Noon.	11 o'Clock, Night.	Height of the Barom. Inches.	Degrees of Dryness by Leslie's Hygrometer.	Weather.
Feb. 25	51°	55°	46°	29·54	16	Cloudy
26	37	40	32	·85	28	Fair
27	28	37	30	30·00	0	Showers of snow
28	32	38	32	·42	9	Fair
March 1	32	39	33	·54	7	Cloudy
2	33	42	39	·48	5	Cloudy
3	39	41	39	·08	0	Cloudy
4	37	42	28	29·86	7	Cloudy
5	25	33	25	·82	19	Fair
6	25	37	32	·81	16	Fair; snow at night
7	32	39	32	·95	10	Showers of snow
8	38	46	35	·70	9	Fair
9	36	39	34	·49	7	Storm of snow
10	32	36	33	30·00	0	Storm of snow
11	33	38	34	·10	0	Storm of snow
12	33	39	35	·24	11	Fair
13	33	44	34	·15	26	Fair
14	34	38	32	·01	5	Cloudy
15	33	40	28	29·95	7	Storm of snow
16	28	37	35	·79	10	Cloudy
17	28	39	35	·50	21	Fair
18	40	50	34	·30	19	Showery
19	33	48	35	·68	22	Fair
20	33	50	40	30·00	41	Fair
21	40	54	41	·21	26	Cloudy
22	44	50	38	·42	28	Fair
23	37	44	36	·48	35	Fair
24	32	43	35	·40	37	Fair
25	33	42	37	·39	20	Cloudy
26	36	40	37	·10	12	Cloudy

N. B. The Barometer's height is taken at one o'clock.

XXXII. *On the Stanhope Temperament of the Musical Scale.* By Mr. JOHN FAREY.

To Mr. Tilloch.

SIR,

WHEN men of rank and fortune, like earl Stanhope, undertake the investigation of difficult points in the physical sciences, whatever success may attend their labours, their names can hardly fail of attracting attention to the subjects on which they employ their talents and pens. Such I am happy to observe to be the case at present; Dr. John Wall Callcott, an eminent musical writer, having announced his intention of publishing a work shortly on the *Stanhope temperament*, in order to point out the numerous advantages of that mode of tuning keyed instruments; while others appear to be investigating the nature and peculiar properties of musical intervals with a depth of research which has, unfortunately for the science, been hitherto very rare among practical musicians. In my letter in your November Magazine (vol. xxvi. p. 172), on Mr. *Hawkes's Treatise on Music,* I hinted at the diversity of terms or notation, in which musical intervals have been usually expressed by the writers who have treated on those minuter parts, or intervals, necessary to be considered in tempering the scale; since which I have carefully re-perused lord Stanhope's treatise in your September Magazine (vol. xxv. pages 291 to 312); and having found it necessary to make several calculations and arrangements of the intervals which compose the *Stanhope* septave, or douzeave, as his lordship's system of twelve intervals in an octave might have been called, I am induced to trouble you with them, hoping that they will aid and facilitate the inquiries, which I have above alluded to, into the merits and defects of this mode of dividing the octave.

My lord Stanhope, from being furnished with a very capital and nicely-divided monochord, and with three grand piano-fortes of the very best construction, (pages 312, 292, and 304,) for making his experiments on the musical intervals, appears to have adopted that mode of expressing

 the

the results of his calculations, which, however convenient it may prove in using his monochord (which I apprehend is rather a costly instrument), whereon the length of wire for sounding C is divided into 120 parts, and the decimals of those parts, the same is not readily adapted for repeating his experiments on the monochords more commonly in use, whereon the length for C, or the key note, is made unity, or 1·00000, and the same is divided decimally: therefore in column 8 of Table I. following, and column 6 of Table II. (pages 195, 196, and 197,) I have reduced his lordship's numbers (xxv. 309.) to this scale, the numbers herein being the numbers answering to the logarithms in the preceding columns. It appears, however, necessary here to remark, that musical intervals are of that peculiar species of magnitude which *cannot be numerically defined by the lengths of the strings* which yield the sounds; and that every attempt of that kind is as futile, as it would be to attempt the definition of a plane surface, or of a solid body, by *one* of its lineal dimensions.

For the purposes of comparing the magnitudes of musical intervals, *the intervals of sounds* themselves may be added to each other, or deducted, at pleasure, *on an instrument* furnished with a sufficient number of adjustable strings, as our noble author has shown (p. 292, &c.): thus any number of the conchords called *fifths* (V) can be added upwards to each other with accuracy, the point of acuteness, or interval from the fundamental or key note thus obtained, can be compared with that obtained by adding in ascent a number of *octaves* (VIII) or other conchords; or we can, from those points accurately descend by deducting (or adding in descent) any other of the conchords, as major or minor *thirds* (III or 3rd), major or minor *sixths* (VI or 6th), or of minor *fourths* (4th), to any fresh points in the scale, from whence we may wish to make accurate comparisons with the key note, and thence with any other notes in the scale.

Notwithstanding that this mode of composing intervals of sound is well known, and is in constant use by tuners of keyed instruments, as organs, harpsichords, piano-fortes, &c.; yet no author that I have read has yet adopted this simple, accurate, and convenient mode of notation or expressing,

pressing, as it is capable of doing, not only every possible interval in the diatonic system, but even the almost endless variety of intervals which arise, in considering the division of harmonic intervals into aliquot parts, as is done by his lordship in obtaining his *bi-equal thirds* and *tri-equal quints* (pages 301 and 302): in this mode, column 5 and column 3 in my Tables I and II following (which are titled, and are to be read, from the bottom upwards) express all the intervals mentioned by his lordship, and are to be read thus: c the *octave*, or VIII, consists of the sum of a *third* and minor *sixth* (III + 6th), of the sum of a *fifth* and minor *fourth* (V + 4th), or a *sixth* and minor *third* (VI + 3d), &c., and may be thus tuned as above explained; always observing, that the 3d, 6th, VI, in this column are *diatonic* or perfect, and not *Stanhope* or tempered intervals: ♭ B, or the 7th, may be tuned by adding two 4ths in succession, or two VIII upwards and two V downwards; ♭ A, or the *Stanhope* 6th, by tuning upwards an VIII and a III in succession, and *bisecting* the interval thus obtained above C by a new sound; of which more hereafter. It is here to be understood, as in algebraic notation, that where neither of the signs + or — (denoting *addition* and *subtraction*) is affixed to any term or interval in these columns, + is to be understood; as denoting ascent and the tuning or reading the interval which it precedes *upwards*; while — denotes that the following term or chord is to be tuned or read *downwards:* at the same time, these signs + and — may be considered as merely expressing contrariety in the direction in which an interval is to be tuned or read; and, if a III was wanted below C, instead of above it at E, the expression VI + V — VIII may have all its signs changed, viz. — VI — V + VIII, and the same will denote a VI and a V downwards in succession, and thence an VIII upwards, which will bring us to a note called ♭ A, which is the *diatonic*, or perfect *major third* (III) below the key note C.

Gentlemen who are conversant in the management of vulgar fractions, and no others should think of comparing the relations of musical intervals, will see no difficulty in adding or subtracting any of the intervals contained in

 columns

columns 5 and 3 of the Tables, first reducing the fractions to a common denominator, and attending carefully to the signs: thus, if the *Stanhope* 6th, C ♭ A, or $\frac{V + 4 + III}{2}$, were required to be deducted from the octave *c*, or V + 4; we have, when reduced to a common denominator, the fractions $\frac{V + 4 + III}{2}$ and $\frac{2V + 24}{2}$, and the former deducted from the latter gives $\frac{2V + 24 - V - 4 - III}{2}$, or $\frac{V + 4 - III}{2}$; or, because V + 4 = VIII, $\frac{VIII - III}{2}$ is the interval required, and appears to be his lordship's *bi-equal third*. See No. 6 in Table II.

As an example of the meaning and uses of column 1 in Table I, we might have inquired what is the value of this interval $\frac{VIII - III}{2}$ in *half notes* or number of finger-key intervals: thus, the VIII containing 12, and the III 4 half notes, we have $\frac{12 - 4}{2}$, equal to four half notes, which is found to answer in the table to E or the III; but is in this case a *bi-equal third* instead of a diatonic III, the minute difference of which intervals, is not taken into account when we speak of, or estimate by, the half notes of music writers and instrument makers.

It is only when musical intervals are supposed perfectly equal among themselves (each $\frac{1}{12}$ of a lineal octave) that they can be added together, and treated as we have last done; and the arithmetical *differences* of the lengths of strings, or even of the fractions expressing those lengths, cannot, as before observed, represent "*the value*" of intervals, or even of the error or difference between two intervals, as they are said to do by our noble author, at the bottoms of pages 294 and 296, last paragraph but one in page 301, fourth paragraph page 302, and in all the instances in the last column of the table at page 311; mistakes, of which the student should be particularly aware.

Table

Table I. *Showing the Relations which the several Notes in an Octave bear to the fundamental Note* C, *when tuned according to the Stanhope Temperament.*—See vol. xxv. p. 309.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
12	c	$\frac{1}{2}$	VIII	VIII, III + 6th, V + 4th, VI + 3d, 4 + III + 3.	$\frac{1}{2}$	·6989700	·5000000	0		
11	B		VII	V + III, VI + V − 4th.	$\frac{8}{15}$	·7269987	·5333333	—		
10	♭B		7th	2 4ths, 2VIII − 2V.	$\frac{9}{16}$	·7501225	·5625	—		
9	A	$\frac{3}{5}$	VI	$\frac{\text{VIII}+\text{V}+2\text{III}}{3}$, $\frac{2\text{V}+4+2\text{III}}{3}$, $\frac{\text{VI}+\text{V}+2\text{III}+3}{3}$	$\frac{2}{5}\sqrt[3]{\frac{10}{3}}$	·7763529	·5975207	*17984	$\frac{3}{2}\sqrt[3]{\frac{3}{10}}$	$\frac{1}{3}$ c
8	♭A	$\frac{5}{8}$	6th	$\frac{\text{VIII}+\text{III}}{2}$, $\frac{\text{V}+4+\text{III}}{2}$, $\frac{\text{VI}+\text{V}}{2}$.	$\frac{2}{\sqrt{10}}$	·8010300	·6456987	♭51500	$\frac{16}{5\sqrt{10}}$	$\frac{20}{21}$ c nearly
7	G	$\frac{2}{3}$	V	V, VIII − 4th, III + 3d, VI − 4 + 3d.	$\frac{2}{3}$	·8239087	·6666666	0		
6	♭G		IV	$\frac{3\,\text{4ths}-\text{V}+\text{III}}{2}$, $\frac{\text{VIII}-2\text{V}+2\,\text{4th}+\text{III}}{2}$.	$\frac{9}{4\sqrt{10}}$	·8521825	·7115125	—		
5	F	$\frac{3}{4}$	4th	4th, VIII − V, VI − V + 3d, VI − III, 6th − 3d	$\frac{3}{4}$	·8750613	·75	0		
4	E	$\frac{4}{5}$	III	III, VIII − 6, VI − 4, V − 3, VI + V − VIII.	$\frac{4}{5}$	·9030900	·8	0		
3	♭E	$\frac{5}{6}$	3d	$\frac{\text{VIII}-2\,\text{4th}+\text{III}}{2}$, $\frac{\text{V}-\text{4th}+\text{III}}{2}$.	$\frac{8}{3\sqrt{10}}$	·9259687	·8432740	♭51500	$\frac{16}{\sqrt{10}}$	$\frac{20}{21}$ c nearly
2	D		II	$\frac{\text{V}-\text{4th}+\text{III}}{3}$, $\frac{2\text{V}+\text{III}-\text{VIII}}{3}$.	$\frac{4}{3}\sqrt[3]{\frac{3}{10}}$	·9506458	·8925772	—		
1	♭D		2d	$\frac{\text{VIII}-2\text{V}+\text{III}}{2}$, $\frac{\text{4th}+\text{III}-\text{V}}{2}$, $\frac{\text{VI}-\text{V}}{2}$, $\frac{\text{4th}-\text{3d}}{2}$.	$\frac{3}{\sqrt{10}}$	·9771213	·9486834	—		
	C		Key	Unison.	$\frac{1}{1}$	·0000000	1·0000000	0		
Intervals in half notes.	Letters, or finger keys.	Diatonic Ratios.	Diatonic Marks.	Stanhope Intervals expressed in Tuneable Intervals.	Stanhope Intervals expressed in Ratios.	Stanhope Intervals expressed in Logarithms.	Stanhope Intervals expressed in Lengths of string	Differences from Diatonic, in Difference of 7 place logarithms.	Differences from Diatonic, in Ratios.	Differences from Diatonic, in Parts of a comma.

Table

Table II. *Showing the Relations of several Notes or Intervals in the Stanhope Temperament, &c. to the Key Note C.*

No.	2.	3.	4.	5.	6.	7.	8.
1	*True major Sixth*, VI - -	VI, VIII — 3d, 4th + III	$\frac{3}{5}$	·7781513	·6	0	
2	*True minor Sixth*, 6th - -	6th, VIII — III, 4th + 3d	$\frac{5}{8}$	·7958800	·625	0	
3	Stanhope V, B♭G, p. 301 and 311	$\frac{5\,4ths - V - III}{2}$ - -	$\frac{3^3\sqrt{10}}{2^7}$	·8241538	·6670429	♭ 2451	$\frac{1}{22}$ c nearly
4	*Equal temperament* V, p. 299	$\frac{7\,VIII}{12}$ - - -	$\left(\frac{1}{2}\right)^{\frac{7}{12}}$	·8243992	·6674200	♭ 4905	$\frac{1}{11}$ c nearly
5	*Tri-equal quint*, p. 302 and 311	$\frac{VIII + VI}{3}$, $\frac{V + 2\,4ths + III}{3}$, $\frac{6 + 4 + 2III}{3}$	$\sqrt[3]{\frac{5}{10}}$	·8257071	·6694329	♭ 17984	$\frac{1}{3}$ c
6	*Bi-equal third*, p. 301 and 311	$\frac{VIII - III}{2}$, $\frac{4th + 3d}{2}$, $\frac{6th}{2}$	$\frac{\sqrt{10}}{4}$	·8979400	·7905694	✻ 51500	$\frac{20}{21}$ c nearly
7	Stanhope III, ♭B D, p. 311	$\frac{8V + III - 4\,VIII}{3}$ - -	$\frac{32}{27}\sqrt[3]{\frac{5}{10}}$	·8994933	·7934020	✻ 35967	$\frac{2}{3}$ c
8	*Equal temperament* III, p. 305	$\frac{VIII}{3}$ - - - -	$\sqrt[3]{\frac{1}{2}}$	·8996567	·7937005	✻ 34333	$\frac{11}{18}$ c nearly
9	Stanhope III, A♭D, p. 311	$\frac{7\,VIII - 8V - III}{6}$ - -	$\frac{3\sqrt[3]{3^2\,10}}{8}$	·8997384	·7938500	✻ 33516	$\frac{11}{18}$ c nearly
No.	Names of Intervals, References, &c.	Tuneable Intervals.	Ratios.	Logarithms.	Lengths of strings	Differences of 7 place logarithms.	Parts of a comma.
		Stanhope Intervals, &c. expressed in				Differences from Diatonic, in	

(Table

(Table II. *continued.*)

No.	2.	3.	4.	5.	6.	7.	8.
10	Stanhope III, FA, p. 311	$\frac{2V - {}_{2}4ths + 2III}{3}$ - - - -	$\frac{8}{15}\sqrt[3]{\frac{10}{3}}$	·9012916	·7966940	* 17984	$\frac{1}{3}$ c
11	Stanhope III, D♭G, p. 311	$\frac{VI - 5V + {}_{10}4ths}{6}$ - - - -	$\frac{9}{10}\sqrt[6]{\frac{3^4}{10}}$	·9015367	·7971437	* 15533	$\frac{5}{18}$ c nearly
12	*True minor Third*, 3d -	3d, VIII – VI, V – III, 6th – 4th	$\frac{5}{6}$	·9208187	·8333333	0	
13	*Sixiéme Wolf* - -	3 VIII – 4 VI, VIII – ${}_{4}$3ds, VI – ${}_{3}$3ds	$\frac{5^4}{2^3\,3^4}$	·9843050	·9645062	156950	$\frac{52}{18}$ c nearly
14	*Tierce Wolf*, p. 296 and 304; *first* - -	VIII – 3 III, 2 VIII – ${}_{3}$6ths, 2 III – 6th	$\frac{5^3}{2^7}$	·9897000	·9765624	103000	$\frac{21}{11}$ c nearly
15	*Quint Wolf*, p. 293, 294	12 V – 7 VIII, ${}_{12}$4ths – 5 VIII, ${}_{7}$4ths – 5 V	$\frac{2^{19}}{3^{12}}$	·9941149	·9865405	58851	$\frac{12}{11}$ c nearly
16	*Comma*, c, T – t -	2 V – VI – 4th, 2 VI – 2 V – III	$\frac{80}{81}$	·9946050	·9876542	* 53950	1 c
17	*Key note*, C - -	Unison - - - - -	$\frac{1}{1}$	·0000000	1·0000000	0	
No.	Names of Intervals, References, &c.	Tuneable Intervals.	Ratios.	Logarithms.	Lengths of strings	Differences of 7 place logarithms	Parts of a comma.
		Stanhope Intervals, &c. expressed in				Differences from Diatonic, in	

When

When I have spoken above, of adding *tuneable intervals* to each other, of subtracting them from others and dividing them into aliquot parts, I did not, as in the case of strings, consider them as lineally or numerically added, &c., but that the *ratios*, of which mathematicians have demonstrated musical intervals to consist, are to be added, subtracted, or divided. In managing numerical ratios, multiplication of the terms answers to addition, division to subtraction, and extracting of roots, or raising of powers of the terms, to division or multiplication of the ratios. Thus in the 6th column of Table I, line 1, when a V, whose ratio is $\frac{2}{3}$, is to be added to a 4th or $\frac{3}{4}$, in order to obtain an VIII or $\frac{1}{2}$: if the two fractions were to be reduced to a common denominator and *added*, we should have $\frac{8}{12} + \frac{9}{12}$, or $\frac{17}{12}$ instead of $\frac{6}{12}$; but by considering these fractions *as measures of ratios*, and of course multiplying them together, we have $\frac{2}{3} \times \frac{3}{4}$ equal $\frac{6}{12} = \frac{1}{2}$, or the true octave. Again, if the V or $\frac{2}{3}$ were required to be deducted from the VIII or $\frac{1}{2}$ (line 8), we should, proceeding arithmetically, have $\frac{3}{6} - \frac{4}{6}$, equal to $0 - \frac{1}{6}$, instead of the geometrical subtraction of ratios, which gives $\frac{1}{2} \times \frac{3}{2}$ (for *division* of fractions is performed by reversing the divisor and then multiplying), equal to $\frac{3}{4}$, which is the true 4th.

Logarithms have the peculiar and inestimable property of *numerically* or lineally measuring or representing *ratios*; and when we read in a table of logarithms that 0·3010300 is the logarithm of 2, we are to understand that 0·3010300 is the numerical measure in this table of the ratio $\frac{2}{1}$, 0·4771213 the measure of $\frac{3}{1}$, &c. And $\frac{2}{1}$, divided by $\frac{3}{1}$, or $\frac{2}{1} \times \frac{1}{3}$, being equal to $\frac{2}{3}$, the ratio answering to a V will be, 0·3010300−0·4771213 =9·8239087; observing, that 10 may generally be borrowed or cast away in the index, or whole number of a logarithm; and even the index sometimes omitted altogether, as is done in these tables. In this manner the numbers called logarithms, in columns 7 and 5, in the Tables I and II respectively, have been deduced from, or measure the ratios (to $\frac{1}{1}$ or C) expressed by the numerical fractions in the preceding columns; and are also the measures of the decimal ratios in their succeeding columns to the common denominator 1, as before observed; the ratios in the 6 and 8, and in the 4 and 6 columns,

lumns, being respectively equal, only the former are *vulgar fractions* (composed of the musical primes 1, 2, 3, and 5, or their multiples) expressed in their lowest terms, and the latter in *decimals*, as better adapted to the divisions of the string upon a monochord.

I beg now to return to the *bi-equal third*, No. 6, in Table II, or $\frac{\text{VIII} - \text{III}}{2}$, as an example for explaining the numbers in the columns of the tables; and first, in order to express the same in vulgar fractions, we have VIII—III$=\frac{1}{2} \times \frac{5}{4} = \frac{5}{8}$, (or 6th) of which the square root is to be extracted, answering to bisecting or equally dividing the interval; but as neither the numerator or denominator are square numbers, multiply them both by 2 or by $\frac{2}{2}$ (which does not alter the value of the fraction), and we get $\frac{10}{16}$, of which the square root is $\frac{\sqrt{10}}{4}$, as in the table. If now we take the logarithm of 10, or 1·0000000, and halve it (answering to extracting the square root), we have ·5000000 for the logarithm of the numerator, from which deduct the logarithm of 4, equal 0·6020600, and we have ·8979400 for the logarithm of the ratio $\frac{\sqrt{10}}{4}$, as in the table; while in column 6, ·7905694 is the number answering to the last logarithm, as it is also the decimal value of the fraction $\frac{\sqrt{10}}{4}$ in column 4.

Let us now consider that the logarithm of the true major *third*, or $\frac{4}{5}$, is ·9030900; from which deducting ·8979400, the logarithm found above, we have ·0051500 or 51500 for the difference in column 7, and which is marked as a *sharp* temperament, or relating to an interval greater than perfect; because the logarithm of the *bi-equal third* in question is less than the logarithm of the III, and the logarithms of intervals (see column 7 or 5) *decrease* as the intervals themselves *increase*.

The smallest musical interval which the antients considered, was the difference between the *tone major* (T) or $\frac{8}{9}$, and the *tone minor* (*t*) or $\frac{9}{10}$, that is, $\frac{9}{10} \times \frac{9}{8}$, equal to $\frac{81}{80}$, which

which they denominated a *comma* (No. 16 in Table II), whose logarithm is ·0053950 or 53950; and it has been usual with modern authors, in considering the temperaments of the musical scale, to express the deviations from the true chords, or temperaments, in parts of a *comma*; accordingly we have $\frac{51502}{53950}$ for this fraction, which is equivalent in small numbers to $\frac{20}{21}$c nearly, or about one part in 21 less than a comma: it remains to explain, that column 3, Table I, contains the true or diatonic ratios of the conchords mentioned in the 4th column.

I proceed now to make a few remarks, which occur in turning over the pages of his lordship's essay in your Magazine (which I request the reader to page with his pen from 291 to 312). The true value of the small interval called the *quint wolf*, deduced from experiment in page 293, and calculated at the bottom of page 294, will be found in No. 15 of my Table II, where the result agrees with his lordship's; but the *difference* of the terms of his *ratio*, in the last line, should be expunged, as useless and calculated to mislead, as before observed.

In pages 295 and 296 his lordship speaks of *four* wolves in the *major thirds*, whereas there is but *one* such interval, which for distinction I have called the *tierce wolf*, and shown its value in No. 14 of Table II; where it must be evident that this interval, VIII — 3 III, owing to the *equality* of all the octaves, whether taken above C, G, D, A, E, or any other of the 12 notes, is always of *the same value*, and is no more the C wolf than that of any other letter in the gamut: what could have induced his lordship to limit his inquiries respecting the *major thirds* in his essay, to the five columns in pages 295 and 310, is to me a mystery.

What is said in the two last paragraphs of page 297, and continued in the next page, also at the bottom of page 299, respecting *the proper object of temperament*, on account of *five* wolves being assumed in the quints and tierces, without noticing those in the sixiémes, appears to me unsatisfactory.

The remarks at the top of page 299 apply equally against tempered consonances in any system whatever, as they do against the *isotonic* or equal temperament. The exact value of the *bi-equal third,* deduced from experiment in page 301, and calculated in page 311, will be found in my Table II, No. 6.

A very radical defect in the application of the *Stanhope temperament* to practice, as directed by his lordship, now presents itself in the mistake made in the third paragraph of page 301, and the third paragraph in page 302, in supposing that *equal temperaments* of two successive *thirds,* or of three successive *fifths,* effected by means of *geometric mean proportionals* interposed between the extremes in each case (as mentioned at the top of page 301, and third paragraph in page 302), and on which all his lordship's calculations are found to be grounded (and to agree very exactly with my calculations upon the same principles), produce "*equality of the beatings,*" by which, says his lordship, "*equal deviations from perfection* may be correctly ascertained."

For the purpose of showing the inconsistency of the two methods here proposed, for obtaining *equal temperaments* to a succession of *the same* conchords, I shall refer to the beautiful theory of imperfect consonances laid down by the late Dr. Robert Smith in his *Harmonics,* or rather to the late professor Robison's popular explication of the same, in his article *Temperament,* in the *Supplement to the Encyclopædia Britannica,* 3d edit. vol. ii. p. 656 and 657.

Referring to his lordship's table at page 303, vol. xxv. of your Magazine, I take the last step or process of the tuning, and consider, that the note C in the middle septave, according to the present concert-pitch, occasions about 240 complete vibrations in the air in one second of time, (see *Sup. Ency. Brit.* ii. 649 and 651,) and, the vibrations of chords being inversely as their lengths, we have $240 \times \frac{1}{2} = 120$ for the vibrations of the C next below; and $120 \times \frac{3}{2} = 180$, the vibrations of G, at bottom of the table; also $180 \times \sqrt[3]{\frac{10}{3}}$ (the tri-equal quint reversed) $= 268{\cdot}9$, the vibrations of d; also, $268{\cdot}9 \times \sqrt[3]{\frac{10}{3}} = 401{\cdot}7$, the vibrations of a; and $401{\cdot}7 \times \sqrt[3]{\frac{10}{3}} = 600$, the vibrations of E or *ĉ* in one second of time: and for proof, if we compare the vibrations of *ĉ* by considering it it as 2 VIII + III above C, we shall have $120 \times \frac{4}{1} \times \frac{5}{4} = 600$, as before.

I have now to calculate* (by means of the last theorem but one, No. 65, in the *Sup. Ency. Brit.* before quoted,) what are *the number of beats per second* made by the *tri-equal quint* G d; and, seeing that the same is tempered *flat* $\frac{1}{3}$ of a comma (No. 5 in my Table II), we have $q = 1$, $m = 3$, $N = 180$, and $p = 3$; and per theorem, $\frac{2 \times 3 \times 180}{161 \times 3 + 1} = \frac{1080}{484} = 2{\cdot}23$, *the beats per second.* Also in the *tri-equal quint* d a we have $N = 268{\cdot}9$ (q, m, and p, remaining the same as before), and $\frac{2 \times 3 \times 268{\cdot}9}{161 \times 3 + 1} = 3{\cdot}33$, *the beats per second.* And in the *tri-equal quint* a é, we have $N = 401{\cdot}7$, and $\frac{2 \times 3 \times 401{\cdot}7}{161 \times 3 + 1} = 4{\cdot}98$, *beats per second.* Now these *three rates of beating*, viz. 2·23, 3·33, and 4·98, per second, must, to support the position of our noble author, be equal!! Are we to suppose that *the monochord* used, failed in determining these sounds (calculated by geometric mean proportionals) within these limits; or, that the *beats* were no better attended to than to conclude, that vibrations of more than twice the length of each other were equal? For the *theory of beats* is too well established to be questioned; and the same is, I believe, correctly applied in the above calculations: indeed, No. 68, of the article *Temperament*, above quoted

* Let the conchord whose perfect ratio is expressed by $\frac{n}{m}$ (n being the *least* term of the ratio in its *lowest terms*) be tempered by the fraction $\frac{q}{p}$ of a *comma* (q being the *least* term of this fraction); also, let M and N be the number of vibrations in one second of time, made or excited by the *acute* and *grave* notes of the above conchord respectively; and let b be the number of *beats* occasioned by this temperament in one second. Then, if the temperament be *sharp*, or the chord greater than perfect, $b = \frac{2\,qm\,N}{161p - q}$ or $\frac{2\,qn\,M}{161\,p + q}$: but if the temperament be *flat*, or the chord less than perfect, $b = \frac{2\,qm\,N}{161\,p + q}$ or $\frac{2\,qn\,M}{161\,p - q}$.

quoted (published in 1801), contains a calculation and experiment on the *beats* made by a succession of *equally tempered fifths*, and mentions, that each fifth in ascending *beats half as fast again* as the preceding one; which is also the result of my calculations above: and the same follows immediately from Dr. Smith's original theorem.

Instead of the three *fifths*, G*d*, *da*, and *aē*, *each flattened by* $\frac{1}{3}$ *of a comma* (as is done by his lordship in his calculations and table, p. 309), producing *equality of the beatings*, I find by a calculation (not direct, but approximating) that the *fifth* G*d* must be flattened about $\frac{47}{100}$ of a comma; the *fifth da*, about $\frac{32}{100}$ of a comma; and the *fifth aē*, about $\frac{21}{100}$ of a comma, in order to make these successive fifths *beat equally quick*, the rate of which will be found about 3·16 times per second in each case; the note *d* making about 268·4, and the note *a* about 401·0 vibrations per second, when thus tempered.

The value of the *tri-equal quint*, deduced by experiment in page 302 of his lordship's treatise, and calculated at page 311, is shown in No. 5 of my Table II.

In pages 304, 305, &c., where *perfect thirds* or *thirds* are mentioned by his lordship, the *major*, or III, is to be understood.

From the *first* experiment, in page 304, the *tierce wolf* results: see No. 14 in Table II.

The value of a major *third* in the scale of *equal temperament*, third experiment, page 304, is shown No. 8 in the same table; and where No. 4 exhibits the *fifth* of that scale, having a temperament only $\frac{3}{11}$ths of that of a *tri-equal quint!*

The *minor thirds* (3d), and resulting *major sixths* (VI), appear to me to have been too slightly passed over by his lordship in the note at page 305, and not to have had their temperaments in the *Stanhope scale* sufficiently examined and considered; especially as the VI must, in full harmony, continually be used with the III, on which so much stress has been laid. The values of the 3d, 6th, and VI, with their principal relations to other conchords, will be found Nos. 12, 2, and 1, in my Table II.

The

The values of all the intervals in his lordship's table, page 311, some of which have been already mentioned, will be found in my Table II.

Twelve successions of four *major sixths* each, may (as in the case of the III, before mentioned) be carried on upwards in tuning, and compared with the third octave; *another wolf* is thus produced, which we call the *sixiéme wolf*, No. 13 in Table II, and is so considerable an interval as nearly to equal three commas!

I beg here to remark, that Nos. 13, 14, and 15, besides representing, in the two last columns, the differences between the *sixiéme*, *tierce*, and *quint* wolfs, and the key-note respectively; represent also, No. 13, the *minor third wolf*, or VIII — $_4$3ds, and likewise the VI *and 3d wolf*, or VI — $_3$3ds: No. 14 represents the *minor sixth wolf*, or 2 VIII — $_3$6ths; and likewise the *6th and* III *wolf*, or 2 III — 6th: and No. 15 represents the *minor fourth wolf*, or $_{12}$4ths — 5VIII, and likewise the V *and 4th* wolf, or $_7$4ths — 5V.

Thus nine out of the *twenty-one wolves* which may arise, by comparing together *every two* of the seven conchords, viz. 3d, III, 4th, V, 6th, VI, and VIII, (including all of those with VIII), have been examined, and produce only *three* different intervals: the remaining twelve wolves I have not leisure at present to examine, but the mode of doing so is sufficiently evident from these tables, and also of comparing all the other combinations of the seven conchords; from a complete table of which, a clearer insight into the *natural scale* of music would be obtained than has, perhaps, yet been had.

I recommend to the reader of lord Stanhope's mode of tuning, pages 300 to 302, to lay my Table I. before him, and to compare the *tuneable intervals* in column 5 with each step of his lordship's process, as he goes along, by which the reason for each step will the better appear.

On the whole, I would not be considered as now giving an opinion on the merits of the *Stanhope temperament*, compared with those of M. Kirnberger (p. 302), Dr. Young, Mr. Hawkes (xxvi. 171), &c. &c., but rather as anxious to assist

assist the inquiries of those who, possessing more leisure than my professional duties at present leave me, may be disposed to examine it thoroughly in *all* its bearings.

Conceiving that the notation by *tuneable intervals*, rather than by T, *t*, and H, or *tone major*, *tone minor*, and *hemitone*, which Sauveur, Dr. Smith, Maxwell, Hawkes, and other writers on the scale of music have used, will greatly facilitate the study of this curious and useful subject, I have composed a table of all the combinations of the *musical primes* 1, 2, 3, and 5, which when multiplied do not in any case exceed 10,000; and another table of these composite or *musical numbers* (174 in number), arranged numerically, with their factors and logarithms annexed; by which, in every possible case, any fraction or ratio, neither of whose terms exceed four places of figures, can be resolved into *tuneable intervals*; and, on the contrary, any combination of *tuneable intervals* in whole numbers can be resolved into a vulgar fraction or ratio, and its logarithm obtained, without reference to any other tables: these tables, with examples of their uses, I intended to have sent herewith; but fearing that I have already exceeded the limits of articles in your Magazine, I shall defer them to another opportunity.

I have too high an opinion of earl Stanhope's liberality of mind, and zeal for the discovery of scientific *truth*, to offer any apology for the freedom with which I have examined and commented on his treatise; and should the pending investigations of Dr. Callcott and others, comparing the *beats* made *by every concord* among themselves, as well as with the key note, ultimately pronounce in favour of the *Stanhope temperament*, the actual number of *beats* of the *tri-equal quints* and *bi-equal thirds* can be readily calculated, and, when arranged in tables, can be as easily applied in tuning without a monochord or glasses, as if the numbers *had been equal*; for they must have been *counted* during a given space of time, in order to ascertain that equality with the necessary precision.

I profess to be influenced but little by the arguments respecting *character* in the different keys; it has never appeared

peared to me, nor have I heard it objected by others, to the rapturous effects produced by the *various and occasional temperaments in the melody*, or leaps from note to note, of their respective parts, which accomplished singers and violin &c. performers of slow music in concert * introduce, for the purpose of producing *all their chords perfect*, that *character is wanting* in these performances, so refined and superior to any wherein common keyed instruments or those with fixed tones are used.

Mr. Maxwell has shown the principles, on which to construct an organ capable of imitating or assisting these perfect performances, by avoiding all temperaments *in the harmony*; for temperaments, and those of a very varied kind, there must be *in the melody*, to obtain *perfect chords* in concert, or the performance of music in parts. I heartily wish that earl Stanhope could be induced, to lend his talents and powerful means to the perfecting of an instrument capable of performing in *Maxwell's complete diatonic scale*, not doubting but the greatest astonishment and delight would be felt, from hearing performances upon such an instrument.

In my letter vol. xxvi. p. 172, last line but four, I beg to correct the error of "October" instead of *September*; and in p. 175, line ten from the bottom, of "four" instead of *five*.

I am, sir,

Your obedient servant,

John Farey.

12, Upper Crown-street, Westminster,
March 28, 1807.

* As in the Glees occasionally to be heard at the King's concert, or at Harrison's concerts, &c.; the sublime *sinfonia* of the heavenly host in the Messiah, &c.

XXXIII. *De-*

XXXIII. *Description of an Apparatus for Curvilinear Sawing.* By John Trotter, Esq.*

Gentlemen,

With the view of obviating many difficulties and expenses, which have long attended the operations of those requiring curvilinear sawing in their trade, and of public bodies connected with those trades, through the licentious and refractory conduct of sawyers, it has been represented to me as a measure extremely desirable, to adopt more generally mechanical powers, could such be discovered as would preclude much mystery and manual labour.

Considering the subject in a national point of view, as connected with our naval yards in the formation of timber; with our military departments, in respect to wheels of every description; with our whale and herring fisheries; our public and private breweries and distilleries; our East and West India companies, and other bodies depending on cooperages, as well as other minor trades peculiarly liable to the evils complained of, I invented a curvilinear saw, which, with little aid of the most ignorant labourer, answers every purpose.

Having effected these ends, suffer me to solicit the honour of your acceptance of a model, together with a drawing of my saw, sufficiently accurate for the use of those in remote situations to work by, who may wish to use or make them.

I have the honour to be, gentlemen,

Your most obedient humble servant,

John Trotter.

Soho Square, Sept. 12, 1805.

To the Society for the Encouragement of Arts, &c.

Fig. 1. (Plate V.) represents a bird's-eye view of the saw and machinery. The dotted lines show the spindle *a*, moving on two centres *b*, *b*, having at one end a pulley *c*,

* From *Transactions of the Society for the Encouragement of Arts,* &c. vol. xxiv. —The Society's gold medal was voted to Mr. Trotter for this communication, and a model of the saw is preserved in their repository.

 and

and at the other a concave saw *d* (with a corresponding convexity to the curve required to be sawed,) secured on the convex side by a collar, and on the concave side by a loose collar, and screw nut.

e, e, Two grooved plates, admitting through the top of the bench and fence *f*, screw bolts fastened by thumb nuts, by means of which, and a parallel motion *g*, the fence *f* is regulated, and consequently the conductor *h* of the wood *i*, admits it to be sawed through, as represented in the dotted line, at any part required.

The fence, conductor, and saw, must all be curved alike; but to saw in smaller circles, with the same saw and at the same time square with the face of the bench, a steel slider *k*, regulated by two screws, is made to press, as occasion may require, on the convex side of the saw, and raise the vertical line of it to a right angle with the bench; otherwise the top of the bench itself must receive the same inclination to the vertical line of the fixed saw.

Fig. 2. Is a front view of the saw and bench, in which the teeth of the saw are more clearly shown.

Fig. 3. An end view of the same machinery.

Fig. 4. Shows the saw, axle, and pulley, all made of iron or steel, and separated from the frame.

XXXIV. *Description of* Mr. James Hardie's *Improved Bookbinder's Cutting Press*.*

SIR,

I have herewith sent a model of an improved press for bookbinders, the invention of Mr. James Hardie, bookbinder, Glasgow. The inventor claims no other merit than that of having simplified the common press, rendered it more powerful, and adapted it to work more œconomically; or, in other words, to save time to the workman. It has been found so superior to the press in common use, that all the

* From *Transactions of the Society for the Encouragement of Arts*, &c.—Fifteen guineas were voted to Mr. Hardie for his improvement, and a model is preserved in the Society's repository.

bookbinders

bookbinders in Glasgow and Edinburgh are adopting it. This is perhaps the best proof that can be given of its utility. The inventor has received certificates from the bookbinders alluded to, which will be sent to the Society, if they think the press worthy of their notice. Mr. Hardie, in desiring me to submit the model to the inspection of the Society, has in view chiefly to benefit the bookbinders in places remote from his residence; an object which he thinks cannot be so well attained in any other way, as by the publicity which the Society is able to give to improvements deserving of its notice.

The improvement of this simple instrument has cost Mr. Hardie much time, and even expense; and he will be glad to receive any remuneration from the Society which they may think his invention deserves.

I am, sir,
Your most humble servant,
A. Tilloch.

Carey-street, Feb. 21, 1806.
To C. Taylor, M. D.

The principal difference between this and the press which has been for time immemorial employed by the bookinders, consists in effecting the business by one iron screw instead of two wooden ones formerly used. This screw works in a nut let into and fastened to the top piece A, (Fig. 5. Plate V.) its lower end working in a collar, fastened to the moving piece B, sliding in grooves within the two sides of the frame. CC are the guides for the plough, as in the common press.

XXXV. *Account of the Fall of Part of the Rosenberg Mountain, in September* 1806. *By the Rev. Mr.* Buckminster, *of Boston, North America, but then residing in Switzerland.*

If you have a large map of Switzerland, I beg you to look for a spot in the canton of Schweitz, situated between the

 lakes

lakes of Zug and Lowertz on two sides, and the mountains of Rosenberg and Rosi on the others. Here, but three weeks ago, was one of the most delightfully fertile valleys of all Switzerland; green and luxuriant, adorned with several little villages full of secure and happy farmers. Now, three of these villages are for ever effaced from the earth, and a broad waste of ruins, burying alive 1400 peasants, overspreads the valley of Lowertz.

About five o'clock in the evening of the 3d of September, a large projection of the mountain of Rosenberg on the north-east gave way, and precipitated itself into this valley: in less than four minutes it completely overwhelmed the three villages of Goldau, Busingen, and Rathlen, with a part of Lowertz and Oberart. The torrent of earth and stones was far more rapid than that of lava, and its effects as irresistible and as terrible. The mountain in its descent carried trees, rocks, houses, every thing before it. The mass spread in every direction, so as to bury completely a space of charming country more than three miles square! The force of the earth must have been prodigious, since it not only spread over the hollow of the valley, but even ascended far up the opposite side of the Rigi. The quantity of earth, too, is enormous, since it has left a considerable hill in what was before the centre of the vale. A portion of the falling mass rolled into the lake of Lowertz, and it is calculated that a fifth part is filled up. On a minute map you will see two little islands marked in this lake, which have been admired for their picturesqueness. One of them is famous for the residence of two hermits, and the other for the remains of an antient chateau, once belonging to the house of Hapsberg. So large a body of water was raised and pushed forward by the falling of such a mass into the lake, that the two islands, and the whole village of Seven, at the northern extremity, were for a time completely submerged by the passing of the swell. A large house in this village was lifted off its foundations, and carried half a mile beyond its place. The hermits were absent on a visit to the abbey of Einsidein.

The disastrous consequences of this event extend further than the loss of such a number of inhabitants in a canton of little

little population:—a fertile plain is at once converted into a barren tract of rocks and calcareous earth, and the former marks and boundaries of property are obliterated. The main road from Art to Schweitz is completely filled up, so that another must be opened, with great labour, over the Rigi. The former channel of a large stream is choked up, and its course altered; and as the outlets and passage of large bodies of water must be affected by the filling up of such a portion of the lake, the neighbouring villages are still trembling with apprehension of some remote consequences, against which they know not how to provide. Several hundred men have been employed in opening passages for the stagnant waters, in forming a new road for foot passengers along the Rigi, and in exploring the ruins. The different cantons have contributed to the relief of the suffering canton of Schweitz, and every head is at work to contrive means to prevent further disasters.

The number of inhabitants buried alive under the ruin of this mountain is scarcely less than 1500. Some even estimate it as high as 2000. Of these, a woman and two children have been found alive, after having been several days under ground. They affirm, that while they were thus entombed they heard the cries of poor creatures who were perishing around them for want of that succour which they were so fortunate as to receive. Indeed, it is the opinion of many well-informed people that a large number might still be recovered; and a writer in the *Publiciste* of Paris goes so far as to blame the inactivity of the neighbouring inhabitants, and quotes many well-attested facts to prove that persons have lived a long time buried under snow and earth. This at least is probable in the present case, that many houses, exposed to lighter weight than others, may have been merely a little crushed; while the lower story, which in this part of Switzerland is frequently of stone, may have remained firm, and thus not a few of the inhabitants escaped unhurt. The consternation into which the neighbouring towns of Art and Schweitz were thrown, appears, indeed, to have left them incapable of contriving and exe-

 cuting

cuting those labours which an enlightened compassion would dictate.

The mountain of Rosenberg, as well as the Rigi and other mountains in its vicinity, are composed of a kind of brittle calcareous earth and pudding-stone or aggregated rocks. Such a prodigious mass as that which fell, would easily crumble by its own weight, and spread over a wide surface. The bed of the mountain from which the desolation came, is a plane inclined from north to south. Its appearance as it is now laid bare would lead one to suppose that the mass, when first moved from its base, slid for some distance before it precipitated itself into the valley. The height of the Spitsberg (the name of the projection which fell) above the lake and valley of Lowertz was little less than 2000 feet. The composition of the chain of the Rigi, of which the Rosenberg makes a part, has always been an obstacle in the way of those system-makers who have built their hypotheses upon the structure of the Alps. It has nothing of granite in its whole mass; and, though nearly 6000 feet above the sea, is green, and even fertile, to its summit. It is composed of nothing but earth and stone, combined in rude masses. It is also remarkable that the strata of which it is composed are distinctly inclined from the north to the south; a character which is common to all rocks of this kind through the whole range of Alps, as well as to the greater part of calcareous, schistous, and pyritous rocks, and also to the whole chain of the Jura.

It was about a week after the fall of the mountain that our route through Switzerland led us to visit this scene of desolation; and never can I forget the succession of melancholy views which presented themselves to our curiosity. In our way to it we landed at Art, a town situated at the southern extremity of the lake of Zug; and we skirted along the eastern boundary of the ruins, by the side of Mount Rigi, towards the lake of Lowertz. From various points on our passage we had complete views of such a scene of destruction as no words can adequately describe.

Picture to yourself a rude and mingled mass of earth and

stones,

stones, bristled with the shattered part of wooden cottages, and with thousands of heavy trees torn up by the roots, and projecting in every direction. In one part you might see a range of peasants' huts which the torrent of earth had reached with just force enough to overthrow and tear in pieces, but without bringing soil enough to cover them. In another were mills broken in pieces by huge rocks separated from the top of the mountain, which were even carried high up the opposite side of the Rigi. Large pools of water were formed in different parts of the ruins, and many little streams, whose usual channels had been filled up, were bursting out in various places. Birds of prey, attracted by the smell of dead bodies, were hovering all over the valley. But the general impression made upon us by the sight of such an extent of desolation, connected too with the idea that hundreds of wretched creatures were at that moment alive buried under a mass of earth, and inaccessible to the cries and labours of their friends, was too horrible to be described or understood. As we travelled along the borders of this chaos of ruined buildings, a poor peasant, bearing a countenance ghastly with woe, came up to us to beg a piece of money. He had three children buried under the ruins of a cottage, which he was endeavouring to clear away. A little further on we came to an elevated spot which overlooked the whole scene. Here we found a painter seated on a rock, and busy in sketching its horrors. He had chosen a most favourable point. Before him, at the distance of more than a league, rose the Rosenberg, from whose bare side had rushed the destroyer of all this life and beauty. On his right was the lake of Lowertz, partly filled with the earth of the mountain. On the banks of this lake was all that remained of the town of Lowertz. Its church was demolished, but the tower yet stood and the ruins, shattered but not thrown down. The figures which animated this part of the drawing were a few miserable peasants, left to grope among the wrecks of their village. The fore ground of the picture was a wide desolate sweep of earth and stones, relieved by the shattered roof of a neighbouring cot-

 tage.

tage. On the left hand spread the blue and tranquil surface of the lake of Zug, on the margin of which yet stands the pleasant village of Art, almost in contact with the ruins, and trembling even in its preservation.

We proceeded, in our descent, along the side of the Rigi, toward the half buried village of Lowertz. Here we saw the poor curate, who is said to have been a spectator of the fall of the mountain. He saw the torrent of earth rushing toward his village, overwhelming half his people, and stopping just before his door. What a situation! He appeared, as we passed, to be superintending the labours of some of the survivors who were exploring the ruins of the place. A number of new-made graves, marked with a plain pine cross, showed where a few of the wretched victims of this catastrophe had just been interred.

Our course lay along the borders of the enchanting lake of Lowertz. The appearance of the slopes on the eastern and southern sides told us what the valley of Goldau was a few days since; smiling with varied vegetation, gay with villages and cottages, and bright with promises of autumnal plenty. The shores of this lake were covered with ruins of huts, with furniture and clothes, which the vast swell of its waters had lodged on the banks. As we were walking mournfully along toward Schweitz, we met with the dead body of a woman which had been just found. It was stretched out on a board, and barely covered with a white cloth. Two men, preceded by a priest, were carrying it to a more decent burial. We hoped that this sight would have concluded the horrors of this day's scenery, and that we should soon escape from every painful vestige of the calamity of Schweitz. But we continued to find relics of ruined buildings for a league along the whole extent of the lake; and a little beyond the two islands mentioned above, we saw lying on the shore the stiff body of a peasant which had been washed up by the waves, and which two men were examining, to ascertain the place to which he belonged. Our guide instantly knew it to be the body of one of the inhabitants of Goldau. But I will mention no more particulars.

lars. Some, perhaps, that have been related to me are not credible, and others which are credible are too painful.

The immediate cause of this calamitous event is not yet sufficiently ascertained, and probably never will be. The fall of parts of hills is not uncommon, and in Switzerland especially there are several instances recorded of the descent of large masses of earth and stone. But so sudden and extensive a ruin as this, was, perhaps, never produced by the fall of a mountain. It can be compared only to the destruction occasioned by the tremendous eruptions of Ætna and Vesuvius. Many persons suppose that the long and copious rains which they have lately had in this part of Switzerland may have swelled the fountains in the Rosenberg sufficiently to push this part of the mountain off its inclined base. But we saw no marks of streams issuing from any part of the bed which is laid bare. Perhaps the consistency of the earth in the interior of the mountain was so much altered by the moisture which penetrated into it, that the projection of the Spitsberg was no longer held by a sufficiently strong cohesion, and its own weight carried it over. Perhaps, as the earth is calcareous, a kind of fermentation took place sufficient to loosen its foundations. But there is no end to conjectures. The mountain has fallen, and the villages are no more.

If we had not been detained at Strasburg waiting for passports for ten days, we should have been in Switzerland on the 3d of September, probably in the vicinity of the lake of Lowertz; perhaps under the ruins of Goldau. Several travellers, or rather strangers, have been destroyed; but whether they were there on business or for pleasure, I know not. Among them are several respectable inhabitants of Berne; and a young lady of fine accomplishments and amiable character, whose loss is much lamented.

XXXVI. *Description of an Improved Stove for Heating Rooms, or Drying different Articles. By Mr.* GEORGE FIELD *.

SIR,

I HAVE the honour of enclosing a plan and account of a stove, which unites the various advantages of heating, boiling, steaming, evaporating, drying, ventilating, &c. These, together with a certificate and model of the stove, I beg the favour of you to lay before the Society.

I have the honour to be
Your most obedient servant,
GEO. FIELD.

No. 87, Newman-street, March 11, 1806.
To Dr. C. Taylor,
Secretary, &c.

Fig. 1. (Plate VI.) represents a longitudinal section of the stove, showing the course of the air from its entrance into the flues of the stove at A, to its entrance into the upper chamber of the stove at B: and also the course of the smoke from the fire-place at C, till it escapes from the stove at D. E, E, are the doors or openings of the fire-place and ash-hole.

Fig. 2. is a similar section at right angles with the above, exhibiting the course of the air through the chambers of the stove, from its entrance into the chamber No. 1. at B to its entrance beneath the fire-place at F. This figure also shows sections of the flues, with the divisions through which the air and smoke pass separately, the smoke-flue in the centre, and the air-flues on each side. G, G, are doors and openings through which the articles to be dried are introduced into the chambers.

When the fire is lighted, and the doors of the chambers, ash-hole, and fire-place, closed, the air by which the fire is supplied enters at A, fig. 1, passes through the air-flues *a, a, a, a,* enters the upper chamber at B, traverses and descends through the chambers No. 1, 2, 3, and arrives beneath

* From *Transactions of the Society of Arts,* &c.—The silver medal was voted to Mr. Field for this improvement.

neath the fire at F, fig. 2. Having supplied the fire with oxygen, it passes through the flue with the smoke, and escapes at D, heating in its protracted course the chambers and air-flues.

As the cold air enters the stove at A, immediately above a plate forming the top of the fire-place, and pursues a similar route with the fire-flue, it enters the chambers very much heated and rarefied. Hence any moist substance placed in the chambers evaporates in consequence, not only of the heated flues circulating round them, but of a stream of warm rarefied air, which, while it continually raises evaporation, as continually bears away the exhaled moisture in its passage to the fire, thus imitating the gradual and efficacious plan of nature in drying by the sun and air. While these effects are taking place within the stove, part of the air which enters at A, fig. 1 and 2, passes through air-flues on the other side of the fire-flue, pursues a parallel course with the first, and gives out a current of warm air to the room at an aperture H. This effect may be obtained in a much higher degree, if the doors of the chambers and ash-hole are opened: should the hand or face be then brought near, they would be fanned with a stream of warm air, especially from the upper chamber.

By means of this stove I have evaporated milk to dryness, without burning or discolouring it; and have dried cherries, plums, and other fruits, so as to imitate those which are received from abroad. I have repeatedly dried colours and the most delicate substances without the slightest injury to them, even though the operation proceeded quickly.

The height of the stove is about 5½ feet; its diameter 2½ feet, and that of the flues 4 inches. The external part is constructed of brick, and the internal parts of thin Rvegate or fire-stone, except the top of the fire-place, which is a plate of cast iron. Were it to be wholly formed of iron, its effects would necessarily be more powerful.

Fig. 3. represents an extension of the plan, in which stoves of this kind may be advantageously connected with one or more furnaces for chemical or other uses. The fire-place, brought out, either in front or on one side, by the

present

present position of its crown I, forms a reverberatory furnace, or will make a sand-bath by reversing it.

The space occupied by the fire-place in fig. 1, may in this be converted into apartments for evaporating substances, or occasionally for cooling them by an opening at K to admit cold air, while the warm air of the stove is excluded by a register or door. The dotted lines show the manner in which a second furnace may be connected by an opening into the flue at L.

In addition to the uses already pointed out, this stove would probably be found extremely serviceable in drying japanners' goods, and consuming the noxious fumes and gas which arise from the oil and varnish used in this business.

Since the stove is not limited to any certain dimensions, it might be adapted to the drying of malt and hops, perhaps of herbs, corn, and seeds generally. It might also be accommodated to the purposes of the sugar-bakers, connected with the great fires they employ for their boilers. It has been shown to be useful in the confectioner's art, and probably it may be equally so in baking biscuits for the navy; nor less so in drying linen for the laundress, dyer, calico-printer, and bleacher. I have myself found it well accommodated for a chemical elaboratory.

The efficacy of the stove in ventilating, boiling, and steaming, may easily be shown. In manufactories and rooms, generally, the heated and noxious part of the atmosphere ascends towards the ceiling: if then the air-flue M, fig. 3, is continued upward according to the height of the room in which it is placed, the air will be drawn from the top, and the room become ventilated, while from the opening at N it is supplied, if requisite, with warm air.

It is unnecessary to show the various ways in which a boiler may be connected with this plan: it is sufficient to observe, that in the space allotted for the fire-place in fig. 1, there is sufficient room within the body of the stove for this purpose; and that if the circulating air be made to pass over the boiler, evaporation may be carried on very expeditiously by the air removing the vapour as it arises. Finally, if another

other division of the flues be made in the manner shown fig. 2, it might form a steam-pipe or flue, running the course of the air and fire-flues to convey steam to one or more apartments of the stove, or extended beyond the stove for heating the room in which it stands. One of the air-flues might occasionally be adapted to this use. It is obvious that the power of steam in a heated apartment would be not only greater, but better kept up. In steaming it would be necessary to close the apartments of the stove, and to give air to the fuel by a different course.

As the stove is not confined in its dimensions, so neither is it necessarily of the form described in the drawing, nor are the apartments necessarily three: all these particulars admit of variation according to local or other circumstances. It is evident that the air-flues themselves may be converted into chambers for drying, &c.; and the fire-place of fig. 3. is well adapted to receive an apparatus for the decomposition of coal, &c.; for producing all the effects of the thermo-lamp, or illuminated smoke, &c. But it is needless to enumerate the many œconomical and philosophical uses to which the stove may be applied. It is sufficient for the present purpose if I have rendered the principle and plan intelligible, the artist and manufacturer will then be at no loss in adapting it to the particular object which he may require it to accomplish.

XXXVII. *New Observations on Volcanoes and their Lava. By* G. A. De Luc.

[Concluded from vol. xxii. p. 271.]

M. Humboldt, considering basaltes as of aqueous formation, attributes the same origin to *obsidian* and to what he calls *basaltic porphyries*. If all the volcanic products, which at the first glance do not seem to have been treated by fire, ought to be considered as natural rocks, there are very few antient lavas which could be recognised as a product of fire. It is thus that count de Borch, who had nevertheless visited Ætna, has said that its fundamental stone is a granite mixed with

with jasper; and Mr. Kirwan after him, and also father De la Torre, were persuaded that Vesuvius and Ætna are not products of fire, their bases being, as they say, marine stones.

I must further remark, that if we refuse to regard as products of the fire all the volcanic substances that our furnaces vitrify in a higher degree than the volcanoes do, there are very few which can be considered as marine, since our furnaces reduce them to a much more perfect vitrification.

The basaltic porphyries mentioned by M. Humboldt may rather be the source of all the porphyries he mentions. It is even doubtful if the Chimboraço is really a volcano. It is almost probable, he says, that it is of a volcanic nature. If it is only a probability in his idea, it is not astonishing that the substances which constitute it appeared to him to be porphyries, or any other natural rock.

I collected upon the sea shore at Portici several fragments of rolled lava, which, if we were determined to see nothing else than porphyries, might very easily be taken for as many varieties of this rock.

"The porphyries in the neighbourhood of Riobamba and Tunguragua (says M. Humboldt) are 2080 toises thick."

According to the measurements made at Peru by the French academicians (which I shall have occasion to mention again) the height of Tunguragua is 2623 toises above the level of the sea; and that of the soil of Quito, situated in the same valley with Riobamba, is 1462. There remain, therefore, 1161 toises as the elevation of the Tunguragua above the valley. Its form is a regular cone, which is the form of all volcanoes, and this cone, which is prolonged outwards far below the valley, is composed of volcanic substances only; for, as I have already remarked, every volcano, whatever be its height, is an accumulation of subtances forced out successively by one or more mouths. In this state of things we could scarcely find room at Tunguragua, and its environs, for a thickness of porphyry of 2080 toises.

Three years ago M. Hergen, professor of mineralogy in the Museum of Madrid, who is mentioned by M. Humboldt, sent me, among other things, three specimens of substances from Tunguragua, named, according to eti-

quette,

quette, *turungagua.* One of these specimens is of an almost compact lava; the other is of a spongy lava; and the third is a pumice stone. The compact lava contains several small whitish crystalline laminæ, which strongly resemble those of the lavas of Ætna, and give to this lava an appearance of porphyry, which may have induced M. Humboldt to regard it as porphyry. This volcano is towards the east, opposite to Chimboraço, and some leagues north from Riobamba.

M. Bouguer, one of the academicians sent to Peru in order to measure the degrees of the meridian, gives a more precise idea of the substances which compose the volcanoes of that country. Upon his return from this long and laborious voyage, he gave an account of it to the Academy of Sciences on the 14th of November 1744, and we find in his discourse the following observations*:

"We have an opportunity at Peru of seeing the interior of the earth to a great depth, because it is every where cut into deep ravines. Many of them have been discovered 200 toises broad, and 60 or 80 deep; some are even twice as large. It is only necessary to descend into them in order to see all the qualities of the different beds; no fossil whatever is discovered in them. We see plenty of that black kind of sand which is attracted by the magnet; and we are able to ascertain, in general, that the layers we observe there, and the shades of which are very distinct, far from being the effect of different alluvial deposits, are rather caused by the expansion of the substances vomited forth by volcanoes; almost every thing seen in these ravines being the work of fire. Some of these mountains, even to a great depth, are formed of nothing else than scoriæ, pumice-stones, and fragments of burnt stones of all sizes; and sometimes the whole is concealed under a layer of common earth, which produces herbs and even trees. I have seen beds of burnt stones reduced into very small morsels, almost as thick as the height of five or six men, chiefly at the bottom of the Cotopaxi, which has become a perfect truncated cone, and of which the summit has been carried off. The bottom of

* Memoirs of the Academy of Sciences for 1744; 4th edition, p. 270.

this

this volcano has been rounded, and has assumed a regular form, by the overflowing of all those matters which have not been pushed out with sufficient force, or which were too light to roll to a distance. If we were to count the different eruptions of the Cotopaxi by the multitude of different layers of burnt stones which are at the foot of it, without even having regard to the inferior layers which are broken and overturned, the last burning would be at least the twentieth; and it would appear that each eruption sent out substances of different colours and of various descriptions, and that they have been successively shot out accordingly as they are differently arranged in the bosom of the mountain."

With the slender knowledge of lithology and geology which the times afforded, M. Bouguer turned his attention to the substances of these mountains which attracted his notice; and according to what he has said on the subject, and from the manner in which he expresses himself, we easily perceive that every thing is of a volcanic nature, from the base to the summit of these mountains. This black sand, attracted by the magnet, resembles the ferruginous sand on the shores of Naples; and these deep ravines, the sections of which show the work of the fire, are similar to the rugged face of Mount Somma hanging over the narrow valley which separates it from the Vesuvius of the present day, where every thing also is the work of fire.

Bouguer had an opportunity of seeing closely the ravines he mentions: he traversed a great number of them in ascending from Caracol, situated at the foot of the Cordelier, to the valley of Quito. The ascents and descents were so frequent, that it occupied him seven days in travelling a distance of only eight or nine leagues in a right line. He at last arrived at the foot of that part of Chimboraço which hangs over the valley. These numerous ravines, which furrow the declivity of the Cordelier from its base, hollowed out by the torrents produced by the abundant rains which fall in this country, show that the substances of which these declivities are formed are quite distinct from each other, like all the heaps of volcanic matters.

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The academicians measured in this high region three degrees of the meridian, from Cuença on the south to the equinoctial line to the north of Quito, not far from the grand volcano of Cayambairo. This valley being bordered on both sides, through all its length, with very high volcanoes, its soil must be composed entirely of an accumulation of the substances they have vomited; they have heaped up the space which originally separated the two lines of volcanoes, and raised the valley to its present height. It is not astonishing that M. Humboldt did not find any slate, micaceous schistus, gneiss, or any vestige of granite; but what is particularly astonishing is, as he says, that granite always occupies the highest parts of the globe in the temperate zones. It is not, therefore, at all ascertained that in this part of the Cordelier, every thing being the work of subterraneous fires, there is any bed of natural rocks. This is probably the reason why he had recourse to porphyry, from the porphyroidal appearance of several lavas. Such are the errors into which we may fall, when we adopt the Neptunian system, in mistaking the productions of fire.

Beyond the two lines of volcanoes their sides are joined by the successive extension of their bases, and show a succession of heaps of the same matter: this is pointed out in a very precise manner by the observations of the academician. These exterior shelves being very old, and descending into the region of vegetation, they are covered with herbs and forests wherever the torrents have not torn up ravines. The base of Mount Ætna is also covered with forests, and that of Vesuvius with gardens and vineyards, which are often destroyed by new eruptions. Perhaps one of the layers through which the volcano of the Cordelier shows itself appears at the exterior: their numerous eruptions may have covered them. The foot of the cones which rise from the valley ought not to be considered as the base of the volcano. Their base is at the level of the sea, and the focus of the crater is considerably below it.

Bouguer, but slightly acquainted with volcanoes and volcanic matters, saw only, in the different beds of the lavas and scoriæ of Cotopaxi, stones simply burned of various co-

 lours;

lours; as the academician of Naples, and father De la Torre, only saw at Vesuvius stones in a natural state, or simply roasted, and calcined of different colours. Thus we ought to regard the work of the French academician merely as a recital, which describes tolerably well the disorder and all the appearances observed in volcanic mountains.

One incontestable proof that the fires of the volcanoes which range along the valley of Quito, Cuença, Riobamba, and Popayan, have their origin below the level of the sea, arises from the frequent and dreadful earthquakes felt on that coast; and they are owing to the same cause which has raised all these volcanoes, and which sometimes gives birth to new eruptions. Unfortunately for the country, the inflammable substances which are the sources of all these disasters, are not consumed; but when we reflect upon what has happened in former times in order to raise these enormous and numerous volcanoes, it is evident that the cause which produced them has much diminished.

I have often had a strong desire to visit that country, the most interesting, perhaps, on the surface of the globe. When it shall be explored by naturalists skilled in the knowledge of volcanoes and volcanic productions, they will, I have no doubt, ascertain that the state of things is such as I have explained. What still further explains why the French and Spanish travellers never found any marine fossil in this vast part of the Cordelier is, that, every thing there being the work of fire, there could not be any marine productions.

The height of the peaks of volcanic mountains, which often surpasses that of the most elevated of other chains of mountains, ought not to be considered as a monument of the height at which the sea has been, each of them having been elevated to this point, since its retreat, by the accumulation of the substances which had issued from the volcano. We cannot even doubt that these enormous volcanoes had been manifested under the waters of the old sea.

Ulloa, in his sixteenth discourse, which treats of the fossils and petrifactions of Peru, concludes, from the marine petrifactions of the high mountains of Guancavelica, that there ought to be the same productions in the other high mountains

tains of the country. In common with other travellers, he has remarked that, the mountains of Guancavelica being marine productions, there were sea fossils in them; but he has not remarked that, the Cordeliers of the Andes being composed of volcanoes, several of which are still burning, there could not be any marine deposit there. It would be very interesting to know the limits of these two classes of mountains, so different from each other; in what place the one finishes and the other begins, and in what manner they join. We may conjecture, with good reason, that the volcanic theory will maintain itself against the Neptunian.

An opinion which I constantly maintained with M. Dolomieu, and some other naturalists, viz. that basaltes are of volcanic production, is confirmed, in the most distinct manner, by the observations made by M. Daubuisson in Auvergne. Thus, what I said at the conclusion of my Observations upon Basaltes is completely verified: "The time will come when naturalists belonging to the Neptunian theory will no longer dispute the volcanic origin of basaltes; for, the more inquirers there are, the more observations are multiplied, and in different places, the more shall we acquire a demonstration that basaltes are a production of fire."—*Journal de Physique, cahier de Fructidor, an.* 9.

Mr. Kirwan, as a proof that basaltes are of sea origin, has instanced some basaltes which contain marine shells. I was persuaded that this was a mistake, and I said so in the observations I made on the subject: since that time my conjecture has been completely verified.

I have seen some pieces of this stone, said to be basaltes, containing shells, brought from Ireland by professor Pictet. This stone is not basaltic. It is disposed in horizontal layers on the sea coast in the county of Antrim; and the true basaltes have nothing in common with it except the colour, which is nearly similar. The shells it contains are those of *ammons*; a kind of shell unknown in animated nature, and which is found only in the argillaceous or calcareous deposits of the antient sea.

There is this important geological fact shown by volcanic mountains,—that they have been much more numerous for-

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merly than they are at present. The surface of our continent is covered with them in various places. The peninsula of Italy, and the neighbouring islands, show a very great number of them, four of which only are still burning, and they are the only volcanoes in activity in a circumference of 6 or 700 leagues, although there must have been plenty of them in the countries and seas comprised in this space. This fact is so well known at present that I shall cite only one example, taken from the Travels of M. Horneman in the North of Africa.

He remarked in his route between Audjela and Moursouk several mountains with all the characteristics of antient volcanoes. This class of mountains was little known to him, and his recital, therefore, wants precision; but his language admits of no doubt. There are, he says, many chains of black and steril mountains. He remarked one which had the form of a truncated cone. He saw basaltes, stones of a red colour like bricks, porous and spongy stones resembling the scoriæ of metals, dull and heavy stones, and others full of holes and cavities; characters which cannot be mistaken for any thing else than volcanic productions. M. Horneman also learned at Moursouk, that there were black mountains upon the route leading from this city to Bornon towards the south-east.

The Lesser Antilles, the Mariannes, the Aleoutes between Kamtschatka and America, the Fero Islands, and the numerous islands of the South Sea, are all volcanic productions, and a few among them are still burning.

This is one of the many proofs that the causes which have produced the changes upon our globe have much diminished, and that it constantly tends to a more stable and fixed state. For although the volcanic mountains of the interior of the earth have only burned under the water of the antient sea, and it may be possible that some of them would have experienced eruptions if the sea again washed them; it is without doubt, from the numerous examples afforded by the seas of the present day, that a great number burn no longer after the sea has withdrawn.

When M. Dolomieu, who has so well described several volcanic

volcanic phænomena, says, in his work on the lava of Ætna, that volcanoes have performed too important a part in the antient history of our globe not to interest every naturalist, he is perfectly right; but when he adds, *that volcanoes have also contributed much to the formation of our continents and mountains*, he attributes an effect to them with which they have had nothing to do. The beds of our continents and our mountains existed before the volcanoes, as every phænomenon shows. The volcanoes have broken out through beds already formed, and have raised up mountains very different from those which owe their origin to the deposits of the sea. The latter are primary formations, and the work of water; volcanoes are posterior formations, and the products of fire.

XXXVIII. *Some Particulars respecting the Geography, Natural Productions, and History of the Crimea* *.

M. Reuilly first describes, in a sort of introduction, the route he pursued on his way to the Crimea. He set out from Petersburgh in February 1803, and directed his course along the Odessa. In order to arrive at the Odessa he traversed what is called *Steps*, wild and uncultivated, where neither trees nor shrubs are to be seen. The small number of inhabitants which live in these *Steps* consists of exiles and deserters from different governments, but travelling is nevertheless secure. Before reaching Nicolaief he fell in with the river Bug, the environs of which, below the town, are remarkable for vestiges of Grecian antiquities. Being arrived at Cherson, he passed the Little Ingoul, then at some distance the Nieper, whence the route leads to Nogais Tartary, an immense plain, often totally obscured by whirlwinds of sand, from which it is asserted that the Nogais Tartars defend themselves by wearing goggles.

The work is divided into two parts. The first contains the physical or geological state of the Crimea, the peninsula

* Extracted from "*Voyage en Crimée, et sur les Bords de la Mer Noire, pendant l'Année* 1803; *par J. Reuilly, &c.*"

formerly

formerly known by the name of Taurica Chersonesus, and so celebrated in antiquity. Its modern name is derived from a small town called Krim. But since it has belonged to Russia it has resumed its antient name of Tauride.

M. de Reuilly, after having given the geographical situation of this country, develops its general aspect, describes its mountains, their structure, and the mines they contain. The most elevated point of ground in the whole Crimea is the mountain called by the Tartars Tchatyr-Dagh (Tent Mountain), which the author thinks was the Trapezzos of the Greeks. It is about 1000 feet above the level of the sea.

The southern part of the Crimea presents the highest mountains, which extend from Caffa to Balaclara. Following the eastern side of the mountain of Karadagh he reached the valley of Kooz, which takes its name from a populous village; the road which leads to it is strewed here and there with ores of iron. In the neighbourhood are found quarries of free-stone, with which the inhabitants build their houses and the enclosures of their vineyards. Immediately afterwards the mountain Bouiouk Sirt presents itself; from whence he proceeded to the village of Joklouk; and a little afterwards to the valley of Soudagh, renowned for its excellent wine. Soldaia was the next place he visited, where there was an antient Genoese fortress, enclosed by a thick wall furnished with towers. Within these few years several ruined buildings in the Gothic style were to be seen; but nothing now remains in the eastern part of the city, except the grand and beautiful cathedral church, and the towers and walls of the place. Near Koutlak, where he arrived by following the course of the Karagatch, there is a quarry, which lies very high, and is very difficult to be wrought. The inhabitants roll down large blocks of it shaped into mill-stones, and which are used in almost all the mills of the Crimea. The Tartars of the village of Kapsokhor, besides their gardens and vineyards, have upon the shores of the sea fine fields of cucumbers and lint, which they cultivate with very great care. From thence he proceeded to Ouskot; half way on, upon a very high promontory, is an antient Grecian tower, very well preserved, to which the

Tartars have given the name of Ichoban-Kalè (Shepherd's Fort). Ouskot, a populous village, is not very far from Touiak, situated in a warm and agreeable valley, almost entirely planted with lint. A little distance from Kourou-Ozen is the valley of *Alouchta*, which separates the eastern part of the high mountains we have just mentioned from the western part we are about to explore with our traveller. Alchouta, an episcopal see, is the first place which presents itself. This city, placed on an isolated situation, contains a considerable population. Vestiges of an old Greek fortification are seen there. The habitations of the Tartars of this region, built upon the declivities of the hills, are low, and covered with earth. "They have moreover a custom of building their houses against the rugged shelves of the mountains. The front wall is composed of rude stones, and the roof is a platform of earth which serves them to walk upon, and on which they lie in summer time. The inside has a large fire-place, with a wide chimney. Coarse carpets, of woollen cloth, and some cushions are their only moveables." The buffalo is the only domestic animal of these Tartars, who employ it in labour. In front of the village of Koutchouk-Lambat, which has a fine harbour, is seen the Ayou-dagh (or Mountain of the Bears), and near it is the village of Parthenit, almost entirely inhabited by Greeks. The valley into which it stretches is intersected by a great number of springs, and embellished by numerous gardens. Near the hamlet of Kourkoulet, at which he arrived by mounting an almost inaccessible rock with a double summit, are to be seen the remains of Genoese fortifications. Behind the promontory of Nikita are some villages, among which are Magaratch and Marsenda, formerly inhabited by emigrant Greeks from Mariopolis. Between these two last villages there is a chapel in ruins, shaded by old walnut-trees, and under which a rivulet takes its source. A wooden cup, constantly placed upon a piece of the rock, serves to allay the thirst of travellers, who respect this rude but benevolent mark of Tartar hospitality. From Derekoi, the environs of which present a copious and beautiful moss to botanists, he descended into the superb valley of Yalta.

The city of the same name, formerly occupied by Greeks, is at present inhabited by a small number of Tartars; it has a safe roadstead. Near Aoutka, inhabited by Greeks who live chiefly by the oyster fishery, the cascades of Akar-sou are seen, the fall of which is 60 toises. Soon after quitting Goshra, Charis and Mouskor, and a little before coming to Aloupka, the scene changes, and presents a very savage aspect. But the traveller is sometimes astonished by meeting with a village, gardens, and even cultivated grounds in the middle of enormous masses of rocks heaped upon each other. The winter of 1802 produced the most frightful ravages in this district; only one laurel-tree escaped. Upon this occasion, as M. Reuilly informs us, the Tartars derived from the Greeks and appropriated to their own language the word *Daphne*, in order to express the laurel. This valley, one of the warmest of all the southern part, is every where surrounded by the famous Kriou-Metopon, the Ram's Head, a mountain well known to the navigators of antient Greece.

After having passed successively Cape *Crotis Bouron*, the valley of Simcus, extremely rich in fruit-trees, and the promontory of Limanes, the village of Koutchoukoy presents itself in view, near which lies the scene of the revolution of 1784, described by M. Pallas. He afterwards traversed Pchatka and Foros, which lead to the smiling valley of Baidair, separated by a very high rock from that of Varmoutka. After some hours journey he reached Balaclava, where ends the chain of the high mountains of the Southern Crimea.

In spite of the assertion of some writers, the Crimea contains no volcanic fires; an opinion so much the more probable because earthquakes are very infrequent. There are much more frequently falling of rocks and watery eruptions between Kertch and Yenikale; but particularly in the island of Taman.

Several rivers water the Crimea; some of them flow towards the north-east into the sea of Sivach, and others run westward to the Black Sea. Among the former are the Salghir, into which the great and little Cara-sou and

Bouroultz

Bouroultz empty themselves; the Souya, the three Indals or Andales, the Soubacke and the eastern Boulgonak. Among the latter the most considerable are the Alma, the Catcha, the Belbek and the Cobarda. The waters of these different rivers are in general pure, agreeable, and contain no noxious qualities. The most salubrious are in the cantons of Koslof and Kertch.

The salt lakes form the principal riches of the Crimea; those of Perecope are regarded as the most important, particularly those known by the names of Staroè-Ozerò, (Old Lake) and Krasnoè-Ozerò (Red Lake).

There are no considerable forests. The trees and shrubs are nearly the same as in Europe.

The soil of the Crimea is rich in pot-herbs, medicinal plants, and many others proper for dyeing and tanning. Wheat is every where cultivated, as also rye, barley, oats, millet and maze, without mentioning an infinity of useful or agreeable objects appropriated to the different places, such as lint, madder, agnus castus, shumac, turpentine, &c. &c. There are only two chestnut-trees in the whole Crimea, which are to be seen near Derekoi.

The animal kingdom is not very populous in this country, and consequently presents little variety. Among the domestic animals, we distinguish a race of greyhounds, in great estimation for hunting. M. de Reuilly received one of very great beauty, as a present, which he brought to France. The birds of the Crimea present nothing remarkable or rare; the same may be said of the fish also, with which the seas abound. One fish peculiar to the Black Sea, and the sea of Azof, is a kind of turbot of a large size.

Reptiles are very rare in the Crimea, and there is not a great variety of insects; the bee itself has been only increased in consequence of unwearied exertions. One of the plagues, which this country shares in common with a part of Africa and Asia, is the locust. It is besides subjected to the ravages of a small grasshopper with red wings, which has made its appearance within these few years.

As to the temperature, it is extremely variable. Nevertheless the air is pure and healthy, but autumn brings on remittent

remittent and intermittent fevers. There is no nation whatever, which has not its method of dividing the seasons: the following is the one in use among the Tartars. The spring, *Bahaar*, commences on the 23d of February, and lasts 60 days, to the 22d of June. The summer, *Tochilla*, is 40 days, which finishes on the 1st of August. This month does not form part of any season, and is called down to the 25th *Agostos*. The 26th of August begins their autumn, *Ghous*, composed of 61 days, and which ends on the 26th of October. It is at this period that the Tartars conclude their bargains and renew their leases. The 36 following days are the precursors of their grand winter, *Kychtchilla*, which begins on the 1st of December, lasts 66 days, and finishes only on the 4th of February. They give the name of *Goud Chouk-ai* to the 24 remaining days of this month. The 53 following days, from the 1st of March to the 23d of April, they call *Mars*, and they form no part of any season. We remark in this last period, according to the meteorological observations of the Tartars, three distinct cold epochs, which they name, *the winter of old women*; the winter of the blackbirds (*berdal asher*), which lasts seven or eight days; and lastly, the winter of the lapwings (*apoffo*).

We now come to the second part of these Travels, which is dedicated to the political state, or rather to the history of the Crimea, or the Antient Tauridis. In this country, like all others, it is difficult, not to say impossible, to tell who were the first inhabitants. Some maintain that they were the Taurians, aborigines of the mountainous part; others have found Amazons there 1700 years before our æra; lastly others, and these are the most numerous, mention the Cimmerians, or Cimbri, as the old masters of this immense peninsula. The latter, driven out by the Scythians, who came from the north of Persia, retired to the mountains. Six centuries before the Christian æra the Greeks established themselves there, at least on the shores of it, and built *Panticapæum* or Bosphorus, now called Kertch; Theodosia, now called Paffa; and Cherson, which became a powerful republic, and upon which the author has given some particular details. There are others who regard the invasion of Darius

Darius as the epoch of the establishment of foreign colonies in the Crimea. In the year 480 before the vulgar æra, the Archoe-Anaktides, aborigines of Mitylene, founded the kingdom of Bosphorus, from which future sovereigns extended their possessions. This country, successively under the dominion of the Scythians, the Sarmatians and the Taurians, was entirely conquered in the year before Christ 82, by Mithridates king of Pontus. Sixteen years afterwards, the defeat of this prince placed the Crimea in the hands of the Romans, who left Pharnaces, the rebel son of Mithridates, on the throne of Bosphorus. In the first century of our æra it was invaded by the Alains, who were supplanted in their turn by the Scythians, then known by the name of Goths. These having been conquered by the Huns, formed a distinct state in the mountains of Kertch, the kings whereof were Christians. We may observe, by the way, that Christianity was received in the Crimea under Dioclesian and Constantin. At length, at the end of the 4th century, the kingdom of Bosphorus disappeared, and about the beginning of the 5th the power of the Huns was annihilated by the Hungarians, who took possession of the southern coast, and their descendants wandered a long time by the name of Roultziagres and Oultzaingoures, and were in 679 subjugated by the Chazares, to whom the mountain Goths and those of the Greek cities also became tributary. In 840 the emperor Theophilus, as sovereign, erected a province under the name of Cherson. At this epoch the Jews became very numerous in that province. After a variety of revolutions the Crimea came into the hands of the Genoese. About 1204 the soudagh or sovereign of the Crimea renounced his allegiance to the throne of Constantinople. In short, after having been alternately in the possession of the Genoese, the Venetians and the Turks, the Crimea was finally wrested from the latter by the Russians in 1783, after a war which had lasted 46 years.

M. de Reuilly afterwards develops the state of the Crimea under the different governments, and particularly under the Khans and the Russians. He describes the physiognomy, the

the character, and the manners of its inhabitants, divided into Tartars of the mountains and Tartars of the plain; and describes the kind of industry and commerce peculiar to each. He also points out certain improvements proper for opening new sources of riches. His critical glance at the commerce of the Black Sea is full of just observations. The author seems to have had it in view to prove, how advantageous it would be to France to form *entrepôts* of commerce in these regions; he also suggests the means of doing away the obstacles which have hitherto retarded the prosperity of the French trade in the Crimea. Notes on the principal trading ports of this peninsula are also given, containing curious details upon Odessa, Nicolaief, Cherson, Caffa and Taganrok. Koslof or Goesleve, and Sebastapol have not been forgotten in this work.

Anxious to omit nothing which might add any interest to his work, M. Reuilly has enriched it with drawings of the coins of the Crimea and designs of medals, almost wholly unknown, which he collected in his journey. They are accompanied by notices from Messrs. Langlés and Millin.

XXXIX. *Thirty-fourth Communication from Dr.* THORNTON, *relative to Pneumatic Medicine.*

April 20, 1807.
No. 1, Hinde-street, Manchester-square.

DEAR SIR,

ATTENDING the wife of Mr. Parkes, a practical chemist, the well-known author of "The Chemical Catechism," a work of considerable reputation, I recommended to her the inhalation of vital air, which was fabricated by his foreman, Mr. Williams, of Tyson-street, who had been afflicted with asthma upwards of 15 years. Many nights together he was unable to lie in his bed; and Mr. Parkes finding that his wife was much restored in her health by the pneumatic practice, he advised Mr. Williams to consult me on his case. As this is very well drawn up by the patient, I shall enclose it.

A Case of Asthma cured by Vital Air.

"When about twelve years old I was taken with an asthma,

asthma, attended at intervals with violent fits which lasted from four to five days, during which time I could not lie down in my bed, nor obtain any rest, being in the greatest agony, supposing every breath to be my last, and often wishing it to be so. These fits came on about once a fortnight, and oftener if I did not take the greatest care. My father consulted a great number of medical gentlemen, as doctors Lyde, Jones, Exton, Wainright, &c. (in the neighbourhood where I was born) of great repute, who lived in the Hay, Breconshire, and in Hereford and Monmouth; but I was given up by them all, as *incurable*. After this I had recourse to various patent medicines, but all to no purpose. A relation residing in London advised me to come to town, where I should certainly get some relief. I resolved to come, bad as I was, and resided at his house, when his physician attended me, and to my great grief told me, the *grave* would shortly be my portion, if I did not immediately return into the country. Distressing now was my situation, having had the asthma on me fifteen years, being 27 years of age, and three years in London; when fortunately for me I tried the vital air, under Dr. Thornton, who ordered me to inhale daily one gallon of vital air diluted, aided by other usual medicines, and in a few days I found myself greatly relieved; and in a few weeks quite well. I have been free from asthma upwards of two years."

Observations.

1. The dose of *vital air* employed was a gallon a day, diluted with atmospheric air four times that quantity.

2. The medicines were of the tonic kind, as mentioned often in the relation of other cases.

3. As the learned Dr. Pitcairn, whose liberality is well known, asked me when I was under examination before the Royal London College of Physicians, the proportion of vital air in the blood under certain morbid conditions, is it not certain, that the *aërial* practice begins to make some impression on *veterans* of our profession, so much more *liberal* are the faculty *now*, than in the *days* of *Harvey?*

4. After so many physicians were baffled in their attempts

tempts to cure this disease, in this case, does not the inhalation of *vital air* proving so quickly salutary, and the benefit continuing, demand some more attention than is usually given to this subject by *juniors* in the profession?

5. The expense attending the application of the air amounts only to one shilling per diem: hence this application comes within the reach of every person.

I have the honour to remain,
Dear sir,
Yours sincerely,

To Mr. Tilloch. R. J. THORNTON.

XL. *Report of Surgical Cases in the City Dispensary, Grocers-Hall-Court, Poultry, from the* 1*st of January to the* 28*th of February* 1807: *with Remarks on the Propriety of establishing a Fund, to be connected with charitable Institutions, for the Relief of the Ruptured Poor. By* JOHN TAUNTON, *Surgeon to the City and Finsbury Dispensaries, and Lecturer on Anatomy, Surgery, &c.*

IN the last surgical report (see Philosophical Magazine, vol. xxvii., no. 105, p. 77,) there were 154 patients under cure.

Cured - - -	129
Relieved - - -	3
Died - - -	1
Now under cure -	21
	154

Since the above report there have been admitted into this Dispensary 181 patients.

Cured - - -	33
Relieved - -	4
Now under cure -	144
	181

The fatal case related was that of a poor man (a watchman), ætat. about 66, whose constitution had suffered from exposure

exposure to the inclemency of the weather. He was confined from accidental injury, by which an abscess on the leg was produced, from which he appeared to be recovering; when the cough and expectoration, to which he had been subject many years, suddenly left him, difficulty of breathing ensued, with pain in the chest: neither did blisters, expectorants, or diaphoretics, appear to produce the least effect, and he died within 48 hours from the accession of the first unfavourable symptom.

The importance and utility of the industrious poor to a civilized and commercial state are indisputable; their services have been for ages past acknowledged, and will continue to be so by generations yet to come. Surely, then, gratitude must confess that they claim the attentive regard, and that they are entitled under infirmities to the charitable assistance, of a generous and benevolent public.

Experience shows that near one-tenth part of mankind are afflicted with hernia! How many of those persons are there necessarily engaged in laborious pursuits to earn a scanty sustenance for themselves and families, without the possibility of providing even the necessary clothing to defend their bodies from the inclemencies of the weather, to which they are daily exposed!

View them the subjects of this malady, a disease of all others, perhaps, the most insidious, and tending to the greatest danger; being in many instances, at its commencement, unattended with pain, or further inconvenience than that which arises from the increased size of the part, which is easily reduced by placing the body in a horizontal position. Circumstances may continue in this state for an indefinite length of time, which no human wisdom can foresee: the unhappy sufferers are seized with inflammation in the part, when, from their ignorance of the symptoms and danger of the complaint, they allow much time to elapse before surgical assistance is called. In this metropolis the first application is frequently made to dispensaries; when behold distress in every countenance! the parent confined on a sick bed, the scanty sustenance of the family ceases with

with the labour of the father, or their domestic conveniences cease to be attended to with the advancing disease of the mother! In this state of things it too frequently happens that an operation is the only resource left, by which even a chance of recovery can be afforded to the afflicted; and that to be performed under circumstances of all others the most distressing, a want of the common necessaries of life combined with disease.

The removal of the diseased to an hospital is attended with increasing danger in a ratio with the delay it produces, and also as it operates on the minds of the sufferers, who are about to exchange every thing that is near and dear to them, in the very hour of danger and distress, to seek an asylum among strangers, at which the human mind recoils, be the advantages what they may. Here the dispensaries, from the daily and ready access which the poor have to them, are paramount to all other institutions.

These distressing scenes, which too frequently occur, and in many instances end in leaving a disconsolate widow with a helpless offspring burthensome to the parish, might generally be prevented by a proper bandage or truss applied in the beginning of the disease, and continued with care. This might be accomplished at a small expense compared with the good that would accrue to society; it would even be a saving to the community at large, by the prevention of accidents which always tend to increase the parochial rates.

The funds required to carry this plan into execution are very small, as three trusses may be provided for each guinea subscribed, no other expense being necessary: the great object to be kept in view is the easy access, by which every diseased applicant may obtain a ready and permanent relief.

This subject will be resumed in a subsequent report.

Greville-street, Hatton-garden,
March 23, 1807.

Erratum.—Page 79, for *mixt. aloes.* read *mist. oleosa.*

XLI. *On*

XLI. *On improved Sheep by the Spanish Mixture; their Wool, and its Value in Superfine Cloth, &c.* By C. H. Parry, *M.D. F.R.S.**

GENTLEMEN, Circus, Dec. 10, 1804.

HAVING, during the last thirteen years, carefully attended to the cultivation of a breed of sheep, for the wool of which, in various forms, the society has done me the honour to award me several premiums, I think myself called on to communicate to them the general resul of my experience. This I shall do in form of propositions, each of which I shall attempt to demonstrate by specimens now exhibited to the society.

I must premise that, except a few Morfe ewes, which I employed at the commencement of my experiments, but which I soon thought I had good reasons for discarding, my ewes were wholly of the Ryeland breed, selected for me in Herefordshire, and altogether uncontaminated by the admixture of any of the larger and more fashionable kinds. The rams which I have employed for the original crosses have been Merinos, from the flocks of the King and lord Somerville. Of these rams I have, at different times, used about ten.

I. The first proposition which I shall endeavour to establish, is, that the wool of the fourth cross of this breed is fully equal in fineness to that of the male parent stock in England.

In order to prove this, I refer to the scoured specimens, Numbers 1, 2, 3, and 4.

No. 1 is the entire fleece of a Merino ram, given by the King to the late marquis of Bath. It is divided into R. F. T. and K.†

No. 2 is a fleece, similarly divided, of a ram of the Merino-Ryeland breed, immediately descended from the former.

No. 3 is the R. wool of a ewe of the same cross.

* From Letters and Papers of the Bath and West of England Society, vol. x.

† Refina, Fina, Tercera, and Caludas.

No. 4 is a very small portion from another ram of the same cross. I am extremely concerned that, by some accident, I should have mislaid this entire fleece; but this specimen, together with numbers 2 and 3, certainly proves the proposition, that wool of the fourth cross may become at least equal to that of the original Spaniard.

This proposition will admit of further confirmation, by taking into the comparison the scoured fleece, No. 5, which is that of the Spanish ram last presented by the King to this society.

I may add, that, except by accident, the wool of no dip, short of the fourth, equals in fineness that of Spain.

II. By breeding from select Merino-Ryeland rams and ewes of this stock, sheep may be obtained, the fleeces of which are superior both to those of the cross-bred parents, and of course to those of the original progenitors of the pure Merino blood in England.

For the truth of this proposition, I refer to Nos. 6 and 7, the fleeces of rams, the sons of the Merino-Ryeland ram, No. 4, who is the son of the pure Spaniard, No. 1. These fleeces are evidently much finer than either of the former, and, I verily believe, than any ram's fleeces ever exhibited in this island. I have unfortunately omitted to save the fleeces of the parent ewes, but I can positively assert that they were not superior to the ewe's fleece, No. 3.

The ram's fleece, No. 8, is also of an excellent quality. He is brother to Nos. 6 and 7.

I beg that the committee would examine not only the R. wool, but also the F. T. and K. of the specimens, Nos. 6 and 7, comparatively with those of the pure Spaniards, Nos. 1 and 5. I believe they will agree with me, that the second, or F. wool, of these fleeces, is at least equal to the R. or best wool of the pure Spaniards; and the fleeces taken together are finer than those of Nos. 2, 3, and 4, the Merino-Ryeland race from which they immediately descended.

This position I have, from accident, been able to establish on a large scale. Having no Spanish ram in the year 1801, I put all my breeding ewes to the Merino-Ryeland ram, No. 4, No. 4, above specified. From this impregnation sprung the rams Nos. 6, 7, and 8, already referred to, and my finest-woolled ewes. In 1802, I ignorantly hoped to improve my wool by one dip more of the Spaniard. Accordingly, one hundred of my best ewes were served by three pure Merinos. The consequence was, that the entire produce was considerably coarser than that of the former generation. The fleece, No. 9, is that of a ram, and is the very finest of this whole dip. The society need not be informed how much inferior it is to Nos. 6 and 7.

What comparison the produce of these mixed rams with unmixed English ewes will bear with those descended from pure English ewes crossed with the pure Merino, I cannot from my own experience demonstrate. All however which I know tends to prove them in no respect inferior; and I have the evidence of a breeder of South-Down sheep in Surry, whose letter to me I am ready to produce, if required, and who has this year employed these rams to upwards of six hundred ewes, to show that their lambs, both in wool and carcase, are superior to those from pure Merinos. I need not point out to the society the important consequences which result from this fact.

III. From mixed rams of this breed, sheep may be obtained having wool at least equal in fineness to the best which can be procured from Spain.

In order to ascertain this point, I request the committee to examine Nos. 10, 11, 12, and 13, scoured specimens of Spanish wool.

No. 10 is of the N. E. or nigrette pile, for which a manufacturer in a neighbouring county, deservedly of the highest reputation, lately gave, in the unscoured state, 6s. 9d. per lb. This specimen is peculiarly interesting, because it is from that Spanish flock which furnished the Merino sheep now in possession of the King, and from which are descended most of our mixed races.

No. 11, is the Tores Paular, a pile of great note.

No. 12, is from the Imperial pile.

No. 13, the finest of all, is the Lastiri pile; for which, unscoured, the gentleman who favoured me with this specimen gave, nearly a year ago, 6s. 9d. a lb. Of course, when scoured, it was then worth 7s. 9½d. per lb.; and I believe it could not now be obtained without a considerable advance of price. This is the finest specimen of Spanish wool which I have been able to procure during the last twelve years; but I do not think it equal to that of my ram's fleeces, Nos. 6 and 7.

In comparing many of my fleeces with the imported Spanish wool of these most vaunted piles, there is one difference which will surely strike the most unskilful observer—that while the latter is dry, and harsh, and intractable, mine is to the touch soft, flexible, and silky.

IV. Wool from sheep of a proper modification of Merino and Ryeland, will make cloth equal to that from the Spanish wool imported into this country.

This proposition I prove by reference to No. 14, which is a piece of navy-blue broad-cloth, manufactured by Mr. Naish, of Twerton. I refer also to a piece of black cassimere, No. 15, made chiefly from ram's wool, by the same gentleman.

Whatever merit there may be in these articles, I will hereafter assign sufficient reasons why they are by no means equal to what may be expected from my flock at a future period.

V. The proportion of fine wool in the fleeces of this cross breed is equal, if not superior, to that of the best Spanish piles.

In what is called a pile of Spanish wool, the R. or Refina is as 20, the F. or Fina, 4, and the T. or Tercera, 1: that is, the F. and T. are equal to one-fourth of the R. or one-fifth of the whole; the F. one-fifth of the R. and the T. one-twentieth. In the blue cloth, No. 14, above specified, the R. was 44 lb. the F. 7½ lb. and the T. 2¼ lb. According to the above proportion of the Spanish, the F. and T. of this wool should have been 11 lb.; whereas they were only 9¾ lb. This difference of 1¼ lb. is in the F. wool, which is so much less than in the pure Spanish. I beg the committee to examine and express their opinion whether this F. wool of my flock, bag No. 16, is not superior in quality to what

what is usually imported from Spain. I am told that the T. wool, bag No. 17, is entitled to the same comparative preference.

VI. This wool is more profitable in the manufacture than the best Spanish.

It requires 60lb. of good Spanish wool, in the imported state, to make thirty yards of broad cloth, dyed in the wool of the proper substance. These 60lb. waste, in scouring, to 52lb. Hence it follows, that 52lb. of scoured Spanish wool are necessary to make thirty yards of good wool-dyed broad-cloth. The R. wool of the British cloth, No. 14, having been 44lb. should therefore have made about 25⅓ yards; whereas, in fact, it made 26¾ yards; and it is asserted by the manufacturer, that if it had not deceived him as to its capacity of milling, to which is owing its uncommon strength, it would have reached in length one yard and a half more of cloth of the usual substance. This account corresponds with that of Mr. Waldron's prize cloth from my wool in the year 1802. The R. wool dyed and picked blue was 47 lb. which might probably have been 48 lb. when only scoured. Now 48lb. of scoured Spanish wool should make about 27¾ yards of broad-cloth; whereas the same quantity of my wool, in this instance, produced 30½ yards of cloth; which the draper, even at that time, sold for 23s. a yard.

From these and many other similar facts which I could adduce, I think myself authorized to infer, that this wool wastes less in the manufacture, and is, therefore, weight for weight, more valuable, than imported Spanish wool.

For this difference very satisfactory reasons might be given; but I shall not take up the society's time with enumerating them. It is sufficient for me to state, and, I think, to have proved the fact.

I have spoken above as to the superior softness and flexibility of this wool. It is probable that several gentlemen are here present, who, in manufacturing it, have found even the coarser samples to make much finer cloth than their appearance in the wool promised. Further evidence as to this point will be adduced under the next proposition.

As to its capacity of felting, I need go no further for proof than the blue cloth, No. 14, in which, as hath been before observed under this head, it turned out greater than was justified by the common experience of Spanish wool.

VII. The lambs' wool of the Merino-Ryeland breed will make finer cloth than the best of that of the pure Merino breed.

In order to demonstrate this, I beg leave to exhibit three pieces of lambs' wool broad-cloth.

The black, No. 18, is the produce of my lambs of 1801, descended from the Spanish ram, No. 1.

The lighter blue, No. 19, dyed in the piece, from the lambs of 1803, got by pure Spanish rams.

The darker blue, No. 20, from the lambs of the present year, most of which were got by the Merino-Ryeland ram, No. 4.

The superior firmness of the cloth, No. 20, to that of No. 19, is a convincing proof of the truth of the second proposition. At the same time, I beg leave to ask whether any gentleman here present has ever seen any cloth from imported Spanish lambs' wool, equal to this in fineness and softness. Thus is established the truth not only of this 7th proposition, but also of the 6th.

I do not however exhibit this cloth as the best which may be produced from the lambs of this cross. The wool was not uniformly good. It was of all degrees of fineness from that of specimen No. 21, to that of specimen No. 22.

Hereafter I shall assign the reason of this inequality, which it cannot be doubted that I shall be able to correct, should it be thought necessary.

VIII. Should long wool of this degree of fineness be wanted for shawls, or any manufactures which cannot be perfected with our common coarse long wools, the ram's fleece of the cross breed, which is exhibited No. 23, will prove that this can be effected by allowing the fleece to remain on the animal unshorn for two years.

I beg leave here to trouble the society with a few remarks. I have said that the cloths from sheep's and lambs' wool, now exhibited, good as they certainly are, are still not the best which are to be obtained from my flock. It will be reasonable

reasonable to ask, why I do not exhibit those best? I answer, Because I have not hitherto had a sufficient choice of fleeces. It has already been stated, that, till the fourth cross, the produce of Ryeland ewes cannot be made to equal the Merino in fineness. On this principle, any one, who will give himself the time to calculate, will find that, beginning with one thousand ewes of the English blood, he will be eight years, unless his lambs take the ram, before he has one hundred and twenty-five sheep of that fourth cross. What then must have been the case with me, who for some years could not procure Spaniards to serve annually more than from five to twelve ewes? In fact, exclusively of the best fleeces, always reserved for exhibition and comparison, I have not hitherto been able to appropriate to the manufacture of fine cloth more, in any one year, than about thirty-five fleeces; and of these several have been only of the second rate. Of this class I consider the fleeces employed for the cloths, and more especially the cassimere, now exhibited. Having now much better rams, a further advance of time, and more experience, I may reasonably hope to remedy this deficiency. It will not however be till the year 1808, which is seventeen years from the commencement of my experiments, that I shall expect to have a flock of four or five hundred sheep, all equal in fineness of fleece to Nos. 6 or 7.

Before I conclude, I wish to call the attention of the society to one more important point; which is my

IXth and last proposition; that though I have never selected a breeding ram or ewe on account of any other quality than the fineness of the fleece, this stock is already much improved as to the form of its carcase, comparatively with the Merinos originally imported.

For this purpose, I exhibit three two-tooth rams, eight ewes, two and four-tooths, and four chilver lambs. These sheep have not been fed for exhibition. All have eaten only grass. They have been constantly together in great numbers; and notwithstanding any want of merit as to high condition, an inconvenience very easily remedied by those who attach importance to it, they will be found superior in carcase to most of the pure Merinos which I have seen. I think they show that, by a proper selection, this breed may soon become equal in carcase to the best South-Downs. From the size of the two-tooth rams, no one will hesitate to conclude that wethers of this breed, at two-shear, may easily be made to reach 16 or 18 lb. per quarter.

I beg the society's pardon for having so long intruded myself on their attention. I shall probably give them little trouble of this kind in future; but as the subject, at this time especially, is of great importance to the commercial interests of the country, I request that they would permit the committee to examine the several propositions which I have stated, and report on them, separately, at the general meeting to morrow.

I have the honour to be,
Gentlemen,
Your obedient servant,
C. H. Parry.

To the President and Members of the Bath Agricultural Society.

XLII. *Present State of the Art of Painting in France. By* T. C. Brunn Neergaerdt, *Member of the French Institute**.

Professor Fiorillo published at Göttingen, some time ago, the third volume of his History of the Art of Painting, which contains that branch of the subject relating to France.

The author says in his preface, that "at first he only thought of speaking of the old French school, and that it was too soon to describe the modern one." I am not of his opinion; I think that the modern school has already produced, and is daily producing, artists of sufficient merit to entitle them to be publicly noticed. I am also of opinion that M. Fiorillo would have done well to have waited until

* From a memoir entitled "*Corrections et Additions pour un Ouvrage de M. Fiorillo sur l'Art de Dessin en France depuis son Retablissement jusqu'à nos Jours.*" Read at the French National Institute, May 11, 1806.

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he had procured some more exact information, or visited France in person.

I have not written the following observations in the spirit of a critic; it is the love of the arts and of truth which has alone dictated them; and I only furnish M. Fiorillo with the present additional information, that he may be enabled, in a second edition, to render his work more useful, by making it more exact and more complete.

The period which embraces the artists of the modern school, will include all such, of any repute, as have died since 1750. I shall begin with Francesco Casanova, whom I knew on my first visit to Vienna. Fiorillo says that he was a pupil of Simonini, that he took Jacob Courtois for his model, and that he studied Wouvermans: all this does him honour; but I cannot coincide in the opinion of this author when he says, "that he (Casanova) was nothing else, in the true sense of the word, than a plagiarist, who sometimes took one groupe and sometimes another from the works of Bourguignon, and placed it in his own pictures." In battle pieces, several things may resemble each other, without our being entitled to say that one painter has stolen from another. People fight and are killed, in general, in the same manner. Casanova was a man of genius, and I think the accusation of our author is ill founded. He has said very little upon the talents and works of this artist; who has, however, acquired a just reputation in France. He has forgot his brother, who was director of the gallery at Dresden; and he has also omitted to mention several of his scholars who are known in France. Francesco Casanova, in his latter years, did some small paintings of animals, of an agreeable composition and of a light touch, for which he was well paid.

In delivering the eulogy which is due to the talents of M. Vernet, he only quotes his design of Hyppolyta, and that of the leader of the car, who returns with his companions. He informs us that Darcis is engraving it. We can tell him, however, that Darcis never lived to finish this engraving.

Charles Vernet laboured a great deal in his latter years.

One third of his designs belongs to Roland, the printseller, who has already got several of them extremely well engraved; particularly fourteen, by Debucours, in the soft manner in which he excels. Five other large designs are not equally well engraved. There is one of them in China ink, another in bistre, and some coloured ones of great beauty; among others, a Departure for the Chase. Vernet is at present occupied with his grand piece, the Battle of Marengo.

Robert is merely named: the author, therefore, does not know the extent of his talents: France, however, never had such a painter as Robert for the interior of pieces of architecture. He was as well acquainted with perspective as Panini, and delineates it in a manner highly agreeable to the eye. At one time, one could not inhabit a dwelling-house without having a bed-room or a saloon decorated with Robert's pictures. His works are of different qualities; he sometimes went too fast, by wishing to do too much. We have sometimes wished him to finish a little more; but perhaps, by being more finished, he would not know how to preserve the spirit which always reigns in his rural scenery and in his architecture: his talents would be of great use in theatrical decorations. His figures are not correct, but they never want spirit. The best pictures of this master are a part of his studies in Italy. He engraved at Rome a small architectural work which he called his *Soirées*, and which has given us cause to regret that he has not done more. Robert treated his own style of painting with so much superiority that he never had any rivals; and France will wait long ere she finds another Robert; particularly in an age where all the men of genius aim at historical painting. Robert has perhaps made too many designs; but not for those who love taste and agreeable effect. He has done a great many pieces with red and black crayons.

The French themselves pay more justice than M. Fiorillo does to Greuze, although his method of designing has nothing in common with the present school. He thinks it extraordinary that he should be called a painter of a particular school; he would rather have him called "the painter of the people or the nation, because his pictures very often represent

represent the most characteristic traits of the entire manner in which the French think and feel." But the good and bad actions which occupy the pencil of the celebrated Greuze do not belong exclusively to the French nation; they are common to all nations. We find in all countries men who have nothing to leave to their families at their death, except their good reputation; there are every where mothers who love their children; sick persons who are consoled by their children; as well as there are children who endeavour to destroy the will of their father when they think that it is not favourable to them; and there are also children who even attempt the lives of those who have given them birth. He grants more nobleness of style to Greuze than was possessed by Cornelius Troust, or Hogarth: I do not know where he has derived this comparison. M. Fiorillo thinks that Diderot has praised Greuze with too much enthusiasm. He thinks the colouring of Greuze is mannered: he has not seen, therefore, any of his heads; at least, he does not mention them. Few artists have painted with so much sentiment and truth as he has done: in France he still passes for a good colourist. The author says, "that Greuze endeavoured never to lose sight of the simplicity of nature; but Nature herself is mannered at Paris." Nothing is easier than to vilify a whole nation. Greuze made a quantity of designs, which can only be regarded as mere studies, all full of sentiment. Greuze created his own school, and it perished with him.

The Germans, Italians, and English, exclaim against the French school, because they envy its superiority. The man who has regarded Europe with an impartial eye for the last ten years, surely cannot think that there is any school in existence at present, except the French school: no country possesses so great a number of historical painters, or so great masters, as France does. Among other nations there are distinguished talents: a Fuger, a West, an Abildgaard, and a Hetsch, will always do honour to their country; and yet for all this there is not a German school, an English school, or a Danish school.

It is necessary that I should quote some passages of M. Fiorillo's

M. Fiorillo's Introduction to the History of the new French school. He asserts "that the modern artists take David for their model, and exaggerate his defects without possessing his talents." He finds, however, that the present is superior to the old French school, and he continues in this manner: "The greatest part of the works of the modern school resemble coloured statues or bas-reliefs; the contours of the figures are sharp and edgy, the expression speaking; but the composition is empty, cold, and dry: in short, the colouring is hard, as if they did not choose any thing in nature except a local colour, and as if they only sought to relieve the effect by forced shades which fall into the dark. The modern French artists think that they have surpassed the simplicity of the Greeks in their works; but they confound simplicity with emptiness, and laboured composition with the great pains they take to become flat and insipid. As they are not possessed of a pure and classical sentiment, they remain at the entrance of the temple of Taste, without finding the fundamental principle of it; and it would seem that the genius of the times removes them from what is called the ideal of the art, &c." These are the bad French artists of whom M. Fiorillo speaks, because he has not succeeded in drawing a picture of the good ones; for he has never seen the works of the latter, and he judges by those of the former. He afterwards says, "that the antique ought to be studied; that Raphael and Michael Angelo studied it; but that they endeavoured, surrounded as they were with noble, grand, and spiritual forms, to idealize, as it were, the forms of nature." The author is therefore ignorant that the good French painters study Nature much, and that she never was more studied by any school: as a painter, he ought to know that people sometimes see with different eyes.

M. Fiorillo says that the picture of Saint Roch curing those infected with the plague, laid the foundation of the celebrity of David: he might have added to this, what has been said of the Horatii, that this picture alone would have been sufficient to secure immortality to him. I do not like to speak of any thing unless I have seen it, because in that case it is my own judgment, at least, that I pronounce;

nounce; and therefore I only named this picture when I wrote upon the performances of David, not having been at Marseilles at that time: I have been there, however, several times since, and had an opportunity of often admiring one of the *chefs-d'œuvres* of this great artist. I may even prophesy that in future ages pilgrimages will be made for the sake of admiring it. I request M. Fiorillo will add to his second edition the few words I am now going to say, if he has any confidence in my judgments.

The picture of Saint Roch was commanded from David for the administration of the department of Marseilles. He did it at Rome in 1780. On receiving it, the purchasers thought it too fine to deprive connoisseurs and amateurs of it: they therefore gave up their first idea, of placing it in their own hall, and sent it to the office of the records, where it has since remained. The subject of the picture is Saint Roch addressing the Virgin, supplicating her to cause the plague to cease. He is upon his right knee, and rests the end of his left foot upon one of the sick persons. He lifts his clasped hands to the Virgin, who is seated with the infant Jesus. Below there is at full length a dying person who rests himself upon his left arm: a little higher up are two young people expiring. The expression in the head of Saint Roch is very fine; the design of the whole figure is admirable: upon examining in detail his arms, legs, and hands, we are equally satisfied. The composition is simple, and well connected in all its parts. Expression is never wanting: we think we see dying persons in looking upon the poor diseased creatures. The Virgin pleased me least of all; her colouring is not so fine as that of the rest of the picture. David appears in this work as great a colourist as a designer; and he destroys the opinion of some of his pupils, who assert that design and colouring never go hand in hand. After having seen Saint Roch, I do not know whether to give the preference to the Horatii or to Saint Roch.

Fiorillo speaks of Belisarius with esteem: he relates the same anecdotes I have already printed: he does not think the head of Belisarius noble. "Every body would take it for a French invalid." I did not experience the same sen-

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sation on looking at this picture; and I never heard this reproach made by any French artist. This picture at present belongs to the senator Lucien Bonaparte.

He praises much the design of the Horatii; but according to him the composition is defective; he thinks the posture of the oldest son confined. "The father (he says), who is in the middle of the picture, resembles an old serjeant, who is drilling three recruits according to strict military tactics." The father of the Horatii never inspired this sentiment. Fiorillo thus continues:—" In the head of the father no trait of his visage characterizes a man who is exposing his children to the greatest danger, and who sees them perhaps for the last time." This judgment would not be at all surprising if it did not come from a painter, who ought to know the different sentiments of mankind as well as he ought to know the effect produced by the mixture of the different colours. Was it ever possible to express better, in the same head, the joy of saving his country, and the fear of exposing his children to danger? The most powerful passion ought naturally to carry away the victory in the mind of the most sensible father.

The author says, at the end of his article upon Brutus, that many people prefer this picture to that of the Horatii. In France, great beauties are discovered in both; but we generally give the preference to the Horatii.

We read in a note that Morel has engraved the Horatii, Brutus, and the Sabines: all this is false; none of the three engravings have yet appeared. It is certain that he is occupied with the Horatii; but he has a full year's labour yet before him. The graving tool of an artist does not move so quickly as the pen of an author.

The portrait of mademoiselle Brognard is mentioned without any distinction among the other portraits of Gerard: this portrait, however, deserves great praise, and it ought to be placed by the side of the *Joconde* of Leonardo da Vinci.

Every thing which comes from the pencil of Gerard is beautiful; every thing is wisely conceived: he paints without having the air of painting: his full length portrait of madame Recamier has done him much honour. He has painted

painted several portraits of his friends in a sitting or two. I ought to mention here the celebrated Ducis; no pencil ever produced more in less time.

Gerard has also done some portraits of his friends, designed at one sitting, which may serve as a model for those who wish to design in this manner. I may quote those of madame Redouté and her daughter, of mademoiselle Coliquert, and my own, of which I am not a little vain.

Ingre ought to go to Rome; but he has not yet set out, as the author says. We expect great things from him. The design of *Stratonice*, which he is doing for me, is well composed and well designed, and we may hope to see a fine picture of it. He has finished several portraits, among which we distinguish that of mademoiselle Riviere, 14 years of age.

M. Fiorillo thinks that Gros has talents; but he forgets to assign to this artist the distinguished place which his country has given him among the pupils of David, and which he so justly merits. He thinks it astonishing that such a terrible subject as the Plague of Egypt, of this painter, should have excited so much enthusiasm. I am very happy, on the contrary, that justice has been done to a fine picture, well designed, well painted, and finely coloured. Gros is one of the first colourists of the modern school. Our author does not recollect, therefore, that such subjects have been represented by the first talents. He does not know Mignard's Plague, Poussin's Massacre of the Innocents, his Deluge, and many others.

The name of mademoiselle Gerard is mixed, without mercy, in a crowd of others who are scarcely known. Her name merits some distinction. Her pictures are agreeably composed; the subjects are well chosen, executed with a careful pencil, and finely coloured. A great deal has been engraved after her.

The author is not well pleased with the miniatures of Augustin; he has, perhaps, never seen them; at least, he is surely not acquainted with the portrait of *Chaudet*. He speaks of Taunay as of a historical painter. It is true that he has done some historical pieces; but his name has been confounded with others. Taunay has a peculiar style of painting

painting of his own. He is excellent at figures, rural scenery, and architecture: he composes well, and varies his manner: no person has wrought more than he has done, and there is genius in every thing he undertakes.

Chaudet, the sculptor, is mentioned with eulogium for his picture representing the Flight of Æneas: but his designs ought also to be mentioned. "The Triumph of Psyche" is very fine: he made several designs for Didot's grand edition of Racine. He is an engraver also. His designs are well composed and well executed.

Thibault, the architect, is only mentioned for some pictures he did ten years ago; the author, therefore, has never heard of the grand and fine landscape he painted for prince Louis, in which Rinaldo and Armida are represented. M. Fiorillo is not acquainted with the pieces in water colours by this master; he does not know that in this branch he has surpassed all that went before him. I shall only mention his View near Tivoli, and that of the Village of Est. M. Fiorillo is also ignorant of Thibault's performances in architecture and in perspective: this artist has begun a work upon perspective, which when published will be a treasure to the arts. His studies in China ink are full of truth and beauty.

In naming Bourgeois, something should have been said of his bistre drawings, which are very fine. His Bridge of Seves surpasses every thing of the kind.

The pictures of Demarne, M. Fiorillo says, have the air of being done in a dark chamber: this accusation might have been spared, as well as that of his compositions being flat and common. He ought rather to have spoken of the beauties to be found in Demarne's landscapes; and he ought to have said that he paints animals extremely well, and that his pencil is very careful.

We find the name of Ommeganck in M. Fiorillo's work; but we are astonished not to find it said that he paints well, and that none can portray sheep better than he does.

I did not know that the youngest of the Redoutés paints or designs flower-pieces only: he belonged to the expedition to Egypt, and has carried the art of drawing fishes in water

water colours to a perfection which leaves nothing for us to desire.

M. Fiorillo charges the French with unsuccessfully imitating the Flemish painters; but they had no occasion to imitate them at all. Taunay, Demarne, Drolling, Swebach, mademoiselle Gerard, Boily, and others, have produced pictures which, without being copied after the Flemish, will do honour to their genius with posterity.

I have thus corrected the defects I have found in running over the work of M. Fiorillo; and I must do him the justice at the same time to say, that his works contain some well written articles, and that he is acquainted with literature; but he writes hastily. In order to compose a work upon the state of the arts in any country, it requires a long time to collect materials, particularly when the author is not in the country itself.

It would be tedious to mention in detail the artists whom M. Fiorillo has entirely forgotten; I shall merely mention their names with some notes, in order that he may inquire for their productions, if he ever gives, what is very much to be desired, a second edition of his work.

Among the pupils of Casanova we look in vain for the names of Norblin, Mayer, Duverger, and of Duvivier. Norblin is one of the first battle painters: he lived a long time in Poland: he paints well, and his composition is agreeable. I am in possession of some fine designs of his in bistre and Indian ink. Mayer died very young, and was buried at Ermenonville by the side of J. J. Rousseau. He possessed a great genius. Duverger died young also: I know several very fine designs of his. Duvivier, who remained with his master until he died, lives at Vienna, and paints with great success.

Lantara painted and designed in the taste of Claude Lorrain, and his pictures have an agreeable effect; his designs, generally in black crayons, are very much sought after.

M. de Boisseu, of Lyons, a true amateur, is one of the best designers I know: no one is superior to him in using Indian ink: his landscapes are true portraits of nature; the very

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hour of the day is observed in them : his figures, his animals, every thing is beautiful in his designs. M. Boisseu engraves in a manner which leaves him few rivals.

The painters of Geneva are entirely forgotten by the author. The works of St. Ours, Vaucher, Topper, Larrive, Linck, and others, deserve his attention.

Professor Jay, of Grenoble, ought to have been named : he has been in Italy, and designs landscape and figures extremely well.

Gamelin, who lives at Carcassonne, in the south of France, has great talents for battle pieces ; it is a misfortune to him that he does not live in a great city. Historical pieces are not his forte, however ; but in the country a painter must do every thing.

Pillement senior, who is still living at Lyons, ought to have been well known by the author : a great deal has been engraved from his designs. Even Woollett has rendered him immortal : the designs most easily made by him are always the best.

Perignon has done some drawings with a very agreeable touch : the designs for M. de la Borde's Travels in Switzerland are by him. They all belong at present to M. Van der Nuil, of Vienna. They are well done ; but perhaps he had not sufficient genius to seize upon the grand masses in this majestic country. Nature in a cultivated state, and nature in a savage state, should be represented in a different manner. If the latter does not strike an artist, he cannot do it justice.

Moreau junior is not named at all. His talents are surely known, however, in Germany : the numerous works of this man, unique in his line, have been almost all engraved. I shall instance his designs for two editions of Voltaire. His fertile genius prevents us from accusing him of copying himself, far less of stealing from others ; his subject always penetrates his mind in such a manner, that his design never fails of becoming an excellent picture. His compositions are wisely conceived, and his figures are well drawn ; his designs, which are generally in bistre or Indian ink, are neither too much nor too little finished. I hope that France will

will long retain this estimable artist. Posterity will be unable to conceive how one man could have found time to make all the drawings which go by his name. The industrious man who is endowed with genius, produces he knows not how.

His brother, known by the name of Moreau the landscape painter, died a long time ago: he painted with great facility, but was not always careful in his works: his tone is not always the truest in the world.

Wille, the engraver, is still alive. He is the patriarch of artists, and is now 92 years old. The revolution destroyed his fortune, and only his life was saved: if to have laboured much and well, and to have done great service to the arts, deserves a recompense, it is surely Wille who deserves it. He was the reviver of engraving in France, which seemed to have been lost since the days of Edelinck, Audran, Drevet, and others. The "*Musiciens ambulans*" and his "*Cleopatra*" will always entitle him to enjoy the epithets we have now given him. All that Europe can boast of in point of engraving has come from his school. His leisure hours were employed in designing, and generally in studying rural scenes.

Wille junior has done several pictures; but for these some years past he has not painted any thing: he handles his pencil in a most wonderful manner. His designs in black crayons are carefully done; and there are some coloured ones to which the same remark applies.

La Fontaine is one of the best painters of domestic scenery. Ganda would have been far forward as an artist by this time, if he had not died too soon: I am in possession of a very precious work of his; it is his Travels in Italy, comprising more than 400 studies and designs. Banks was educated by Casas, and travelled in Italy for him: he excelled in water colours. Laurentz designs animals very well, and seizes upon effects with propriety: his pencil is astonishing. Mandewar is a landscape painter; he is chiefly known for the light and agreeable manner in which he works with lead pencils. Bera designs natural history well; he is a pupil of Redouté, and he endeavours to follow the footsteps of his master. Brijandet, an able landscape painter, is dead. In his trees we observe that he studied nature much, and that he studied her with good effect. No man can paint a head better than Wallin; it is a pity he has not studied nature; his incorrectness, perhaps, would have been less. The two Ozanes are excellent at designing sea pieces: one of them has engraved a great deal, and has done it well. They are acquainted with the forms of vessels, and they give them in an agreeable manner. Bergevin designs very well with the pen, and composes bas reliefs with facility. Mistback gave great hopes. He designed landscape well, and executed with care the details of architecture. He was a pupil of Belanger. The journey he made with M. Bianco de Brant in the south of France did him great service. He died last year.

Percier, the architect, has made some fine designs in water colours, consisting of antique and architectural subjects: he has an exquisite taste for furniture.

Baltard, the architect, favourably known by several works, designs architecture and landscape extremely well.

Bertaux, who has been distinguished generally by the name of the modern Callot, designs with an astonishing facility. I have seen, with very great pleasure, his pen and ink design of the Battle of Austerlitz, which he is engraving for placing below the portrait of the French emperor.

Pillement junior, whom I ought to call the first landscape engraver, designs perfectly well this kind of drawing.

Several sculptors are distinguished for their designs. The name of Moitte has been for a long time favourably known among the amateurs of designs: a great deal has been engraved after him. His designs are well composed and well conceived. Taunay, the sculptor, his pupil, has not made many designs, but they are very fine ones. I possess two of them; one representing *Charon, to whom Mercury has delivered the Shades of those who are to pass the Styx:* all seem desirous of returning: the small heads are full of expression; the composition is agreeable, and the Mercury is of an astonishing lightness. The other is *Time extinguishing the Torch of Love.* One of the first painters said it was worthy of Julio Romano; I have therefore nothing to add.

Boichot

Boichot designs very well after the old masters; he prefers the Florentine school. Naudet is one of those artists who unites in one person all the qualities of a travelling painter. He has accompanied me for these five years past in my travels. The 500 designs, which are the fruit of these travels, will prove the accuracy of my opinion.

I may have still omitted some very distinguished artists, who may have been forgotten by M. Fiorillo also; and as I have trusted to my memory alone, my only desire has been that it should not deceive me too often.

XLIII. *Upon the Preparation of Indigo for obtaining Blue Colours for printing Calicoes* *.

M. Haussman, in a letter addressed to M. Berthollet, gives an account of the manner in which the solution of indigo is prepared, by means of an alkaline solution of red arsenic, for the use of calico printers.

He merely makes a caustic alkaline solution of red arsenic, to which he adds, while it is still boiling, a sufficient quantity of indigo bruised, in order to obtain a very deep shade; which it is still easy to render more or less intense, as the object may require, by diluting the solution of indigo with a weak ley of caustic potash, which is preferable to pure water, because it retards a little the absorption of the oxygen of the atmosphere, and consequently retards the regeneration of the indigo. The beauty of the blue in the stuffs requires that this regeneration should not be too sudden or too tardy. The too slow absorption, proceeding from a too great excess of caustic alkali, should be avoided in the blue for pencilling with, as well as in the sone blues, which advantage we procure by passing the stuffs printed with bruised indigo, mixed with a gummy solution of sulphate of iron, alternately through vats of caustic potash, sulphate of iron oxidated at the *minimum*, and finally through a vat acidulated by the sulphuric or muriatic acids.

* From *Annales des Arts et Manufactures*, May 1806, p. 181.

On exposing to the sand bath a mixture of bruised indigo and muriatic solution of tin with excess of acid, and oxidated at the *minimum*, the colouring substance is decomposed, liberating a gas of an insupportable and pernicious smell, which ought to be examined.

If indigo, treated with the muriatic solution of tin oxidated at the *minimum*, without the assistance of a caustic alkali, is of no use in dyeing, this is not the case with sulphate of indigo treated or mixed in different proportions with the same solution of tin, after having previously absorbed the sulphuric acid; the latter being made use of in printing-houses for producing all sorts of blue and green shades.

XLIV. *Letter of M.* Veau de Launay, *M.D. to M.* Delametherie, *upon the Production of the Muriatic Acid by means of Galvanism* *.

Since my note, inserted in your journal for July last, the experimental class of the Galvanic Society has repeated several times the experiment of Messrs. Pacchiani and Brugnatelli † relative to the formation of the muriatic acid, and always with success; *i. e.* with the formation of muriatic acid at the zinc pile in a manner more or less perceptible; sometimes even the acid was of a very strong smell, and coloured yellow ‡. I also obtained it several times in my own laboratory with a pile *d'alizeau* of seventy pairs only. It is more than a year ago since I was convinced of the truth of this interesting experiment, which would not be called in question at present, but that every chemist or natural philosopher endeavours to explain it by a theory of his own, more or less ingenious. For my own part, I am contented with knowing the fact to be true from personal observation. In the last experiments made at the arsenal at M. Riffault's, one of the members of the experimental class of the Galvanic

* From *Journal de Physique*, August 1806, p. 165.

† See Philosophical Magazine, vol. xxv. p. 260.

‡ We operated with a gold wire.

Society,

Society, the apparatus made use of for obtaining the muriatic acid was constantly covered with a glass receiver, or bell glass, which prevents the contact of the air surrounding the pile, and preserves such gases as may be liberated. This receiver does not seem to injure the experiment, the success of which chiefly depends on the number of plates or metallic disks, as well as on the cleanness of their surface. The greater the number is, the more muriatic acid is formed. As to the extent of surface, that augments very little the action in this experiment, as has been demonstrated when plates of more than a foot of surface have been used.

XLV. *Letter from W. Thornton, Esq. to the Members of the North Carolina Gold Mine Company.*

GENTLEMEN,

I LATELY visited the land in North Carolina belonging to the company, and rode several days in various parts of it. The fertility of the soil exceeded very much the most favourable idea I had formed of it. I saw some of the best corn in it that I saw during our whole route through Virginia and North Carolina, and I was informed by general Steele, late comptroller of the United States, who resides not far from the lands, that he had made particular inquiries respecting them, since my former visit, and learnt that they were very good corn and cotton lands, and it was his opinion, if the company kept the lands a little while till they could select such portions for the gold as they might incline to retain, they might sell the remainder for the whole purchase money they gave, viz. 110,000 dollars. Some of the corn I thought so fine, was in ground that had been in cultivation for ten years—and this is the driest year that the oldest inhabitants remember for fifty years.

The grounds, except in a few cultivated places, are generally covered with good timber. Some company viewing the land with me, measured one of the trees by the road side, and found it nine feet six inches circumference, and above a hundred feet high: orchards of apples, peaches, &c.

 flourish

flourish in a very luxuriant manner, and red clover, with plaister of Paris for a manure, grows astonishingly.

Before I mention the gold runs, it may be proper to observe that the healing springs are surrounded within the distance of half a mile by the company's land. These are powerfully chalybeate, and were resorted to from various parts of the country, as well as South Carolina, not only on account of the tonic virtues of the water, but also in consequence of the salubrity of the air and healthiness of the country. From the number who have visited these springs this summer, (the first) it is imagined they will be much resorted to hereafter.

This was one of the most unfavourable seasons I could have selected for an examination of the runs for gold. They were dry, like most of those we passed in Virginia and North Carolina; indeed so dry that no examination could be made of them for gold but with great trouble, as it was necessary to carry the sand and gravel in small portions, sometimes above a mile, before water could be found; and what gold was obtained was principally found by washing the gravel and sand where there was water, rather than by searching for the gold where there were indications; and though this was the case, I did not see a single frying-pan full of gravel and sand washed without gold being found therein. Some fine specimens were thus obtained, one about two pennyweights, and some smaller: but after we had obtained about twenty dollars worth, we were prevented from proceeding by the want of water to wash for more—though, from what I saw, I am of opinion we might have got some hundred dollars worth in a very short distance if the branch had not dried up. While we were engaged in washing for gold, Mr. Love, one of the proprietors of the adjoining mine of Mr. Read, on washing some of our gravel and sand, in which he found gold, said in my hearing, that he really thought our prospect as good as theirs. They have only four hundred acres; and though it is said they have obtained between thirty and forty thousand dollars worth of gold from this small place, they value it still at one hundred thousand dollars. We possess thirty-five thousand acres at least!

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The gold of our land is perfectly pure, and requires no refining. I visited Mr. Read's mine, and found that by amalgamation with quicksilver, which is very easy, and which answers completely, a great quantity of gold is obtained from the sand, after picking out all the lump gold. I was informed they got about six or seven ounces at a distillation, several times a week, from a very small still. I afterwards visited the mines of Mrs. Parker and Mr. Harris. They lie in a hill that intersects the company's land. Mr. Harris, in ploughing across a small branch in his land, turned up a good sized piece of gold. Having no regular weights, he tried it in a pair of scales against a pewter plate and spoon, which it outweighed. He then searched the run, and was successful in finding gold. This little branch runs immediately into the company's land, lying between it and Mrs. Parker's. But it was dry, and I consequently made no search in it, nor in any of the branches on that side, though I heard of gold being found in several.

Mrs. Parker's mine was discovered in a very unexpected manner. Hearing of several discoveries, she said in a joking manner to some company while drinking tea with her, "I wish, gentlemen, any of you could find a gold mine in my land." On which Mr. Etherton said, "I will go, madam, and search for you." He went, and in a little time returned with a very good specimen. After this they found six hundred dollars worth, and this season three hundred more, though they had not yet prepared any apparatus for even washing the gravel and sand. They were making a small wooden machine when I was there.

I cannot pretend to give an account of all the places where gold has been discovered in the grounds belonging to the company, for it will take some time before they can be sufficiently explored, and but few of the streams and small runs have been searched in the slightest manner. Every place examined, though some lie many miles apart, has furnished gold, except one, and that had but a very slight examination, and perhaps not deep enough. Among the principal places that promise well, from the small trials made, I must mention the Rock-hole creeks, which are

branches

branches that join about three miles below their sources. The one where I got most of the gold, in consequence of there being a small supply of water, is the west branch. The upper end could not be examined, nor any place but one, for want of water. The east branch is supposed from a single trial to be good, but the want of water prevented any further search. Three forks of Island creek, about three miles each, contain gold; but little search could be made for the same reason. Mr. Robins, who lives below, told me he found gold below the junction of these branches—some was found in Cucumber creek. The prospect good. Some in the Camp branch of Island creek, also in Long creek and below Mr. Harris's. Mrs. Osburn took only as much sand and gravel as she could carry between her hands, from a small spring in the company's land between the Rock-hole branches, and on washing it found a piece equal to a dollar, and two pieces equal to half a dollar in value, besides some smaller pieces. It appears on examination that some of the hills are rich in gold; and I think it is not carried far by the currents, but only falls down into the small hollows and little branches near which it originally lies, as it has been found in considerable quantities in the smallest depressions on the hills, as well as in the more deep runs and branches. Were we to measure all the runs, the small branches, the springs and depressions where gold has been found in the company's land, I think I may admit the truth of the current opinion there, that the company possess 100 miles of gold land. Though it may be highly advantageous to work some of the places already discovered, and particularly Rock-hole branch, and the Spring branch, I think a further examination of the runs essential, as it is admitted our discoveries already made entitle us to expect immense returns, if our operations be well directed in the first instance. The expenses are so very trifling, that the whole necessary apparatus will not cost 200 dollars; but the particulars will be laid before the directors, for their consideration.

I am, gentlemen,

Very respectfully, &c.

W. Thornton.

City of Washington, Oct. 20, 1806.

XLVI. *No-*

XLVI. *Notices respecting New Books.*

Lectures on the Art of Engraving, delivered at the Royal Institution of Great Britain. By JOHN LANDSEER, *Engraver to the King, and F. S. A.* 8vo.

It gives us some pleasure to be able to announce the publication of these Lectures, which, by the amateurs of engraving, have been anxiously expected to make their appearance. It is well known that before Mr. Landseer had finished his proposed course, he received a notification from the managers that they had resolved to discontinue his lectures; and it is equally well known that the real or supposed crime which procured Mr. Landseer's dismissal from the lecture-room, was his "having *alluded* to a certain individual—not a living character"—the late alderman Boydell. Mr. Landseer states, and we have never heard the fact contradicted, that his dismissal was the act of four managers who had not been present at the offensive lecture, and who even refused afterwards to hear the exact words he had made use of read to them! In the preface the author has offered some just, and we think, all the circumstances considered, temperate remarks on this transaction. How could lectures of the smallest use, on an art so important, and on which nothing had before been given in the English language, be delivered without alluding to those who had been engaged in the commercial part of the business? We might as well expect a history of any country to be produced, without those ministers being alluded to that have at times involved their country in danger by their individual folly and misconduct. The author affirms what cannot be denied when he says, "No lecture upon art has ever been delivered without personal allusions. Not the having alluded, then, but the justifiable or unjustifiable nature and occasion of the allusion, was the fit object of inquiry." The lectures are now before the public, and the public will judge impartially, we doubt not, between the parties.

It is impossible to spare room in a work like ours to give even an analysis of lectures which trace the art from its early origin,

origin, and treat of Chaldean, Indian, Egyptian, Hebrew, Etruscan, Sidonian, Greek, Roman, and modern engraving, in its multifarious forms—as exhibited on sacerdotal ornaments, signets, hieroglyphics, scarabees, instruments of war, furniture, gems, coins, and prints; nor could any analysis convey to our readers a correct idea of the instruction and information these lectures are calculated to afford, not only to those who by their habits and pursuits may be supposed more immediately interested in such inquiries, but to every person possessing a cultivated mind. The subjoined extracts from the third lecture (p. 148 and 176) will serve as a specimen of the author's style, and his manner of treating his subject.

"Toward the close of my last discourse (on the several species of modern engraving) I found myself obliged to anticipate that the meanings I annex respectively to the words *general* and *particular*, as applied to works of art, would not be misunderstood: an anticipation of some terms is not easily avoidable, and can be no reason why they should not be subsequently explained.

"To *particularise*, is to be attentive to the minutiæ, severally considered, of the object or objects before us. In imitative art, it is to represent those objects in detail.—In explaining the term *generalising*, as it is less well understood, I shall be obliged to be more diffuse.

"To *generalise*, is not to render vague and indeterminate, but to express with sufficient firmness, what is common to a number of objects of the same class. A general idea, if the word idea may be used to signify any other than recalled and particular sensation, is a generic idea; and a general representation or description, in painting or in poetry, is also generic, or such a representation as is common to a number. In moral philosophy, general ideas being comparatively vague and indeterminable, have sometimes been denied to exist; but in art, they may be rendered obvious, may be 'returned back to the sense from whose particular impressions they are constituted or abstracted:' and this, I believe, is practicable in all arts, though perhaps not in the same degree. The statuary, the poet, the painter, the engraver, the musician,

musician, all who aspire to touch with pure delight the imaginations of others, all generalise; and without generalising, it may be questioned whether any have attained to high and lasting reputation.

"Great mistakes have arisen in the philosophy of art (if not in the philosophy of morals) from confounding a general, abstract, or common idea or representation, with a vague idea or representation. Now, with respect to art, the difference is very important, amounting in our critical reasonings, to as much as the difference between a bust chiselled in the rough, and a finished head of an angel or deity:—a Jesus Christ, for example, can only be exalted above all individual men, by possessing what is common to all good men in character and expression.

"Permit me then to repeat, that a general representation is not a vague, but a generic representation: not a representation of what is hastily seen or carelessly noticed and imperfectly recognised, but a firm representation of what is most frequently seen. What is most frequently seen, is best remembered; what is common to a species or a genus is more frequently seen than that which is peculiar to an individual: and hence we recollect the general character of man or woman, or of the oak or the ash, when they are well painted or engraven, more strongly than we recollect in all their details, any particular man or woman, oak or ash, we have seen.

"To generalise, is therefore to define broadly or comprehensively; and every comprehensive definition, such as is proper in a dictionary, must be of this kind: languages, like the imitative arts, being modes of imparting information by exhibiting principled combinations of thought."—

"As we frequently hear the uninformed talk as if they conceived the highest effort of painting was merely to *copy* nature, as nature appears to them, so it is very common to hear unreflecting people speak of engraving, as if it were no other than an art of copying that of painting: which though a great mistake, is yet a very pardonable mistake on the part of those who have been led into it, when we consider

sider the state in which the art of engraving has hitherto existed, and the difficulties and the degradation under which, in this country, it has hitherto laboured.

"Now, engraving is no more an art of copying painting, than the English language is an art of copying Greek or Latin. Engraving is a distinct language of art; and though it may bear such resemblance to painting in the construction of its grammar, as grammars of languages bear to each other, yet its alphabet and idiom, or mode of expression, are totally different. If English be made the vehicle of the same thoughts which have previously been conveyed to us in Greek; or if engraving be made the vehicle of the same thoughts which have previously been imparted to us by painting, it affords the means of affecting our minds in the same manner: this similar affection of the mind has led to the mistake, and I have little doubt but that English would have been inconsiderately called an art of copying Greek, if we had never read any other English than translations from the Greek.

"The pretensions of engraving, as of all the arts denominated fine, are simple, chaste, unsophisticated. Art ever disdains artifice, attempts no imposition, but honestly claims attention as being what it is. A statue is to be looked at as being a statue—not a real figure; a picture, not as a portion of actual nature; a print, not as a copy of painting.

"An engraving therefore, that of the death of General Wolfe, for example, is no more a copy of Mr. West's picture, than the same composition, if sculptured or modelled in low relief, would be a copy. In both cases they would be, not copies, but translations from one language of art into another language of art. How far Woollett's may be esteemed a correct translation, we shall inquire upon some future occasion: at present, let those to whom the distinction is not rendered sufficiently obvious, recollect, that neither in the case of the basso-relievo nor the engraving is local colour employed, which forms so indispensable a part of a picture, and is consequently so essential to the production of the resemblance of a picture, that it would have been among the first considerations that would have engaged the attention of him who should conceive he was exercising an art of copying that of painting."

In a future number, if we can possibly spare room, we shall give a larger extract from this amusing and valuable work.

XLVII. *Proceedings of Learned Societies.*

ROYAL SOCIETY OF LONDON.

April 9. The right honourable Sir Joseph Banks, Bart. President, in the chair.—The reading of Capt. Flinders's Observations on the magnetic needle was continued. The captain made a great variety of experiments both at sea and ashore on the variations of the needle; and was led to conclude, that the guns and shot aboard ships are sufficient to produce a magnetic atmosphere, which must operate powerfully on the polarity of the needle. Hence he infers the reason of the variations in the needle according to the direction of the ship's head, which amounted sometimes from 4 to 8, 9 and even 10 degrees. As to the regular variations, he found no material difference between his own observations on the coast of New Holland, and those made by Capt. Cook 30 years before.

April 16. The President in the chair.—The reading of Capt. Flinders's paper was concluded; and that of another, by Everard Home, Esq. "On the Stomachs of Animals," was commenced. The author's observations were first directed to ruminating animals, noting their different appearances on dissection, and the number and dimensions of their respective cavities or bags. He afterwards details his numerous remarks on the size and peculiarities of the stomachs of several other animals, all of which were illustrated by well-executed designs, taken in general from fresh subjects.

April 23. The President in the chair.—A letter from Dr. Olbers to Dr. Young (foreign secretary to the society) was read, announcing his discovery of a new planet on the 29th and 30th of March last. This planet is about the size of a star

star of the 5th or 6th magnitude, and was found in the sign *Virgo.**

The reading of Mr. Home's paper on the stomachs of animals was then resumed. This anatomist continued his remarks on the peculiar and the analogous features of this organ in man, horses, dogs, rabbits, elephants, &c. &c. which were illustrated by numerous drawings. The remainder of this paper was postponed till next meeting.

SOCIETY OF ANTIQUARIES.

On Thursday the 23d of April, being St. George's Day, the Society met at their apartments in Somerset-place, in pursuance of their statutes and charter of incorporation, to elect a president, council, and officers, of the society, for the year ensuing; whereupon

George earl of Leicester,	Anthony Hamilton, D. D.
William Bray, esq.	Samuel Lysons, esq.
Nicholas Carlisle, esq.	Craven Ord, esq.
Francis Douce, esq.	John lord bishop of Salisbury,
Sir Henry Charles Englefield, bart.	Joseph Windham, esq. and
	Rev. T. W. Wright, A. M.

eleven of the council, were re-chosen of the new council; and

Frederick Aug. Barnard, esq.	George Isted, esq.
Hon. Robert Clifford,	Sir Thomas Plumer, knt.
John lord bishop of Exeter,	John Townely, esq.
William Fitzhugh, esq.	George Vanderzee, esq.
Henry viscount Harberton,	Roger Wilbraham, esq.

ten of the other members of the Society, were chosen of the new council, and they were severally declared to be the council for the year ensuing: and on a report made of the officers of the Society, it appeared that

George earl of Leicester was elected president,
William Bray, esq. treasurer,
Samuel Lysons, esq. director,
Rev. T. W. Wright, A. M. secretary; and
Nicholas Carlisle, esq. secretary for the year ensuing.

The Society afterwards dined together at the Crown and Anchor Tavern in the Strand, according to annual custom.

* See a subsequent article in the present number.

ROYAL COLLEGE OF SURGEONS.

The surgical prizes given by the college have this year been adjudged as follows:—The prize for the best essay on the "Diseases of the Joints," has been adjudged to Mr. S. Cooper, of Golden-square; and that for the "Essay on Hernia," to Mr. Lawrence, of John-street, Adelphi.

We understand that both these essays will very shortly be given to the public.

SOCIETY OF ARTS AND SCIENCES OF HAARLEM.

This Society has proposed the following as prize questions; the answers to be transmitted (post free) to M. Van Marum, their secretary, at Haarlem, on or before the 1st of November 1807. The author of the best of each of the memoirs is to receive a gold medal or thirty ducats. The papers may be written in Dutch, French, Latin, or German.

1. What have the most recent observations taught us on the subject of the influence of oxygen of the atmosphere? Is it connected with light in the alteration of colours; and what utility may be drawn from such observations?

2. As experience has shown that rain water, which runs through leaden pipes, or is kept in lead cisterns, carries off so much of the metal that the water becomes prejudicial to health, and occasions fatal diseases; and as such food or liquids which are prepared in contact with lead are also deleterious, the Society, therefore, requires to be informed of the best method to prevent or remedy these pernicious effects. The Society also particularly requires it to be pointed out, from actual experiments and observations, in what circumstances lead communicates its pernicious qualities to water? Whether lead might not be so wrought as to prevent any bad consequences? Whether we have any reason to be afraid of the white lead collected in leaden pipes? What is the best method of avoiding any bad consequences from this cause? To point out if there are any good grounds for thinking that the glazing which is made use of for China or stone ware, communicates any of its pernicious qualities to the victuals or drink which may be put into vessels made of these

 materials;

materials; and what is the best method of preventing these bad effects?

3. What has experience taught us on the subject of purifying putrid water, or other things, by means of charcoal? How far can we explain its action on chemical grounds; and what further advantage can we derive therefrom?

4. What is the real difference, in properties and consistency, between sugar extracted from sugar-canes, and that which is the produce of some trees and plants? Does the latter contain true sugar; or can we alter it into true sugar?

5. What is the cause of the shining of sea water? Does this arise from the presence of living animals only? What are these animals? and do they communicate any deleterious effect to the atmosphere? This is required to be decided from the result of positive observations; particularly that it may be ascertained how far the shining of the sea, which is very remarkable on the coast of Holland, has any connection with contagious and epidemic diseases.

6. What is the most probable origin of what is called spermaceti? Can this substance be separated from whale oil, or be produced therein? and could this be done to advantage?

FRENCH NATIONAL INSTITUTE.

Notice of the Mathematical Labours of the Class of Sciences in the French National Institute for the Year preceding the 1st of July 1806. By M. Delambre, *perpetual Secretary.*

To give a hasty sketch of the mathematical labours of this class; to present it in few words, without, however, omitting any thing which might ensure to the different authors the share of applause they have merited; to detail their discoveries by employing with reserve the language of science; to notice their difficult and abstract researches, and at the same time show their importance, if it does not show their whole merit in detail: such is the task which is imposed upon us, and the object we attempt, without flattering ourselves we shall be able to attain it.

We

We have already heard how rich the harvest of this year has been in the science of nature: the zeal of the mathematical department has not been worse supported, nor less fortunate. Even those of our fellow-members who had the greatest right to enjoy in tranquillity the renown acquired by a long series of labours, have not shown less ardour or less activity.

Thus, in the question started on the subject of the new measure of the degree in Lapland, when it was necessary to discover the cause of the error which had been committed in 1736, M. Lalande has sought, during the course of long experience, facts which might put us in the way of the desired explanation. He recollected that at this time the use of the proving telescope was entirely unknown. This instrument, so convenient and so simple, which was supposed to be invented about the same time as the application of telescopes to sectors and quadrants, is more modern, however, than we thought: we make use of it every day, as is too often the case, without inquiring to whom we are indebted for it. It is mentioned for the first time in M. Lalande's Astronomy, in the edition of 1764. In order to adjust the parallelism of the telescopes, Bouguer recommended the use of two little pins, which might reciprocally change places, to ascertain whether they really had the same height. He himself made use of a more imperfect method, and which may, still less than the pins, enter into comparison with M. Lalande's proving telescope, so universally adopted at present. We are uncertain whether Graham had any thing equivalent to this for adjusting his sector: Maupertuis makes no mention of it in the chapter where he treats of the adjustment of this instrument; and this negligence may partly explain the error which is imputed to him.

This same measure of the degree in Lapland has given occasion to M. Lalande to furnish us with another memoir, where he demonstrates the necessity of attending to the oblateness of the earth in the operations of levelling which reach to any considerable distances.

The attention of all the astronomers of Paris was given to the eclipse of the 16th of June last. To M. Messier, one

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of the members of the class, we are indebted for the only observation which succeeded. The clouds opened an instant for him only, and permitted him to see the beginning, which he observed at $4^h\ 52'\ 43''$. He was also able to measure three phases, the accuracy of which, however, he does not warrant.

The atmospheric variations which hindered us from seeing the eclipse, were also unfavourable for the observation of the solstice; but as the latter may be supplied by observations made on the days which precede and follow, we have collected a sufficiently great number of them together, in order to find a confirmation of what we have observed for these ten years past.

M. Bouvard, a pupil worthy of such masters as Messier and Mechain, has discovered two comets, and calculated their orbits. Messrs. Biot and Arrago have made these same calculations by the method of M. Laplace. M. Legendre has not omitted this opportunity of submitting to new trials the formula he published last year. We may justly remark, that there is scarcely any method which does not become inconvenient, or even uncertain, under particular circumstances. This is precisely what happened this time to M. Legendre; but he immediately found in his analysis resources to obviate the difficulty, which had not been foreseen in his first memoir, and to simplify considerably the general solution which he had given of the problem.

M. Legendre is now occupied on a more important question, although the applications of it are more rare: his memoir is entitled "*Analysis of Triangles described on the Spheroid.*"

The first astronomers who measured the earth with any accuracy considered it as a sphere, the radius of which is immense in comparison of the small intervals which they proposed to ascertain. The largest side of the triangle which enters into these operations is never 60,000 metres, and the difference between such an arc and the right line, which joins the extremities, is scarcely two decimetres, or a three-hundred-millionth part. We may therefore consider, with great reason, triangles whose curvature is so little, as rectilineal.

In

In operations where it is required to determine more exactly the difference between the terrestrial globe and a perfect sphere, attention must be carried still further. Triangles formed on the surface of the earth were considered as very small portions of a sphere, which in the extent of each triangle differs imperceptibly from the spheroid.

Does this supposition, less inaccurate than the preceding, promise all the precision which we wish for; and since it is a spheroid which it is required to measure, why have not the triangles been calculated as spheroidal? The question is so natural, that it ought to present itself at first sight to the astronomers who are occupied with the operation, and to each of the scientific men in Europe, who have united in order to examine and judge the work lately executed. In one of the first meetings of the commission, a learned foreigner, M. Tralles, remarked that the bases of Melun and Perpignan ought not to be simply considered as arcs entirely in the same plane, but as curves with a double curvature. This remark had before been made by Clairant more than fifty years ago; but it was always thought that the effect of the double curvature could not become in the least sensible, except upon intervals much greater than those which are given us to measure directly; and it was concluded that the consideration of the spheroid would only uselessly complicate calculations which were already become too complicated. In fact, the spheroid differs far less from the sphere than the sphere itself differs from a plane. But the sphericity of the triangles only introduces into the calculations terms of the second order for the angles, and of the third order for the sides. It was therefore natural to think that the terms depending on the spheroid were of an order still higher, and still more insensible by their extreme minuteness. But although no person had as yet written upon this subject, we ought not to conclude from this that we should remain contented with vague considerations and simple probability. This point is discussed under the article *Calculation of Triangles* in the second volume of "*The Determination of the Meridian,*" now in the press: it is expected to demonstrate, by very simple and entirely elementary considerations, that the difference between the spherical and spheroidal angles is not more than 1-60th of a second in the greatest of our triangles, and that the double curvature does not change the length of the greatest of all our sides more than about a centimetre. These results are confirmed by the ingenious analysis of M. Legendre.

To these geometrical considerations upon the figure of the earth, we were anxious to add the geographical researches upon the extensive plain of the interior of Africa, by M. Lacepede; the researches upon Persia, and the communication of the Caspian with the Black Sea, by M. Olivier; but these memoirs belonging more particularly to the physical sciences, and having been analysed by M. Cuvier, we shall pass on to the *New Memoir of M. Ramond upon measuring the Height of Mountains by the Barometer.*

We said in our notice of 1805, that there was scarcely 1-500dth of difference between M. Laplace's coefficient for calculating the height of mountains by the observation of the barometer, and that which M. Ramond has deduced from the numerous observations of this description which he made in the Pyrenees. Some new researches have entirely dispelled a difference which might be attributed to the uncertainty either of the barometrical observations, or to the old experiments upon the weight of the air and mercury, which M. Laplace considered as data in his calculation. M. Biot has recently repeated these experiments with every possible precaution: it results from this that the coefficient ought to be diminished by nearly 1-500dth, and the agreement between the two methods is then complete. On the one hand, we see the geometrician resting on facts observed in a cabinet, and deducing from thence a rule for measuring the height of mountains: on the other hand, we see an observer taking for a base the known height of a mountain, and the effect it produces upon the elevation of the mercury in the barometer, and concluding from it the relative weight of mercury and air, and finding again the same quantity which was made use of as the foundation of the geometrician's calculations. These comparisons, which are daily multiplying in the application of analysis; these identical results,

results, obtained by processes so contrary, and drawn from phænomena so different, are proofs to which the most obstinate sceptic can have nothing reasonable to oppose.

This important result is not the only merit of M. Ramond's memoir. We there find means for distinguishing circumstances which are favourable or contrary to this kind of observation. The author ranges them under three different titles: the Influence of the Time of the Day; the Influence of Stations; and the Influence of Meteors. That of the time of the day occasions the altitudes observed in the evening and morning to be always too small; whence it follows that it is always best to make observations about the middle of the day: and this is easily attained. The influence of stations is not less real, but it is less easy to be guarded against. The rule to be followed is, that the portable barometer and the barometer of comparison should be in stations where the local circumstances are perfectly similar. Great distance is not always an obstacle: thus M. Ramond remarked that his observations at the Pyrenees, compared with those continually made by M. Bouvard at the Imperial Observatory, present a regular agreement, whilst these same observations of M. Bouvard compared with those of M. Ramond made at Marli-la-ville, indicate from one day to another, differences of from ten to eleven metres in the relative height of the two stations; whence we conclude, that the use of the barometer for measuring heights that differ but little is rather uncertain, when the two stations are on a plain.

As to the Influence of Meteors, it always acts in the same sense; it makes the heights appear too small, and we ought to reject all observations made on a stormy day. From all these considerations, it follows, that in order to measure the height of a mountain more accurately, we must not indifferently take a mean between observations taken at different seasons, and at different times of the day, as by this means we should evidently be liable to find the heights too little.

We shall not mention the grand work which Messrs. Biot and Arrago have just concluded, upon the affinities between the different gases and light. M. Biot himself will read an extract of it to the Institute.

There will also be read a memoir by count Rumford, on the adhesion of the molecules of water; but we shall give the principal results of the observations made by this learned philanthropist, *upon the dispersion of the light of lamps by the means of shades and globes of ground glass.*

The facility with which the eye distinguishes objects, does not merely depend upon the intensity of the light which illuminates them, it also depends much upon the shadows; if they are simple and well marked, the vision is distinct: but if the light comes from several sides at once, there are several shades which confound and weaken them; hence we see badly even with a good deal of light. A good distribution of the light is therefore important for œconomy, and particularly for the preservation of the eyes.

The direct rays of a lamp, with a double current of air, fatigue the sight. In order to lessen this inconvenience, shades of different kinds have been invented, and at last globes of ground glass. What renders the use of the latter less common is the fear of losing too much light. Nobody, in France at least, has attacked this prejudice, but count Rumford demonstrates, by an experiment very easy to repeat, that the loss of light is almost insensible. The surface of ground glass, full of furrows and roughnesses, presents to the light a number of minute smooth planes, but differently inclined, which dispersing the light, render it softer, and distribute it in such a manner as to carry a more uniform clearness to every corner of the piece which we wish to illuminate.

This advantage is not the only one possessed by ground glass. Being substituted instead of polished glass, in the glazing of windows, it will spread the light of day with more equality in the highest as well as in the lowest situations, in the furthest as well as the nearest; and this remark is particularly useful for great cities, where the confined width of the streets and the height of the houses, only admit of the light penetrating very obliquely. The author has

has seen a proof of this fact; and the explanation he has given of it is extremely natural.

This memoir is terminated by the description of a new lamp, so constructed as not to admit of any direct ray being seen, and yet to give the most equable and pleasant light in every corner of a large saloon, without throwing any shade, although the reservoir for the oil is circular, and the cylinders which distribute the light are placed in the centre.

We should give but an imperfect idea of the labours of the class, if we omitted to speak of the particular works of each of the members; but the bounds we have prescribed to ourselves not allowing us to enter into any particular detail, we can only barely mention the reports upon the particular Solutions of Differential Equations and Equations of Differences, presented by M. Poisson; on the new Demonstration of the Principle of the Virtual Velocities, by M. Ampère; on a new Method of raising Water to a Great Height, by M. Baader, engineer to the king of Bavaria; on the Experiments of M. Peron, made upon the Physical Strength of Savages compared with that of Europeans, and from which he has drawn this result, which will surprise many,—That there is no comparison in this respect between the civilized man and the savage, and that the difference is completely in favour of the former.

Among the inventions approved by the class, we ought to mention the spinning-wheel of M. Bellemere, which enables many industrious persons to double their work: the loom for wrought and finished stuffs, on account of the simplicity of its operation, has been thought worthy to be kept as a model, and of a reward from government to M. Rivey, its inventor: the stocking loom of M. D'Autry, the reporter of which stated its advantages with so much precision to the class, that he was ordered to print his report in order to serve as a history of the art: lastly, another stocking loom of M. Favreau Bouillon, which has reduced all the labour to the simple balancing of two levers; an advantageous improvement, which admits of this machine being easily wrought by weak persons, or such as have only one arm.

Since

Since its last public sitting, the class has published the first volume of memoirs, presented to it by learned foreigners, and vol. vi. of its own memoirs. The subsequent volumes will be published every six months, commencing with the month of July next. The class has also published the first volume of *The Meridian of Dunkirk*, being *the basis of the metric-decimal system:* this work will contain all the observations, all the methods of calculation, which have fixed the two fundamental unities of the metrical system, the metre and the kilogramme.

Several members have published new works, and new editions of works already known, in which we find important additions. Thus M. Legendre has published a sixth edition of his Geometry, and M. Lacroix a second edition of his Traité Elementaire du Calcul Differentiel et Integral.—Astronomers have now Tables of the Sun, in which, for the first time, the attractions of all the planets are taken into account.

Lastly, M. Lagrange has given a more complete edition of the *Calcul des Fonctions*, a truly classical work, which it would be superfluous to mention here to such geometricians as have considered the whole of it, and difficult to give in a few words a sufficient idea of it to those who have not. The same reasons compel us to pass rapidly over a dissertation lately published by M. Laplace as a supplement to the tenth book of the *Mecanique celeste*, and in which he gives a complete theory of capillary action. For the first time we see these phænomena so contrary in appearance happily referred to one law; the ascension and depression between two planes explained by the same analysis which accounts for analogous phænomena, which are remarked in tubes; the numerical results of the theory perfectly identical with those of the observations, perhaps still more exact than Messrs. Haüy and Tremery have made expressly in order to submit the new theory to the most rigorous trial.

Let no one imagine that these delicate researches have no other merit than that of difficulty overcome, every thing holds in the physical sciences as in nature herself; there is no phænomenon which, when explained, does not throw

throw some new light upon some other phænomenon. From the new theory there results already the decision of an important point in meteorology. Opinions were divided upon the method of estimating the height of mercury in the barometer. The one party reckoned from the base, and the other from the summit of the convexity. This last method is much less inaccurate, but it still gives heights that are less than those which result from the pressure of the atmosphere; the difference is the effect of the capillary action. In order to correct it, the author points out two methods: one of which is analytical; the other, which will no doubt be preferred by the greatest number of observers, only rests upon an easy experiment and a very simple and short calculation. By one or other of these means, results will be obtained more precise, more certain, and which may be more easily compared.

XLVIII. *Intelligence and Miscellaneous Articles.*

ANOTHER NEW PLANET.

M. Olbers has discovered a new planet, being the second which we owe to the observations of this learned and indefatigable astronomer. The following was nearly its situation: On the 29th of March at $8^h\ 21^m$, mean time, $184^d\ 8^m$; northern declination, $11^d\ 47^m$; on the 30th of March at $12^h\ 33^m$, mean time, $189^d\ 52^m$; northern declination, $11^d\ 54^m$.

This new planet was found and observed by Stephen Groombridge, esq. at his observatory on Blackheath, from the account transmitted from the Continent. Mr. Groombridge says, it appears as a star of the sixth magnitude, of a dusky white colour, very like in its appearance to the Georgium Sidus. Observed in the meridian of Mr. Groombridge's observatory, Blackheath, the following were its positions on the 25th and 26th inst.

	R.A.	Decl. N.
April 25th,	$11^h\ 56^m\ 50^s$	$12^\circ\ 57'\ 46''$
26	11 56 25	12 56 44

The

The persevering industry with which Mr. Groombridge applies himself to the cultivation of so useful a science as astronomy, merits the highest commendation.

P. S. Just as our work was going to press, Mr. Firminger favoured us with another observation by Mr. Groombridge, as follows:

April 27th, at $9^h\ 36^m\ 1{\cdot}6^s$, mean time, right ascension $11^h\ 56^m\ 2^s$; declination 12° 55′ 19″ N.

ANTIQUITIES.

There has been lately discovered in the collection of the duke of Buccleugh, a curious manuscript of the statutes of the Orders of the Garter and the Bath, with various old drawings; among the latter are portraits of Richard III. and of Anne, his queen. These drawings prove to be the originals from which the late lord Orford's outlines were taken, as represented in his "Historic Doubts," and it is remarkable, that the above learned nobleman was always of opinion that the original was in existence. (Historic Doubts, page 104.)

Mr. Sancho, of the Mews Gate, has presented the public with a fac simile of these interesting portraits.

LALANDE SENIOR.

This astronomer died at Paris, on the 7th of the present month (April), in the 75th year of his age. By his will he ordered his body to be dissected, and the skeleton to be placed in the Museum of Natural History. His relations, however, regardless of this ridiculous injunction, buried him a few days after his death. His funeral was attended by the members of the French National Institute.

MISCELLANEOUS.

The bust of D'Alembert has been placed in the hall of the National Institute by order of the emperor Napoleon.

A Swedish naturalist (chamberlain Liung) has discovered the smallest animal of the order of mammalia that has yet been seen; he calls this animal *Sorex caniculatus,* and it is a kind of earth mouse.

LECTURES.

LECTURES.

Mr. Taunton will resume his Summer Course of Lectures and Demonstrations on Anatomy, Physiology, Pathology, and Surgery, on Saturday, the 30th of May 1807, at Eight o'clock in the evening precisely, at No. 21, Greville-Street, Hatton-Garden. The Lectures will be continued at the same Hour every Tuesday, Thursday, and Saturday.

Particulars may be known by application to Mr. Taunton, as above.

On Monday, the first week of June, a Course of Lectures on Physic and Chemistry will recommence in George-street, Hanover-square, at the usual morning hours; viz. the Medical Lecture at Eight, and the Chemical at Nine, by George Pearson, M. D. F. R. S. Senior Physician of St. George's Hospital, and of the College of Physicians.

Proposals may be had in George-street, or at St. George's Hospital.

LIST OF PATENTS FOR NEW INVENTIONS,

For March and April 1807.

To John Day, of Camberwell-green, in the parish of St. Mary, Lambeth, stone-mason; for his method of applying friction-boxes, either with or without a perpetual screw, spindle, and cog-wheel, to extend and facilitate the power of engines, cranes, capstans, and other machines used for loading and unloading ships or vessels, and for raising anchors and other great weights or bodies, and also to the steerage-wheels of ships or vessels. March 20.

To Thomas Johnson, mechanic, in Glasgow; for a machine for weaving yarn. March 23.

To Archibald Thomson, of the parish of St. John, in the city of Westminster, and county of Middlesex, engineer; for certain improvements (by the application of known principles) upon certain parts of mill-spinning, for spinning wool or cotton. April 2.

To James Peache, of Cupers Bridge, Lambeth, in the county

county of Surry, barge-builder; for a floating hollow buoy on a new construction, for supporting mooring chains, cables, ropes, &c. April 8.

To William Chapman, of the town and county of New-castle-upon-Tyne, civil engineer; for a method or methods of reducing the wear, and prolonging the duration of ropes used in drawing coals, or other minerals from pits or shafts of mines. April 8.

To Samuel Williams, of Finsbury-square, in the city of London, merchant, in consequence of a communication made to him by a foreigner residing abroad; for a new and improved machine and machinery for spinning wool, cotton, hemp, and other filamentous substances. April 8.

To Richard Francis Hawkins, of the parish of St. Ann, Limehouse, in the county of Middlesex, gentleman; for certain improvements to all kinds of gun and carronade carriages, so as to facilitate the working, or using, securing, and housing thereof, particularly adapted to ships. April 8.

To William Southwell, of the city of Dublin, musical-instrument-maker; for certain improvements upon a piano-forte, which is so constructed as to prevent the possibility of its being so frequently out of tune as piano-fortes now generally are, which he denominates "A Cabinet Piano-Forte." April 8.

To William Chapman, of the town and county of New-castle-upon-Tyne, civil engineer; for a method or methods of putting coals on board of ships, lighters, and other vessels, so as to prevent a great portion of the breakage of the coals, which takes place in the usual method of shipping them by spouts. April 11.

To Thomas Paty, of St. Thomas's Watering, Kent-road, in the parish of St. Giles, Camberwell, in the county of Surry, manufacturer; for a method of dyeing, spinning, weaving, and manufacturing of East India Sun-Hemp into carpets, and carpet-rug mats, which will be more durable and less expensive than any now in use. April 11.

To Alexander John Forsyth Clerk, of Belhelvie, Aberdeenshire, in Scotland; for his advantageous method of discharging

discharging or giving fire to artillery, and all other fire-arms, chambers, cavities, and places in which gun-powder, or other combustible matter, is or may be put for the purpose of explosion. April 11.

To Anthony Francis Berte, of the parish of St. Dunstan in the West, in the city of London, merchant, in consequence of a communication made to him by a certain foreigner residing abroad; for certain improvements in casting printers' types and sorts, and other articles of metal. April 15.

To James Forbes Dalton, of High-Holborn, in the county of Middlesex, coach-maker; for certain improvements in the construction of four-wheel carriages. April 21.

To William Shotwell, of the city of New York, in America, now residing in the city of London, merchant; for certain machines and improvements upon machines for the purpose of bleaching, washing, and cleansing linen and every other article that can be done by hand. April 21.

To Abraham Matterface, of the parish of Christ Church, in the county of Surry, millwright; for certain improvements in the construction of a machine for mashing and mixing malt. April 21.

To Mark Noble, of the parish of Battersea, in the county of Surry, engine-maker; for a new chain-pump, a new hand-pump, and a new improved extinguishing fire-engine. April 25.

To Robert John Stanley, of the town of Gainsborough, in the county of Lincoln, gentleman; for a new method of tanning leather without the use or application of bark (or mineral astringent) except in the tanning of backs and bins, yielding a great advantage both in respect to time and expense, whereby as good, if not a superior, article or commodity is produced. The ingredients required by this method of tanning are entirely of a vegetable quality, and the principal part thereof the produce of the United Kingdoms. April 28.

METEORO-

METEOROLOGICAL TABLE,
By Mr. Carey, of the Strand,
For April 1807.

Days of the Month.	Thermometer. 8 o'Clock, Morning.	Noon.	11 o'Clock, Night.	Height of the Barom. Inches.	Degrees of Dryness by Leslie's Hygrometer.	Weather.
March 27	36°	43°	39°	29·82	7	Cloudy
28	38	43	38	·72	6	Cloudy
29	39	43	34	·75	10	Cloudy
30	36	40	36	·77	15	Cloudy
31	35	44	35	·52	5	Cloudy, with snow
April 1	35	41	36	·57	0	Cloudy, with snow
2	32	33	33	·75	0	Great fall of snow
3	30	41	32	·84	30	Fair
4	28	42	34	30·10	25	Fair
5	37	46	35	·16	36	Fair
6	36	53	35	·07	51	Fair
7	36	55	46	·06	47	Fair
8	46	58	44	·24	45	Cloudy
9	44	63	46	·24	55	Cloudy
10	46	53	49	29·92	22	Small rain
11	49	56	50	·56	41	Fair
12	52	60	46	·40	48	Fair
13	46	55	41	·30	10	Showery
14	40	56	40	·35	30	Fair
15	40	41	40	·36	0	Showery
16	40	40	32	·62	10	Cloudy
17	32	32	31	·78	0	Great fall of snow
18	32	43	30	·82	21	Fair
19	32	42	31	·95	24	Fair
20	32	41	32	30·16	16	Cloudy
21	33	43	36	·10	26	Cloudy
22	36	51	44	29·90	26	Cloudy
23	44	58	49	·92	30	Fair
24	49	63	50	30·05	27	Fair
25	51	64	52	·15	40	Fair
26	51	66	49	·25	55	Fair

N. B. The Barometer's height is taken at one o'clock.

XLIX. *Letter from* Ezekiel Walker, *Esq. containing further Remarks on his new Transit Instrument.*

To Mr. Tilloch.

SIR,

In a paper, which was printed in the 25th volume of the Philosophical Magazine, p. 173, I described a method of constructing an instrument for observing the sun's transit over the meridian upon a much smaller scale than that which I had formerly used, yet sufficiently exact for regulating common clocks and watches; but it now appears, from an instrument that has lately been erected according to those directions, that the method deserves further consideration. A gentleman has communicated to me five observations, made with this instrument, on the sun's passage over the meridian; and the greatest difference between any two of them amounts to no more than one second and six tenths. These were the only observations that this gentleman had taken at the time he communicated them to me, and not chosen out of a great number: they were taken with a chronometer, which was immediately compared with observations made on the same day with a transit telescope. Hence I am inclined to believe, that with some improvements in the construction of this instrument, and in the mode of using it, the sun's transit may be determined still nearer the truth.

When the utmost precision is required, it will be necessary to protect the instrument from the extremes of heat and cold, by laying the foundation of the pier about two or three feet below the surface of the ground, and from that depth erect a small building over it, at the distance of eight or ten inches, leaving an empty space all round. This building should be carried up higher than the gnomon at the south, but it need not be more than six or eight inches higher than the stone upon which the meridian line is drawn at the south.

If the plane on which the line is drawn should dip either to the north or to the south, the correctness of the instrument will not be affected by it; nor will a small inclination east or west alter the position of the line itself, but it will affect the gnomon. It is therefore necessary to make this part of the instrument adjustable, which may be done in the following manner:

Let a triangular stone, resting on three foot screws, be placed with one side facing the north and the opposite angle pointing to the south; near the middle of this side the gnomon must be fixed to stand directly over the meridian line. Then, by means of these screws and a plumb-line suspended from the top of the gnomon, the right line which passes through the centres of the perforations may be readily set perpendicular to the horizon. The plumb-line must be suspended on the south side of the gnomon to pass over two dots, one made near the top of it, and the other near the bottom, in a line parallel to the line of perforations; and, as the plumb-line will not be in the way when observations are taken, it may always remain attached to the instrument.

No light should be suffered to enter the instrument from the south further than the gnomon, except those rays of the sun which are transmitted through one of the small apertures made in it; but at the north a small door must be made in the roof, to be opened when the observations are taken.

The precise time that the limb of the solar image comes in contact with a line drawn on a plane surface, cannot be exactly observed, in consequence of the penumbra which surrounds; but I am of opinion that this inconvenience may be avoided by using a different mode of observing.

The eye is capable of judging with considerable exactness when a right line divides a circle into two equal parts: thus in fig. 1. Plate VII. it is easy to see that the segment on the right hand side of the line is greater than the other; in fig. 2. it appears that the circle is divided into two equal parts, but in fig. 3. the greater segment is on the left side of the right line. Hence I am inclined to think, that if an observation be taken when the line bisects the solar image, it will be nearer the truth than when the two limbs are observed. If five lines be drawn at proper distances, five observations may be taken this way in less time than six minutes.

But a still better method would be to observe with three lines at a time, as represented in figures 4, 5, and 6, as the [illegible] eye

eye would be better able to judge when the two small segments are equal than when the whole circle is divided into two equal parts. I am persuaded that the mean of five observations taken by this method would determine the time of the sun's transit over the meridian to less than a second, with a gnomon only three feet high erected upon a stone three feet in length.

To illustrate this mode of observing by an

Example,

If fig. 5. (Plate VII.) represent the solar image, and the distance between the two lines *a* and *n* be = 108″, the two segments will be each = 10″ when the sun is in the equator, as he then takes about 128″ in passing over a space equal to his own diameter. Then, if an observation be taken only 1″ too soon, the two segments will be to each other in the ratio of 9 to 11, which may be too great a difference to pass unobserved.

When five observations are to be taken by this method, it will be necessary to have seven lines drawn at equal distances; but the first observation must not be taken until the centre of the solar image be upon the second line, at which time the first and third lines will cut off two equal segments; when the centre comes to the third line, the second and fourth lines will cut off two equal segments; and the third, fourth, and fifth observations must be taken in the same manner. If these lines be drawn at such distances that the centre of the solar image may take about 54 seconds in passing from one line to another when the sun is near the equator, the five observations may be taken in less time than four minutes.

This instrument, though erected at a small expense, is infinitely more convenient for keeping the rate of a clock or a chronometer than either Hadley's sextant or the astronomical quadrant, and perhaps superior to either of them in point of accuracy.—I am, sir,

Your most humble servant,

Lynn, April 9, 1807. EZ. WALKER.

N. B. The letters *no* are omitted in Plate III. vol. xxvii.

Erratum.—On page 99, line 18, for *objects* read *object*.

L. *On the Utility of making Family Wines from several of our Garden Fruits, especially for benevolent Uses. Extracted from an Address, on different Topics, to the Board of Superintendence of the Bath and West of England Society.* By W. Matthews *.

I will now beg to be indulged with your attention to another subject, which some circumstances of the times have led me to reflect on. I mean the present enormous price of foreign wines. It may possibly occur to some of you, that this subject, however serious in a national point of view, is not among those which such a society as ours can hope to take up with success; and even, that it is not among those subjects most properly cognizable by our institution; that foreign wines may be considered, which frequently has been the case by the legislature, as an article of luxury, but little connected with the comfort of the great body of the people. To these possible objections I am prepared in part to assent; and I would not lightly ask attention to a subject of doubtful propriety. But my views are not directed to wine as a luxury, or to an interference with the taste and habits of persons of sufficient wealth to afford the prices which are now paid for the different kinds of foreign wine. From all present appearance, a sufficient number of those persons will be found to purchase whatever may be importable from the foreign markets, at whatever shall be the current prices. I propose to consider the real use of wholesome wine for medicinal purposes, and those of general comfort, frugally used among the middle and lower ranks of the community. It is allowed, and justly, that for the laborious classes the refreshment of sound malt liquor is the common article of the country; and that no substitute for that, or the wholesome unadulterated cider of some districts, is either to be expected or prudently sought for. But it is to be considered that there are innumerable cases in which some refreshing vinous liquor, different from these, is frequently desirable, for the comfort of persons in delicate situations and states of health, who cannot afford the expense of even a very little foreign wine; many

* From *Letters and Papers of the Bath and West of England Society*, vol. x.

many of whom, from motives of what they deem œconomy, have recourse to the use of different kinds of spirits, too often, indeed, in large quantities; but among the more cautious, even the smaller ones, though diluted with water, are commonly injurious. It is also obvious that the beginning of this habit of using spirits is too commonly delusive in a large degree, and insensibly leads on to strong and confirmed habits of pernicious drinking, especially in towns and cities. The mischief to health and morals is well known to be incalculable. The wines commonly sold under the name of British sweets, and which formerly used to be resorted to in cases of sickness and weak health, are now become so expensive, that even their aid is generally beyond the reach of the poor; and it seems probable that the consumption is chiefly by adulteration of foreign white wines, affording a lucrative trade, by mixture, for tavern consumption, and partly also, in a like mixed state, for private families. Thus the revenue is considerably diminished by the deception. This last, though not an immediate object of our concern, may be allowed its weight in favour of what we wish to propose, as very desirable in itself, and but in a small degree doubtful with regard to the revenue, *i. e.* the increased manufacture of family wine from the best of our own fruits. What these are, or may by management be, is the next question. To the red and white currant, commonly used, there seems an objection, on account of the acid quality from which their juice is almost inseparable, except by long keeping; and I cannot but look with much more confidence towards the black currant, the abundant juices and salutary virtues of which seem to have been too little known. Indeed, as an article for wine, few persons seem to have regarded it, though perhaps it will be found to be one of our best garden fruits for the purpose in question. There is in this fruit a richness beyond the common estimate; and its flavour, though to some palates unpleasant when eaten in its recent state, is found to lose much of its characteristic roughness and flavour, when judiciously made into wine, and kept to a moderate age. I am confirmed in this statement by sufficient authority; and perhaps in many cases of sickness, as well as for more common use, it has salutary properties, which render it more valuable than the public are generally aware of. The black currant tree is known to be hardy, and in our climate an abundant bearer, by the common mode of garden propagation. But it is well worthy of trial, whether it may not be trained against the walls of the garden, and the sunny sides of houses and cottages, with still greater success. From the best accounts I can get, this seems highly probable; and if so, such abundant propagation may be at once easy, and largely beneficial for our purpose. That such has not been the general practice, is no good reason why, under strong recommendation, it should not become so; and recommendation of useful things, in all the departments of culture, is certainly one of the proper provinces of this comprehensive society. The best mode of making such wine may be more commonly known than practised; and at any rate it is as easy as any similar process. I therefore feel much confidence of utility from our recommending this domestic object. Another fruit presents itself to our notice, which, in all countries famed for its wines, is of proverbial excellence, *i. e.* the grape. I am aware that it is a common opinion that our climate is in general too cold and precarious for the full ripening of the grape; and that vineyards, which in various places have been attempted, have not succeeded so as to answer the cost and labour of vintage. I am persuaded that few are the situations in this island where success may be expected in open-field culture. That object, therefore, I cannot think of recommending. But experience, and some considerable observation, have convinced me that much greater success may be expected than many persons are aware of, in cultivating the vine in our warmest districts against the southern walls of numerous farm-houses, country cottages, and even in the small gardens of many towns and cities, where the soil is light and favourable, and that with very easy attention. In cold lands and bleak exposures it would be a fruitless attempt, and common reflection would point out the absurdity. But in some parts of the county of Essex, though less favourable to its success than in other spots of our island,

island, particularly in Devon and Cornwall, I have known vines so abundantly and successfully wall-trained, as to produce, for private families, an ample supply of most pleasant and valuable wine. Indeed the practice is so common among the cottagers and others inhabiting houses built of brick, that at the ripening season many poor and middling people are in the habit of selling large quantities of grapes, at very reasonable prices, to their more wealthy neighbours, for the purpose of making wine. And it is not easily conceivable, by strangers to the practice, what quantities of useful and pleasant wines are made in warm summers from these sources, and that at an easy expense. The fruit, indeed, cannot be expected to be uniformly ripe and excellent, but by far the largest part of the bunches are generally good, and fit for use; and those who have been most in the habit of the manufacture, and can afford to keep the wine by them for years in succession, well know that the improvement by melioration of time is sufficiently remarkable and encouraging. As to the benevolent uses to which such wines may be occasionally applied among the poor and sickly of a neighbourhood, little need be said to recommend the practice. It is sufficient to say, that this species of useful benevolence is known to be excited by the cheapness and ease with which families in sufficient affluence become possessed of a moderate store by their own œconomy and provident exertions. I would therefore submit to you the propriety of our recommending a more general attention to this domestic object than our part of the nation seems to be acquainted with. The risk is small indeed; no land, useful for the purpose of agriculture, need be encumbered with it. The trial is easily made. The success may be at once pleasing and beneficial; and examples of such success, though gradual in their evidence, may become in process of time extensively and lastingly influential.

William Matthews.

I shall now take the liberty of annexing a letter on the foregoing subject from an old and valuable correspondent, James Anderson, esq. LL.D. and F.R.S., in answer to one written to him in the style of inquiry, his garden abounding with excellent wall-trained vines.

"DEAR SIR, Isleworth, Jan. 24, 1804.

"I received your letter, some days ago, respecting the wines that may be made from the natural fruits of this country, which I should have sooner answered, could I communicate any thing of the importance I wished; but that not being the case, I felt a great reluctance at the thought of troubling you with any thing not satisfactory.

"I can say little else than that, from our own experience for a short time past, and what I have seen of others, I am perfectly satisfied that wine may be made from our native fruits;—red and white currants, gooseberries, black currants, raspberries, and other fruits, (with the help of sugar,) as good, and of as rich a flavour in all respects, as any that are imported from abroad. But the particulars in the process that may vary the qualities of the wine, where the materials are the same, are so numerous, and the time that must elapse before the result of any experiment can be known is so great, that I despair of living to see any certainty established on this head. At present, I sometimes taste as good wine of that sort as could be desired, and again as bad as can be thought of, made by the same persons, when they can assign no reason for the difference. From our own limited practice I have been able to ascertain only two points that I think can be relied upon as tolerably well established: These are, first, that age, I mean not less than three years, is required to elapse before any wine that is to be really good can attain such excellence as to deserve the name of good; and second, that it never can attain that perfection if spirits of any kind be mixed with it. I apprehend that most of our made wines are greatly hurt by not adverting to these two circumstances.

"Another circumstance that is, in my opinion, very necessary for the formation of good wine of this sort, is a certain degree of acidity in the fruit, without which the wine never acquires the zest which constitutes its peculiar excellence, but hurries forward too rapidly into the state of vinegar,

gar. Currants at all times possess enough of that acidity; but if gooseberries be too ripe they are apt to want it, and become insipidly sweet at an early period, though they soon become vinegar. It ought to be remarked, that the native acidity of the fruit is different from the acidity of vinegar, and possesses qualities extremely dissimilar. The sourness of vinegar, when it has once begun to be formed, continues to augment with age; but the native vegetable acid, when combined with saccharine matter, is gradually diminished as the fermentation proceeds, till it is totally lost in the vinous zest into which both this and the sugar are completely converted before any vinegar is produced, if the fermentation be properly conducted.

"This, I believe, is a new opinion, which experience alone enabled me to adopt not very long ago. But I have had so many experimental proofs of this fact, independent of the support it derives from reasoning, that I am satisfied it is well founded. I am satisfied further, that the wines of this country are debased chiefly by not adverting to it, and of which I think you will be convinced also by a moderate degree of attention.

"Every person knows that an insipid sweetness is the prevailing taste in liquors when they begin to ferment, and that it is gradually changed into a pungent vinosity as the process proceeds; but few persons have had occasion to remark that the native acid of fruit undergoes a similar change by the fermentatory process. Every one who tastes made wines, however, soon after the process has commenced, perceives that sour to a certain degree is mixed with the sweet. It chances, indeed, that the sweet is sooner blended than the sour; so that when the liquor is tasted a few months after it has been made, it hath lost some part of its sweetness, but still retains nearly the whole of the sourness of the native acid of the fruit. And as the vinous flavour is yet but weak, the liquor appears to be thin and weak, and running into acidity. It is therefore feared, that if it be not then drank, it will soon run on to the state of vinegar; on this account it is often used in this state, when it forms a very insipid beverage. Frequently also, with a view to check the acetous

tous process, and to give that degree of strength which will entitle it to the name of a cordial liquor, a certain portion of brandy is added to it, after which it may be kept for some time. The effect of this addition is to put a stop to that salutary process of fermentation which was going slowly forward, and gradually maturing the native vegetable acid into vinous liquor, which being at last blended with the saccharine vinous juice, produces that warm exhilarating fluid which cheers the heart and invigorates the strength of man. In this way, the sharp, insipid, and poor liquor which was first tasted, is, by a slow process, which requires a great length of time to complete it, converted into rich pleasant wine, possessing, in a great degree, that high zest which constitutes its principal excellence.

"My experience does not yet enable me to speak with certainty respecting all the circumstances that may affect the flavour, or augment or diminish the strength of wine, or accelerate or retard the time of its ripening. But my opinion at present is, that a great part of the flavour of wine depends considerably upon the skin of the fruit, which may be augmented or diminished by the degree of pressure the fruit is subjected to, and other particulars connected with it; or by the macerating the fruit more or less in the juice before the skins be separated from the pulp; and that the ultimate qualities of the wine are considerably affected by the proportion of the original native acid of the fruit conjoined with the saccharine part of the juice. It seems to me very evident, also, that the saccharine juice can be more quickly brought into the state of wine than the acid portion of it, and that of course those wines that consist entirely of saccharine matter, flavoured only by some pleasing vegetable perfume, such as cowslip or elder-flower wine, and others of similar sorts, may be sooner brought to be fit for drinking than those in which the juice of fruit form a considerable ingredient, and may be also made of a weaker and lighter quality. And that fruit wines, in proportion to the diminution of the quantity of fruit to that of sugar, or in proportion to the quantity of acid in the fruit, may be accelerated or retarded in the progress of fermentation; but that strong full-bodied wine, of good flavour, must have a considerable

siderable proportion of native acid, and requires to be kept a long while before it can attain its ultimate perfection.

"I have had too little experience in the practice of making grape wine to enable me to speak with precision. The flavour of different kinds of grapes, we know, varies considerably, which must affect the wine; but other circumstances in the process must affect it greatly. It is the only fruit known in this country that affords juice in abundance sufficient to admit of being made into wine without the addition of water, or rich enough without the use of sugar. Two years ago the season was so favourable that my grapes (the muscadine) ripened completely, and I determined to try to make some wine of them without either sugar or water. The juice was squeezed out by hand without any other pressure, as I had no press. It fermented very well, and after a proper time it was tried. The liquor tasted sweetish, but wanted much of the vinous zest we wished for. This arose, I have no doubt, from the want of a due proportion of native acid, which would have been probably supplied by a complete pressure of the must, had I possessed the means of doing it; especially if the bunches of grapes had not been separated from the small foot-stalks to which the berries adhere. But not having a quantity sufficient to make it worth while to have a press, I thought of another method of attaining the end I aimed at, to which I was forced to resort: on finding that birds and vermin are so greedy of the grape, that it is a matter next to impossible to preserve them for any time here in quantities after they are ripe without being broken, which, by letting the juice flow out, lodges between the berries in the clusters, and which there becomes mouldy, and communicates a musty taste that cannot be gotten rid of.

"To avoid all those evils, I determined to gather the fruit when it is so far ripened only as just to begin to be pecked by the birds. As the juice possesses at that time more vegetable acidity and less of the saccharine taste than when fully ripe, I conceive that the wine made from it will be sharper and have a higher zest than the other; but dreading that the juice might not be sufficiently matured to do by itself, I added a portion of sugar and water to the juice, and have

have put it by for trial. It fermented well, and the liquor has at present as promising an appearance as I could wish. Should this mode of making grape wine succeed, it will be by far the cheapest wine we can make in this country; for the quantity of juice yielded by the grape is so much more abundant, and so much richer than that of our other fruits, and it is so much easier to be gathered and otherwise managed, that it must be much more desirable. The quantity of fruit produced, too, is so much greater when the vines are properly managed, than can be gotten from the same extent of ground of other fruits, as to give it a decided preference on the whole. I have just now in my cellar about forty gallons of that wine made from the grapes that were gathered from a wall of about fifteen yards in length, and fifteen feet high. Nor was that a crop above the average. Neither had that wine above half the quantity of sugar that other fruit wines would have required. I have no doubt that were vines raised from seeds of the best and earliest sorts, and carefully selected when they come to bear, we might thus obtain a grape that would ripen very well in this country without the assistance of a wall. It is by no means improbable that such a vine was once known in England.

" Next to the vine, I agree with you in thinking that the black currant is the best fruit we have of that kind for making wine. I have seen some of it that was truly excellent. It would be of great use for giving flavour to some other wines.

" When I began this letter I thought that I had nothing to say; but being once begun, it has run on to an enormous length. I hope you will forgive me for it. I now speak little, and write less: and it requires an effort for me to begin with either; but, like a disorderly clock, when I am once fairly set a-going, I run on perhaps without rhime or reason. Wishing you success in all your useful pursuits,

" I remain, dear sir,

" Your most humble servant,

" JAMES ANDERSON."

To Mr. Matthews.

LI. *Ob-*

LI. *Observations upon the crystallized Bodies contained in Lava. Read at the Meeting of the Physical and Natural History Society of Geneva, on the 17th of April* 1806. *By M.* G. A. De Luc*.

Volcanoes hold such a remarkable place among terrestrial phænomena, that they have become the subject of a multiplicity of conjectures upon their origin, influence, and the geological consequences which might be drawn from them. Wherever they were put in requisition in order to found a system upon them, they have been made to act that part most convenient for their authors. In this manner they have seized upon a simple and isolated fact, the only one of its kind which has no relation except with the soil occupied by the volcano and its environs. Several naturalists and geologists, although a volcano only resembles mountains of its own species, and does not at all resemble other mountains, either in form, construction, or the substances which compose it, have concluded that the layers and mountains on the surface of the earth owe their origin to the action of fire; that element, as they say, presenting us every day with productions entirely similar to the primitive rocks of the globe.

From this it results that these naturalists regard the different crystals inclosed in lava, not as productions in the humid way, anterior to the lava, and which existed in the layers reduced into fusion by the volcanic fires, but as crystallizations formed in the lava itself, and of its own substance, by the slow cooling of the mass.

It is chiefly upon this opinion that M. Fleuriau de Bellevue has founded the system he has adopted and published upon the action of the fire of volcanoes and upon the formation of the terrestrial globe, of its layers and its mountains, inserted in the *Journal de Physique* for May 1805.

Let us reduce this question to its most simple term, viz. The crystals which lavas contain, have they been formed in the

* This is a second paper by M. de Luc on this subject. The first paper has already appeared in the Philosophical Magazine.—See our last Number.

the lava and its substance; or are they foreign to it, and formed anteriorly, by the humid way, in the substances or layers which the volcanic fires have reduced into fusion? From this inquiry, deduced from the true state of things, and carried by facts to a degree of evidence beyond all uncertainty, a question will be decided of important consequences to geology, by presenting a just idea of volcanoes and their phænomena.

The principal argument of M. Fleuriau de Bellevue is drawn from the connection which he finds between the formation of crystals contained in lavas and the species of crystallization which has been called crystallites, and which are formed in the glass-house pots when in a state of fusion, and afterwards slowly cooled.

We shall now examine what these glass crystallites are. The entire mass of cooled glass presents a confused crystallization all of the same colour, in which we see small compact bars confusedly interwoven, some of them slightly striated and others disposed in stars equally confused. At other times there is formed at the bottom of the crucible a multitude of threads which cross each other, and also present starry forms.

In the first case, these crystallites compose even the mass of the glass, and are only distinguished in some places; in the second, there are seen, through the transparency of the glass, these heaps of threads and star-like forms, which have some connection of form with the small stars of ice which fall along with the snow in a strong frost. Perhaps we see some examples of vitreous crystallizations more decided; but this case, which is rare, only proves that there may be such a circumstance as favours this crystallization in a very small space.

M. Fleuriau de Bellevue finds that these crystallite forms singularly resemble the tremolite. This opinion, that there exists a singular resemblance between two substances, of which the one is a production of a vitreous nature, and the other of a mineral layer, astonishes me, I must confess; for in that case there is no substance which we might not assimilate to another, if it only has a relation to it in point of form.

form. Thus we may say that capillary schorls, or mineral asbestos, resemble cotton or linen threads, although between these two substances there is merely a resemblance of form, without any reality. This remark was necessary, because one might think from the expression "singularly resemble" that there is something more than a mere appearance.

The tremolite, which derives its name from Val-Tremola, near St. Gothard, one of the principal places where it is found, is a radiated mineral substance, the threads of which are often of a brilliant white, and united in sheaves or bundles. These sheaves issue from one centre and diverge in a round form, which gives them the form of a radiating star; and, these centres being varied, from this there results different directions in the rays, the length of which is from half an inch to three inches and upwards. This mineral substance is one of the most curious and agreeable to look at. It is sometimes mixed with talc and calcareous spar, *i. e.* of two substances, one of which is vitrescible, but of difficult fusion, and the other is calcinable; a circumstance which of itself excludes the idea of the least relation between the tremolite and the produce of the glass-houses: and when we compare these products with the brilliant threads of the tremolite, which, taken by themselves, have each the form of a four-sided prism, we must be astonished that such an assimilation has been made. The tremolites are vitrescible but not vitrefied, and never were so.

Let us, however, turn our attention to such crystallized bodies inclosed in lava to which the vitreous crystallites have been assimilated. I can make this comparison upon a great number of pieces, which I collected in burning and extinguished volcanoes.

The lavas which contain leucites, or white granates, also frequently contain pyroxène volcanic schorls, and crysolites or olivines *. Here there are two kinds of crystals, very distinct from each other by their form and colour, contained in the same lava, surrounded by the same crust, which in

* I shall afterwards designate these schorls by the name of *pyroxène schorls*, because the simple denomination of *pyroxènes* does not belong to them exclusively; all the bodies contained in lavas being also pyroxènes, *i. e.* strangers to fire.

itself

itself has no relation to them, either in its nature, colour, nor chemical properties, as we shall soon see.

The form of the leucites and pyroxène schorls is perfectly determined; nothing is confused, all is precise and well characterized. The leucite is constantly of a round form, shaped into 24 trapezoidal faces, and of a whitish gray colour; the pyroxène schorl is an octaëdral prism with two biëdral* pyramids of a deep olive colour, and sometimes black; the crysolite is of the colour of a peridot. These three crystals are found in the spongy and cellular lava, as well as in the compact lavas.

The schorl is so strongly united to the lava that it cannot be detached from it, nor appear with the polish of its faces and the distinctness of its angles, unless by a chemical operation produced by the sulphurous acid fumes of the volcano. The leucite is more easily separated, leaving upon the lava a distinct impression of its round shape. Its impressions in the lava may be compared to those left by granates, cubical martial pyrites, and several other crystallized substances upon the rocks which contain them; with this difference, that the impression of the leucites is made in a manner in fusion, and that of the granates and pyrites in a rock which had been in the state of softness by the humid way.

From this the following conclusion results: That the leucites are no more a formation produced in the lava at the moment of its cooling, than granates and pyrites are a formation extracted from the substance of the rock which contains them when it is dried and hardened. Both equally are foreign to the substance which contains them, and have existed before it; the leucites before the lava, and the granates and pyrites before the rock which envelops them. We often found also the leucites isolated, and in a great number, among the volcanic ashes.

Do we see in this exact description of facts any resemblance, any analogy between bodies crystallized in lavas and the confused heaps of vitreous crystallites formed of the substance of the glass in the crucibles of glass-works? Neither is there any resemblance between these curious crystalliza-

* This is the author's own term.—A. T.

tions of cooled glass and the crystals of the beds of our mountains, all of constant and regular form each in its species.

The pyroxenated schorls are also often isolated, and sometimes in innumerable multitudes. The crater which opened at the base of Mount Ætna in 1669, which elevated a cone of 4300 paces in circumference at its base, from which proceeded the enormous lava which we now see, and the mass of which astonishes us, shows a peculiarly striking example of this. The summit of this crater is covered with these schorls mixed with small scoriæ, with this remarkable circumstance, that the schorls at the exterior of the crater have all, without exception, retained at their surface a crust of lava which envelops them, and that those of the interior show their natural polish.

I shall here explain the cause of this difference, to which, I think, I am the first observer who has directed his attention. The sulphurous acid fumes of the volcano penetrate and decompose the surface of the lavas and scoriæ which are there exposed, and the schorls which they do not attack appear at that time, *in relievo*, in their whole integrity perfectly cleaned from the lava which environs them, as rock crystals, covered sometimes with a calcareous stone, are sometimes cleaned of it by the nitrous acid, and appear in all their lustre. Here is an operation proving that there is no chemical affinity between lava and the pyroxenated schorl it contains, since the one is attacked and dissolved, and the other is not. This effect sometimes presents a very curious spectacle: it is pleasing to see these schorls of all sizes, even microscopical, fixed upon lava, the surface of which had been decomposed, brilliant in their polish and very sharp at their angles.

It sometimes happens that the schorls themselves are attacked and their colour altered, so that their points appear like small crystals of sulphur, or of a whiter tint; this effect is produced, without doubt, when the fumes contain a mixture of acids that act upon the schorl being united, which they cannot do separately; a chemical operation, of which we have a well known example in aqua regia, composed of nitrous and muriatic acid.

To these facts, which prove most completely that these crystallized bodies are anterior and foreign to the lava which contains them, I shall add, as a superabundant proof, a singular accident, found in the ashes which covered Pompeia, and which is in my collection of volcanic matters.

It is a leucite isolated from three to four lines of diameter through its whole crystallization, joined to a schorl, the greatest part of the prism of which it embraces; this schorl is also in its perfect crystallization, and each of these crystals has retained the colour which is proper to it: we see by the vestiges adhering to the schorl that these two crystals have been enclosed in a reddish spongy lava. This is not the only curiosity of that description I am in possession of; I have another from the same place, not so clean as the former, because it has retained more lava. It is also a leucite of the same size, perfectly distinct, which embraces a small group of schorl, one of which is greater than the two others which are joined to it.

Are these not similar examples to those which frequently happen to the crystals of the layers formed by the humid way? These green-schorls, or epidotes as they are called, which we see enclosed in rock crystals; these micas, these pyrites, also enclosed in this same species of crystal, and the latter, in its turn, in crystals of calcareous spar,—junctions which indicate a succession of formations. The green schorls, micas, and pyrites, have preceded the rock crystal, and the rock crystal has preceded the calcareous spar. We also find junctions of these three crystals in the same order. Whence this natural conclusion follows, that the pyroxène schorl has preceded in its formation that of the leucite.

I shall also mention spongy lavas, which show in their fractures leucites partly isolated and the greater number solitary, and others in groups, as it happens to crystals of every kind. Is this the process; is it what is shown by that confused heap of crystallites of cooled glass in the melting-pots of glass-houses?

We

We know of no lava of Ætna, and I know of no others which contain leucites; nor lavas of Vesuvius which contain the whitish crystalline laminæ so abundant in the lavas of Ætna. This is a fact to which those naturalists who think that these crystals are formed in lava ought to pay some attention. If the leucites are in reality formed in them, Why do not the lavas of Ætna contain them also; while the latter are filled with pyroxène schorls and chrysolites, which are common to them with the lavas of Vesuvius? Is this difference rather not more naturally explained by the absence of the leucite in the beds from which the lavas of Ætna flow?

We observe these same varieties in the lavas of different volcanoes. Those of Hecla, some large specimens of which I have, which were brought by Sir Joseph Banks, neither contain pyroxène schorls, leucites, nor chrysolites, but plenty of small white crystalline bodies cleft into pieces, from the size of a hemp-seed to that of a pea, and of an irregular form, which have the appearance and the hardness of quartz, and which seem to be actually broken from it.

The lavas of Mount d'Or, an antient volcano in Auvergne, contain large crystals of *amphibole*, or hornblend and feldspar, which by their cracks and vitreous reflection show that they have experienced the action of the burning lava; and we find in other old volcanoes in Auvergne, pyroxène schorls without leucites.

The small gravel of the volcanic lake of Andernach is filled with isolated pyroxène schorls, both whole and in fragments. Do we find in this state the confused rays of the cooled glass which form part of the mass of the glass, from which they cannot be separated, except in irregular fractures?

Among the facts which I opposed to the opinion of sir James Hall, quoted by M. Fleuriau de Bellevue, an opinion which is the same as his, I mentioned a singular eruption of Vesuvius which happened in 1754. An orifice was opened near the level of the valley which separates the present cones of Mount Somma. This orifice formed at the production of the lava a grotto fringed by the shootings of melting lava; it was a mass of scoriæ in the form of stalactites, the sprigs of which, interwoven together, of a reddish colour and full of hollow bubbles, were from three to six lines in diameter. In the fractures of these sprigs I found pyroxène schorls of a perfect crystallization and of a deep olive colour. These shootings of lava show that the lava was in complete fusion, and that the sprigs were cooled and hardened the moment they were separated from it.

There was here no slow cooling which could have formed these crystals, nor was there a continuous mass sufficient to give birth by this means to crystalline forms. Nevertheless there are pyroxène schorls, the most of them even at the surface of the shootings: Is this not a new proof that these crystals were pre-existent to the lava? M. Fleuriau de Bellevue does not admit this conclusion; but if we draw our attention to the fact, we shall find it very probable. The surface of the sprigs of this singular stalactite and that of the interior of the bubbles are covered with a multitude of brilliant points, which are only perceived when the light shines strongly on them; when viewed with a magnifying glass, they look like minute particles of sublimed iron.

The following is another very remarkable fact, and which, in order to discover it, requires all the attention with which I entered upon the observation of volcanic phænomena; I have already mentioned it, but it is necessary to bring it again before the public.

The branches which are separated from a flowing lava, or the lava itself when it is not abundant, are broken into fragments at their extremity, which in this case has no progressive motion, except by the shaking of these fragments pushed forwards and sideways by an interior impulsion. These heaped up fragments preserve their inflamed state a long time: this is very perceptible at night; and in the daytime it is known by their great heat, and the sulphurous fumes and mephitic gases which they exhale. These fragments, broken from the lava itself, and which have never been for one moment uninflamed, show pyroxène schorls at their surface. I am in possession of two of these fragments, which I gathered at a place where they abound. What can we reasonably object to this great number of

 facts?

facts? "M. Salmon and M. de Buch," says M. Fleuriau de Bellevue, "have demonstrated to all those who are acquainted with volcanoes in activity, that the crystals of leucites cannot be formed except during the slow cooling of the lava."

I am acquainted with volcanoes in a state of activity; I have given some proofs of it; and nevertheless I draw from my observations quite a contrary conclusion. The facts I have quoted, which are true and exact, decide the question.

As to the opinion of these two naturalists, I may add, that it is wrong in an essential point. Upon what is the distinction founded which is made between leucites and pyroxène schorls and chrysolites, since these three crystals are found together in one and the same lava? They are separated from each other, and from the paste of the lava, by a line equally clean and distinct as the small flints which compose a pudding-stone are separated from each other and from the paste which joins them. If one of these crystals is foreign to the lava, the two others are so also: this is a rigorous consequence. The fact is rather completely certain that the whole three are foreign to it.

The two examples I have mentioned of isolated leucites, each of which envelops pyroxène schorls, is a fact inexplicable in the hypothesis of the formation of these crystals by fire, while nothing is more frequent or more easy to conceive than these mixtures among crystals of different species by the humid way.

"I should never finish my observations," M. Fleuriau de Bellevue proceeds, "if I related all the objections which present themselves against the system of the pre-existence of crystals in lava: we find several of them, under the articles *Lava* and *Leucites*, in the New Dictionary of Natural History, where M. Patrin has strongly combated these suppositions."

I am sorry to hear this; because the readers of this dictionary, who may be desirous of knowing what lavas and leucites are, will be led into error. I have presented *facts*, and not *suppositions*. In the phænomena of terrestrial na-

 tural

tural history, the exact knowledge of which always depends upon truths in point of *fact*, I was never fond of suppositions, which rarely lead to any thing else than error.

I shall call to M. Fleuriau de Bellevue's recollection a very remarkable lava of the antient volcanic mountain of Vituba. This lava contains a multitude of leucites, from the size of a large pea to that of a grain of rapeseed. These leucites have undergone a sort of calcination, which renders them very white; and the lava which contains them is black; which makes a very singular contrast between the two substances. Is it not evident that all these leucites existed previously to the lava? If we reject this conclusion, we might, with equal propriety, contend that every foreign body whatever contained in a rock has not existed previous to that rock.

The leucite does not resist the action of fire and volcanic vapours in the same degree as the schorl does: the volcanic vapours seem to have almost as much hold upon it as upon the lava; at least, none of the specimens in my possession, upon being exposed to their action, showed any leucite well preserved. But it retains its characteristic form in the midst of burning lava. When the heat is carried to a higher degree, it may soften it, and cause it to undergo a sort of calcination; it then falls into shivers, and the substance of the lava penetrates the leucite by the fissures; whence it happens that we see in its interior small parcels of lava, which are distinguished by their black or brown colour and small bubbles: but the form of the leucite is preserved, and is not at all altered, because, the lava enveloping it intimately, no part of its surface can be separated from it. This is the case of the leucites of the old lava of Viterba; and we see upon the piece I have, several indentations of leucites with the impression of their faces. The lava and the leucites coming together from the fires of the volcano, the lava ought to be there in a degree of fusion greater than when it flows out; and in its subterraneous route moving through narrow passages which compress it, its substance ought to penetrate more easily into the crevices of the leucites.

It has been said that the lavas which have flowed out rapidly

pidly contain no leucites, and that those which have run out slowly contained them. This is a mere ideal distinction; because, By what sign can we ascertain that one lava has flowed rapidly and the other slowly? We should be very much embarrassed to determine it in a certain manner; and besides, What change can be produced in the substance of a lava by the more or less rapidity or slowness of its course?

The following is a very remarkable fact related by M. Dolomieu:—"The isolated leucites are so abundant in the environs of Rome, that it may be said that the road to Frescati is covered with them; the rains wash them down and collect them in large quantities in the ditches by the side of the road." At the end of this fact M. Dolomieu presents some conjectures upon the origin and formation of leucites, in which, I think, he is wrong; but he is very far from thinking that they are formed of the matter of lavas.

I have never seen this singular place, but I am in possession of a great number of these same leucites, from the smallest possible size to that of a small cherry; they seem to come from spongy lavas, not very far distant, which are decomposed. I have seen them of the same nature near Civita-Castellana; all their surface was sprinkled with a multitude of white grains. Unfortunately, and to my great regret, it rained heavily at the moment, so that I could not leave the carriage. How could we conceive that this multitude of isolated leucites in the environs of Frescati have been formed from the substance of the lava which contained them? The latter are a little transparent, and of a slight yellow colour. Do we recognise the colour and the substance of the lava in these leucites? In truth, we might maintain, with equal propriety, that the granates contained in a rock have been formed from the substance of this rock.

M. Fleuriau de Bellevue thinks that the crystals thrown out in an isolated manner by the crater "are new products, which have taken their origin in the crater itself on a former cooling."

There never was formed in the crater, or, to speak more precisely, on its interior sides, any thing else than crystals of salts or sulphur by sublimation, and never any crystal of a solid matter, such as those contained in lava.

In order to found this opinion he fixes upon two epochs: the first took place, according to him, in the crater itself, upon the occasion of a former cooling; and the second epoch took place outside the lava itself. A former cooling in the crater! Supposing we should admit this supposition. Here is a lava cooled and hardened. But in a lava which has attained this state, not one of the bodies it contains can be any longer separated from it in an isolated manner; for this purpose it would be necessary to replunge it into the fire of the volcano, or perhaps it would not enter into fusion.

The crystals which are found isolated upon the cone of the craters have been separated in the very bosom of the volcano by the boiling which the lava in fusion undergoes, and the squirtings of its explosions. The crater opened upon Ætna in 1669 shows a very instructing example of this. The very large cone elevated by this orifice is covered with an innumerable multitude of pyroxène schorls, all of them, without exception, covered with a slight crust of the lava which contained them mixed among the scoriæ which contained the latter themselves. This lava, from the first moment of its fusion, could not have been cooled for a single moment, yet here there are a multitude of crystals issued from the crater ready formed: Is it possible they could have been so formed by a former cooling of the lava? The enormous mass of this lava which has issued from the foot of the cone contains itself a prodigious quantity of these schorls, all the traces of them are distinguished upon the surface of the fractures.

This same lava, and the *jets* of its explosions, present another interesting fact. It contains, besides the pyroxène schorls, a multitude of small crystalline flakes of a whitish colour, which have no regular form, and seem to be nothing else than the shining particles of a substance, which are produced by the heat. These flakes are also isolated, mixed with schorls and small scoriæ. Can we here discover the *play of affinities* to which is attributed the formation of the

crystals

crystals contained in lava, when they have no regular form? Besides, the play of affinities cannot take place unless when the molecules upon which they act are at liberty to unite themselves; which could only take place in fluids in a state of perfect liquidity. This is not the case with the lavas, in the heart of which, it is said, these affinities are exercised. They are certainly in fusion, but it is a dull and heavy fusion, which has no progressive motion, except upon rapid declivities, or by the successive impulse given by the matter which comes out of the volcano pushing it forward and driving aside those which precede it. How could the affinities exert themselves upon such a mass?

The burning substances thrown out by the explosions of the crater, some of which are drops of compact lava, and others are fragments torn from the lava in fusion, at that time full of bubbles or presenting a thready substance, also contain pyroxène schorls, which are shown throughout the whole of these fragments when they are exposed to the erosive action of the vapours of the crater. This action is sometimes carried so far as to reduce these fragments to a state of softness almost equal to that of common flour paste; and the schorls being then also perfectly well preserved, they are very easily distinguished by their black colour from this yellow and sulphurous paste, which on drying resumes some consistency, but is easily broken. I have collected several pieces in these different states, which are at present before me.

We cannot suppose that there had been in this a former cooling for one moment, since these fragments were thrown from the cauldron of the volcano at the moment even of the greatest fusion of the substances it contains.

"One of the most natural ideas which would be presented in order to resolve so many difficulties," M. Fleuriau de Bellevue says, "would be to compare carefully the products of the volcanoes and the circumstances in which they are, with the results which the large masses of fire produce, by means of which we separate, dissolve, concentrate, and combine the minerals, and cause them to change their form."

I have

I have made this examination; I have compared the produce of the furnaces of glass-houses and those enclosed in lavas, and it results from this comparison that the difference is total.

"Every thing shows that in volcanoes the depth of their furnaces is immense." This is what M. Fleuriau de Bellevue says; and he adds, "this is the opinion of M. de Luc, and of several naturalists."

I have said, and I think, that the fires of volcanoes are of very great depths, against the opinion of those among naturalists who think that these fires are very near the base of the volcano, and who place them in the very cone even which rises above the ground; an opinion so contrary to every phænomenon, that it is wonderful how it could enter into any man's idea. But I do not think I ever used the word *immense*, which would indicate a depth which cannot be imagined even, and which is very far from my idea. The depth of a vertical league is a great depth, and I do not think that the fires of the volcanoes may be much deeper. But every thing shows that they have ramifications. The fragments of natural rocks which they throw out, can only come from these lateral galleries, from which they are detached and carried off by the lavas which traverse them. Another phænomenon also indicates it; that is, those burning places which are to be seen at the bottom of the sea in the neighbourhood of a volcano in eruption, at the same time that they are a sign that their fire is not at a depth which may be called *immense*. I have thought proper to dwell upon this expression, because, from this supposed depth, theories have been deduced as to the formation of the globe which have no foundation at all.

[To be continued.]

LII. *On*

LII. *On different Temperaments of the Musical Scale.* By *Mr.* John Farey.

To Mr. Tilloch.

Sir,

It was not until some days after the publication of your last Magazine, that a letter from a friend casually informed me that, in the *Retrospect*, vol. ii. p. 418, published on the 1st of February, an eminent writer and professor of mathematics had noticed a letter of mine in your Magazine for November last (vol. xxvi. p. 171) on what I then called Mr. Hawkes's system of musical intervals, but what Dr. Bradley, a gentleman not less distinguished for his knowledge on this subject than for his medical skill, has very lately informed me was practised long ago, and published, I think he said, in Holder's Treatise on Harmony, printed in 1694; a learned work, which I lament not to have seen: but for my ignorance of the publication of the remarks in the Retrospect above alluded to, and which are preceded by a review or examination of lord Stanhope's essay, with which I was alike unacquainted, I should earlier have replied to that part of the same, which relates to *the proper object of temperament*, or to *the principles on which we ought to decide, on the pretensions of different systems proposed.* Conceiving that the investigations of Dr. Callcott, this learned professor, myself, and other persons engaged in the inquiries which the publication of lord Stanhope's essay has happily set on foot*, are unlikely to lead to any practical improvement, unless these preliminaries or *data* are truly settled; on this account I earnestly invite the free remarks of the above gentlemen, or of any others, who have considered the subject, on what I have written and am about to write on these essential points; and, should they happen to differ with me, that they will carry their reasonings through, to

* Which inquiries, I sincerely hope, will not again subside, until practical musicians are able to reap that advantage which they have in vain hitherto sought in the works of mathematical writers, on this very curious and important subject.

the stating of general and definite propositions, which do include *the true principles of temperament.*

First, then, I conceive that we may fairly throw out of this consideration every thing relating to full performances by voices, violins, and other *perfect instruments*, or those whereon each performer can at will, make any gradation of pitch, however minute, in order to produce a *perfect chord* with the note of some one other of the performers, who, either from taking the principal part in the piece under performance, from the opinion entertained of his superior skill (if performing a subordinate part,) from the early, firm, or loud striking or sounding of his Note, happens *to lead the harmony* in that instance; it being far from universally true, that the upper parts always attemper their *melody*, or leaps from note to note, so as *by that means* to make harmony with the bass part; but it as often happens, perhaps, that a bass voice or violoncello performer, finds himself obliged to yield the note which his, perhaps superior, judgment and dexterity would have struck, or indeed nascently did strike, and instantaneously to slide a little higher or lower, to avoid a false or *tempered harmony* with some early and loud soprano, counter-tenor, or tenor voice Note, or that of some instrument under the same circumstances:—where obligatos for particular instruments with fixed tones, as for flutes, oboes, &c. are introduced, the occasional temperaments in the *melodies* of the parts, for voices or perfect instruments, are still further multiplied; as they are again by the frequent lowering, and sometimes raising of the pitch altogether, in performances entirely vocal; and respecting which I feel justified, on the authority of Dr. Robison, in saying that the nicest ears are incapable of judging of intervals *in melody* within one-third of a comma (an error which produces a disagreeable jar *in harmony*), and in asserting that a frequent and perhaps perpetual undulation of pitch takes place in such performances: on all which accounts, the *intervals of melody* which are actually introduced in such performances, probably amount to *several hundreds* within the octave! How absurd, then, to think of limiting such to *twelve* intervals within the octave; notwithstanding that the very

very *language of music writers*, or the notation of music itself, may be still in that barbarous and unrefined state as to want the power of expressing more than those *twelve* sounds; and that organs and all *imperfect instruments* are limited to that, or even to a smaller number of notes within the octave —the trumpet, horn, &c., for instance: and let it be recollected, that *vocal and perfect-instrument Performers* never have attempted, and I may add never will or ought to attempt, to execute any system of sounds limited to twelve notes within the octave, because all such are *utterly inconsistent with perfect harmony* *, did performers possess the power of exactly accomplishing or giving such temperaments, but which it is evident that they do not. Although the number of temperaments, or intervals, necessary for accomplishing *perfect harmony* appear thus numerous, in performances where no tones are actually *fixed*, yet it follows, from the excellent writings of Mr. Maxwell, that, were *one* of the parts in a concert, the bass for instance, to be performed on a certain system of *fixed tones* (which it will be seen is quite consistent with *perfect chords*), that the number of notes would in this case not much exceed 60 within the octave to effect *perfect harmony*, or the avoiding of all temperaments therein, in modulating through 24 keys. If it should be objected, that the best performances by voices and perfect instruments do not always present us with *perfect chords*, I answer, that carelessness and deficiency of skill in the performers, together with the want of any common principle or pre-concert, on many occasions, as to *which part*, or note, should lead the conchords, occasion frequent attempts, by different performers, perhaps of the same part or instrument, at suiting their harmony, or being *led* by a different note or part, whence it is easily perceived that numerous anomalies must arise; but after all, these performances with all their defects, many, if not all of which are remediable by instructions from such an instrument as I have alluded to in page 206 (of which I may say more hereafter), are incon-

* Which is a definite and attainable thing, by the judgment of the ear only, of vastly more value, in the delight it affords, than any *temperament of harmony* whatever.

ceivably

ceivably more gratifying to the ear, than any modification of twelve notes within an octave possibly can be.

Secondly, before we can reason as to *the proper temperaments* to be applied *to the harmony* of the conchords (which are seven, viz. 3d, III, 4th, V, 6th, VI, and VIII, within the octave), it is absolutely necessary to determine *the exact number* of fixed sounds, which we mean to admit in an octave: in any one mode or key, practical musicians admit but seven notes, yet for the purposes of modulation, or changing of the key, they have extended the number to twelve, by the admission of five half-notes marked either ♭ or *, distinguished on keyed instruments by shorter finger-keys; and to this system of twelve notes within the octave, the writing of music throughout the civilized world is, I believe, confined, and almost all the instruments with fixed tones which are in use, are adapted to this system; yet attempts have not been wanting to remedy the glaring defects of this arbitrary system, by the introduction of more fixed tones within the octave, as at the church in the Temple, and the chapel of the Foundling Hospital, London, where fourteen notes are said to be admitted; in the instruments manufactured some years ago by Mr. Clagget, of Soho, (of whose principles and construction I should be glad to read some account,) where more tones were admitted; and in Dr. Robert Smith's harpsichords, where 21 notes within the octave were used: all these being for the purpose of *better tempering the harmony*, and not for *avoiding all temperaments* in the harmony, (as Maxwell's scheme proposes,) by throwing the same *into the melody*, where ordinary ears would not be able to perceive them, any more than in performances by voices and perfect instruments, by which last, *temperaments of the harmony* cannot be effected, according to any system, unless by accompanying in unisons, the fixed upper notes of an imperfect instrument, which I think no one would wish to recommend.

Thirdly, unless the exact number of *twelve* notes in an octave be assumed for tempered systems of fixed tones, to adapt them to the musical language and instruments in use, we are under the necessity, either of instructing musicians to

perform

perform on a greater number of finger-keys (or strings of harps, &c.) than they have been used to, which has not been, nor is it, I fear, very likely to be effected; or to adapt moveable stops, as Dr. Smith and Mr. Maxwell have described, for readily changing the pipes or strings on which the keys are intended to act, as often as a change of key requires. Hence we see one reason why lord Stanhope, and numerous others who have written on the temperament, have confined their inquiries to twelve notes, or to the *douzeave*, as I have ventured to call such a division of the septave, for the sake of distinction. We see also why the isotonic scale, or equal temperament, has so many advocates; because it agrees exactly with the imperfect language or notation of music, with the practice of modulation, and with the dogmas on this subject, (for I confess many of them have appeared such to me,) of composers and writers on the elements of composition.

Fourthly, our inquiries being thus limited to *douzeaves*, or systems of twelve fixed notes within an octave, it becomes important to consider, that every piece of music is written, that is, generally begins, and always ends, in some one key *major* or *minor*, which signify, systems of eight notes above a certain sound, called the *key note:* thus, c, B, A, G, F, E, D, C, are the notes in the *major* key of C, the last or lowest being its key note; c, ♭B, ♭A, G, F, ♭E, D, C, are the notes in the *minor* key of C, and a, G, F, E, D, C, B, A, of the *minor* key of A, or key of A minor, which last, from having none of the ♭ or ✻ notes in its scale, is often called the *natural* minor, or flat key, as the key of C major is for the same reason called the *natural* major, or sharp key. Before I speak of such modulations from the natural keys, as can call into action any of the ♭ or ✻ notes, it will be proper to show, that whatever intervals are assumed above the key or lowest notes C or A, as constituting the eight notes of that key, it becomes necessary to consider, *what is the effect of performing or accompanying a bass through this octave?* for instance, if in the major key of C we assume c, or the VIII = $\frac{1}{2}$; B, or the VII = $\frac{8}{15}$; A, or the VI = $\frac{3}{5}$; G, or the V = $\frac{2}{3}$; F, or the 4th = $\frac{3}{4}$; E, or the

the III = $\frac{4}{5}$; D, or the II = $\frac{8}{9}$; and C, the key or unison = $\frac{1}{1}$ (see vol. xxvi. p. 174, of your Magazine); and go through the comparison of the usually harmonies, which must be taken when D, E, F, G, A, and B, become successively the bass notes, in performing a piece of full music in that key, we shall find several instances wherein *an error of a whole comma occurs in the harmony*, and which cannot be cured by any arrangement or alteration of the intermediate or half-notes ♭ or ♯, because none of these are or can be used in this key, besides their laying, at the distance of several commas from the notes which are erroneous, and therefore cannot be substituted for them: thus, in considering or using D as a 3d below F, as a VI above F, or as a V below A, &c., we shall find that D, for such purposes, ought to have been $\frac{9}{10}$ (instead of $\frac{8}{9}$, at which it is properly fixed, for the other harmonies in which it occurs), or a *comma* different from its other value: in like manner, when B is to be used as a 3d below or a VI above the D last determined, &c., we shall find the same require the ratio of $\frac{27}{50}$ (instead of $\frac{8}{15}$, at which it is properly fixed for the other harmonies in which it occurs), or a *comma*, different; and thus has Mr. Maxwell ably shown that, *no septave* (or octave, as it is called, when the key note is repeated at top) can be *perfect*, as lord Stanhope (p. 19, and others of his essay) asserts his key of C major to be; but every such contains *within itself* temperaments, perhaps equal to or exceeding a comma! and nothing short of a *neufave*, or system of *nine notes within the octave*, for each key, both major and minor, can cure this inherent defect or disagreement between melody and harmony.

We have next to consider, that composers and performers are in the constant habit of modulating into different keys, or of making at times every note in their *douzeave* a key-note, major as well as minor: thus the keys in use are not less than 24 in number, but these are by no means of equal frequency in use; if they were, I think every practical musician would at once agree, in adopting the *isotonic* or equal division of the *douzeave, for imperfect instruments*; and here our inquiries might end: but the fact is, that the occurrence of these different keys *in practice*, is very different as as to frequency, although the same has never yet been ascertained or expressed in numbers, for accurately stating *their proportionate frequency of occurrence*; and hence, a large portion of practical musicians or performers on *imperfect instruments* *, as well as professional tuners, reject the *isotonic* system; and claim, some to make one key *perfect* (as they improperly call it), or *nearly perfect*, and some another, without assigning any just or satisfactory reasons for their assumptions, as may be fairly objected to lord Stanhope, in his very imperfect attempt at obtaining perfection in his key of C major.

But further, we ought not merely to know how frequently each key is likely to occur, and how long to be used, in proportion to the use of the other keys, in order to make *the keys* proportionally perfect, in the order in which they are likely to be used; but we are required to take into consideration, *the frequency with which chords*, between almost every two of the notes in the septave, (of which *each key* must consist,) are likely to occur: and this, I humbly submit, leads to the conclusion on this subject, which I came to at p. 176 of your xxvith volume, to which the learned Professor has in the Retrospect (no. 7. vol. ii. p. 420 and 421) objected, and whose objections I beg now the liberty of considering, in a way which I hope that he will not hesitate to examine, whatever I may write on this or any other subject. In p. 420, Mr. Professor, after speaking of *logarithms* as the measures of ratios, or means of deciding on the pretensions of different systems proposed, says: "The best system of temperament will be much more readily ascertained by this mean" (logarithms) "than by endeavouring to determine, as Mr. Farey likewise recommends, the proportionate frequency of occurrence of the several harmonic intervals," and "advising that the chords most frequently occurring may be made proportionally nearer to perfection;

* It has been shown, I hope, that *vocal* performers and those who use *perfect instruments* have nothing to do with this inquiry, all keys being alike to them, whether pitched exactly from any note in a given *douzeave*, or from any possible intermediate pitch, as a key, as every singer knows.

because (says the professor), since *other chords* beside these must necessarily occur in different parts of every piece of music, the ideal system now objected to cannot be adopted, any more than lord Stanhope's, without doing mischief, and particularly by occasioning transitions, during performance, from a better to a worse harmony." How, I ask, are logarithms to be applied to determine *the best* system of temperament, but on some *principle*, previously settled, as to *wherein the perfection* of a tempered system consists? In the letter alluded to (vol. xxvi. p. 176) I mentioned the principle, quoted above, which I have endeavoured more fully to explain in the previous part of this letter, and which, it may not be irrelevant to state, was the result of many conversations with the late justly celebrated Dr. Arnold, and with other musicians, as well as of much observation and thought on the subject; and wherein I meant to include, the consideration of *every conchord* or harmonic interval (less than an octave) which can occur upon each finger-key as a bass or lower note, as a 3d, III, 4th, V, 6th, and VI, above each note, or 72 conchords in the whole; and my inquiry goes to the finding, by a very extensive experiment, a series of 72 numbers, expressing the order of frequency, in which the several chords above named arise in the music in use, or likely to be in use, if the experiment can be so far extended: these obtained, we should, I think, (if possible,) attemper the *douzeave* so, *that the imperfections of the conchords shall be in the inverse ratio of their frequency of occurrence.* What *other chords*, besides those included above, can arise? For I speak not of *dischords*, because their consideration would so involve the subject as to render all success hopeless; and after all, the absence of any sensible phænomena, like the *beatings* which attend conchords when tempered, renders it, perhaps, impossible to fix any principle on which their temperaments can be regulated; and they may therefore, I think safely, be left to receive such temperaments, as the fixing of the conchords may happen to give them. Does the learned Professor rest his objection, on the supposed inconsistency of that sound maxim, which I quoted from Dr. Smith (as to worse harmony succeeding better), with the principle I have

have assumed? In this case, let him reflect on what I said above, and consider, that chords *very differently* attempered* are not, according to the law of chances, very likely to succeed each other, because the whole attempering must lie within small limits, and one of the most frequent chords in occurrence, is not very likely to be preceded or followed by one of those the most rare of occurrence, and *vice versâ.* It is the want of agreement with Dr. Smith's maxim, on which my chief objection to the *isotonic* system (which the learned Professor thinks the best) is founded, and for explaining which I beg to refer him to Emerson's *Algebra*, prob. ccii, and to request of him to consider, what the effect must be of hearing a Vth (above the bass, or F cliff note), beating only once in a second of time, quickly succeeded by a III beating 11 times per second, a VI 13 times, a 3d 15 times, or perhaps, a 6th beating 18 times per second, and these perhaps intermixed with 4ths, which beat but $1\frac{1}{3}$ times per second? It is my fear that lord Stanhope's system will furnish frequent instances, of transitions from *perfect* Vths to those *beating very considerably*, and from the former to other chords, beating faster perhaps than those stated above; which induces me to withhold my approbation of it, until a complete table of all its temperaments and beats is before us, and which I heartily wish that some person, with more leisure to spare for these pursuits than myself, would undertake. In the remarks at the top of p. 421, a similar oversight is, if I mistake not, observable, as in lord Stanhope's essay, in first fixing the notes by means of a regular series of *fifths* (tempered in this case), and afterwards talking of adjusting the same notes, to suit the temperaments of the *thirds*. The temperaments of no one conchord ought to be exactly the same, throughout the octave, nor ought any one interval above the key to be attempered, without taking into consideration, the effect which the same will have upon all the conchords above and below its upper note, according to the view which I have taken of this matter. I beg to be

* I have not yet attempted to decide, whether this attempering should be regulated, without taking into consideration, the degree of temperament which different conchords will bear.

 permitted,

permitted, before I conclude, to say a few words on what has fallen from the learned Professor, in the same number, respecting the Stanhope system (p. 417): and first I would ask, How is Dr. Smith's system, or *vintunave*, to be reduced to a *douzeave* for use on the common instruments? And if this is not to be done, but the doctor's unmutilated system to be used, surely it must be preferable to the isotonic?

The *test* which we find proposed in this page, of the comparative correctness of different tempered systems, appears to me useless, and incapable of any decision: if the singer, or violinist, is to make *perfect chords* with the notes which he hears on the imperfect or tempered instrument, are they to be unisons with the upper notes? and with which of those notes, if the piece is full? or are they to be true conchords to the bass? In either case, what result can be expected different, from what might have been heard on the instrument itself, without singing or fiddling to it? I cannot doubt but the learned Professor would, on reconsideration, prefer examining a table of the *differences* of the logarithms, and of the number of *beats* per second, to any test of this kind. And I remain

Your obedient servant,

JOHN FAREY.

12, Upper Crown-street, Westminster,
May 8, 1807.

LIII. *Description of an improved Hygrometer. By Lieutenant* HENRY KATER, *of His Majesty's* 12*th Regiment.*

To the Editor of the Philosophical Magazine.

SIR,

THE following paper was forwarded, some time since, to the Asiatic Society at Calcutta, and will probably appear in the next volume of their Researches; but as the hygrometer of which it contains a description is at present made by Mr. Thomas Jones, of No. 124, Mount-street, Berkley-square, I conceive some account of its construction, and manner of using it, may not be unacceptable to your readers.

I am, sir, your obedient servant,

HENRY KATER.

London,
May 14, 1807.

THE

THE principal objection to the hygrometer described in my former paper*, arose from the necessity of shortening the beard of the *Oobeena hooloo*, in order to reduce the scale to a convenient length; this was to be obviated only by giving the instrument a circular form, and inventing some mode of ascertaining, without difficulty, the number of revolutions made by the index.

A, B, C, D, (fig. 1. Plate IX.)† is a frame made of small square bars of brass or silver; this frame is soldered to a square plate B, E, the edges of which are turned up, as represented by the dotted lines, to secure the *index* from injury. On the face of the plate is engraved a circle (see fig. 4.) which is divided into *one hundred* equal parts: three holes *a*, *b*, *c*, (fig. 1.) are made through the frame and plate in the same direction; the holes *a* and *b* are of a conical form as represented by the dotted lines, and are highly polished to lessen friction: the hole at *c* receives a screw, one end of which is tapered, and has a notch cut in it with a fine saw, which may be closed by means of the sliding ring *d*.

The axis *e*, *f*, is made of silver wire, very smooth and straight, and of the size of a large knitting-needle; on the axis a screw is formed by twisting a smaller silver wire tightly round it *from left to right*. This screw should be fourteen or fifteen threads in length. The end of the axis, *f*, is divided, and is to be closed by a small sliding ring. As this is the most important part of the hygrometer, fig. 2. represents it on an enlarged scale.

A loop and drop (fig. 3.) is made of fine gold wire, of such a size that, when suspended on the screw, it may slide along it with perfect freedom by means of the revolution of the axis, but not escape from one interval to another by any other motion. Should the loop, on trial, be found too large, (as indeed it ought to be,) it may easily be closed a little by placing it on the screw, and pulling it gently by the drop; it will then assume an elliptical form, as in the figure. This loop is intended to register the number of revolutions

* The description of an hygrometer made of the same material, but of a different and inferior construction.

† The plate here referred to will be given in our next Number.

volutions made by the index, as it hangs freely from the axis, and advances one *interval* between the threads of the screw for each revolution.

The index *g*, *h*, (fig. 1 and 2.) is made of fine wire, accurately balanced, and as light as possible. It fits on the end of the axis *e*, and *is to be placed at right angles with the commencement of the screw.*

The beard of the *Oobeena hooloo* is represented at *f*, *d*, (fig. 1.) The top of it, which is crooked, being cut off, it is first secured between the cheeks of the axis, at *f*, by means of the small sliding ring; the axis is then turned round till the gold loop is brought to the fifth or sixth interval of the screw, counting from the dial plate: the screw at *c* is then advanced so as to receive the lower or thickest extremity of the beard of the *Oobeena hooloo* in the notch, where it is also confined by the sliding ring *d*.

The extremes of dryness and moisture are determined in the following manner:—The hygrometer is placed in a convenient vessel, and exposed for a considerable time to as great a heat as the grass can bear without injury; when the index is perfectly steady, the hygrometer is to be taken out of the vessel, and the screw at *c* turned round with a pair of pincers so as to bring the gold loop to the *first interval* of the screw on the axis, counting as before, from the dial plate (*which is to be placed to the left hand*), and the index to 100, or *zero*. The hygrometer must now be suffered to cool gradually, during which, if the atmosphere be in a mean state of moisture, the index will make four or five revolutions. The *Oobeena hooloo* is then to be continually wetted with a hair pencil and water until the index is again *perfectly steady*; this will require some time, as it moves very slowly when within a few degrees of extreme moisture. The degree at which the index stands is now to be noted, and the number of *intervals* counted between the dial plate and gold loop, and this number prefixed to the observed degrees will give the extent of the scale.

All observations made with this hygrometer are to be reduced to what they would have been had the scale consisted of 1000 *parts, or ten revolutions of the index.* This is most convenient,

convenient, as it facilitates the comparison of observations made with different hygrometers. An example may not be thought superfluous. Suppose the scale of the hygrometer to be 1145, or eleven *intervals* and forty-five *parts*; and that at the time of observation there are four *intervals* between the dial plate and gold loop, and fifty *parts* shown by the index; this would be written 450. Then as 1145 : 1000 : : 450 : 393 nearly, the number of degrees to be registered.

If two of these hygrometers, in which the extremes of dryness and moisture are well determined, be compared together, they will seldom differ ten divisions from each other*; which is as near a coincidence as can be expected.

In the above description I have confined myself to the name by which the grass is known in the Canarese language, viz. *Ooheena hooloo*; but it may be proper to remark that it is the *Andropogon contortum* of Linnæus. It is found in every part of the *Mysoor* country in the month of January; when it should be gathered, and thoroughly dried in the sun before it is used.

This grass appears to be far superior to any other hygroscopic substance hitherto discovered. In the *Encyclopædia Britannica* the scale of Saussure's hygrometer is said to consist of 400 degrees, or rather more than *one* revolution of the index. The hygrometer here described makes *eleven or twelve revolutions*. It possesses also the advantage of being very portable, cannot easily be deranged, and may be much reduced in size, if thought necessary, without affecting the extent of the scale.

St. Helena, May 15, 1806.

P. S. It is evident that, though the principle *and scale* remain the same, the form of this instrument may be varied so as to render it far more portable and safe; and this has been done by Mr. Jones, who has made several in a very superior manner of a *cylindrical* form, *three inches* only in length and one inch and an eighth in diameter.

* As the observed difference between the compared hygrometers was always nearly the same, and on the same side, I have reason to think the difference mentioned above arose, in a great measure, from the extremes not having been determined with sufficient accuracy.

LIV. *Second Extract of M.* Paysse's *MS. Memoir upon Coffee. By M.* Parmentier *.

Method of preparing Coffee as a Beverage.

Although coffee berries do not seem to possess either a smell or taste which is absolutely agreeable before or after torrefaction, mankind have nevertheless found in the water which is saturated with the principles they contain, partly disorganized by the action of the fire, something savoury and delicate: this is the reason why the use of coffee has been general among every people known. The use of it was at first established among the Persians, Arabians, Egyptians, Turks, &c.: but it was very difficult to establish the practice of drinking coffee in Europe, where it was long considered to be dangerous, and contrary to health: many memoirs were written against it; but time, or rather the good effects of this beverage, have buried them in merited oblivion.

The antiquity of its use, the great numbers who continue it, and no doubt find themselves better for it, are certainly respectable testimonies in its favour.

The English and Dutch among the Europeans are those by whom the use of coffee seems to be most generally adopted; the Dutch, as well as the inhabitants of the ci-devant Low Countries, where the beverage is in great use, do not, however, prepare it well, although their process admits of some advantages.

The best kind of coffee is generally employed in the above country; the roasting is carefully managed, and never carried too far; the grinding of it, as well as the infusion, is equally well attended to: it is not so with the quantity of water; this vehicle is employed in great profusion, and we may assert, without being accused of exaggeration, that the quantity of coffee employed in Holland for making six dishes of this beverage, by their method, is what is used in

* From *Annales de Chimie*, tom. lix. p. 293.—See p. 18 of our present volume.

France

France for making one. We may conceive from this that their infusion of coffee, besides being well made, is nothing else than water with an infinitely small quantity of the principles which this roasted grain contains, and from this œconomy necessarily results the weakness of the coffee used in this country.

The Dutch attempt to rival the excellent infusions of coffee used in France by drinking a greater number of dishes, and which they draw off more frequently than we do during the day: but this is ridiculous reasoning; and in my opinion it is no better than saying that, because one grain of sugar sweetens six or eight grains of tea, the same quantity would produce a similar effect upon one or more pounds of the same liquid.

Of the Roasting of Coffee.

The roasting of coffee properly is a very difficult operation, and to which sufficient attention is not paid, particularly in France. Some people, under the pretext of obtaining coffee which they call *strong*, carry the roasting of this grain so far that they almost char it completely: in fact, this bad method gives a high colour to the infusions, but it is easy to divine that it is always in an inverse ratio to the goodness of this liquor: it has neither that aroma nor that taste which the amateurs of coffee require. The taste is bitter and sharp, with a very disagreeable back taste of empyreuma; and, in one word, the intensity of its colour proceeds only from the solution of some principles which the fire has developed in coffee by the too strong roasting; of which we have already spoken in treating of its analysis.

The roasting or frying of coffee generally takes place in cylinders of plate iron, a kind of vessel well known in Holland, and particularly among the grocers of Paris. They also make use of an iron kettle, or frying-pan, when they have only very small quantities to roast. In Holland and the Low Countries they only employ coal or earth as their combustibles, and the greatest precautions are taken not to char the grain: for this purpose, it is constantly stirred during the

the whole time it continues on the fire, and until it has acquired a clear and uniform brown colour. Some persons are in the habit of adding, about the end of the operation, a small quantity of beer; others use sugar, and it is heated once more. The former assert that a fat body hinders the coffee from transpiring, as they call it, or rather from losing its aroma. The latter suppose that the sugar communicates to the infusion of coffee a peculiar and pleasant taste, which is in fact that of boiled or partly decomposed sugar.

When properly roasted and cooled the coffee is put into tin boxes, which are well closed. The Dutch are also so prudent as not to grind it or pulverize it, except as it is wanted; because, when kept too long in a state of powder, it loses a portion of its aromatic qualities, and does not furnish to the infusions those globules of oil which we often perceive swimming on the surface of the aqueous liquor, and which are, as they say, a proof of its goodness.

Of all the kinds of coffee I have seen undergo the process of roasting, none of them have furnished so much oil at the surface of the grain, while roasting, as that of Java.

If, as we have already observed, the Dutch and the Flemings employ too great a quantity of water in the preparation of coffee, it is not less true that they are the only people in Europe who retain the method of the antient Greeks for manufacturing these infusions: they know very well that the decoction, or the ebullition, of this roasted grain, is not a convenient method, and that it deprives the coffee of that peculiar flavour which epicures are so fond of.

We may also remark that, besides the strong colour of the decoctions, the bitter and disagreeable taste which we distinguish in them, they are always dull, and difficult to clarify. The infusion, on the contrary, is an operation which consists in pouring upon coffee, supported by a filter of paper not sized, and more commonly of a woollen stuff, a sufficient quantity of water at 86 degrees of temperature: the funnel is generally furnished with a lid which fits exactly. This precaution is necessary for two reasons equally essential: the first, in order to avoid the loss of a slight portion of of volatile aromatic oil; and the second, in order that the external air may not carry off too speedily the caloric from the water, and that it may dissolve more easily the principles with which it may saturate itself in passing over the coffee.

If, after what we have said above, we compare the liquor proceeding from this last operation with that which results from an equal quantity of water and coffee boiled together, we shall find that the infused liquor also possesses a perfect transparency, is of a very agreeable flavour, of a sweet taste, and that it possesses, in short, all the properties which we require in this beverage.

The decoction, on the contrary, which is not aromatic, and is disagreeable to the taste, always preserves the muddy appearance which we have already mentioned. In order to give transparency, recourse has been had to methods which still more diminish the qualities of it: in fact, we know that fish glue, or even albumen, may by their mixture with this liquor clarify it very speedily; but what all the world perhaps has not observed, is this, that, independently of the bodies suspended in coffee, and which darken the appearance of it, the gelatine or the albumen envelops the little oil, which floating upon the infusion or decoction of coffee, gives it a slight smell, or rather it is taken up by the depurating matter. The filtration of coffee would certainly deserve the preference, if the infusion, by pouring boiling water upon coffee supported on a woollen strainer, did not answer better than the decoction of coffee, which ought to be rejected.

There is one observation as important as the former, which occurs in the preparation of coffee by decoction, and applies against this bad practice: it is also grounded upon the property generally possessed by the extractive matter of vegetables, of decomposing the air of the atmosphere and combining with oxygen, with which it forms an insoluble compound, which is separated, and precipitated to the bottom of the liquor: it is at first manifested in the form of very slender pellicles, which become thicker and thicker; it is also to this phænomenon, or chemical combination, that we ought to refer the very perceptible discoloration which the decoction of coffee undergoes when the ebullition is too

long

long continued. It is evident from this, that the little extractive matter contained in the liquor may be completely oxygenated; and for the same reason this insoluble composition ought to produce, by being precipitated, coffee of a lighter colour.

From what precedes it would result, that, of all the methods adopted for preparing coffee, there are none superior to that followed by the Dutch and Flemings; it should therefore be preferred, taking care not to fall into an excess as to the quantity of water they employ: to infuse, but not to boil the coffee, is, in my opinion, the true way to obtain this beverage in an agreeable and wholesome manner.

In order to obtain this infusion possessed of all the qualities of which it is susceptible, it is preferable to use, in place of the woollen strainer generally employed in those countries where this beverage is prepared by infusion, a vessel which has been invented for some time. It is a kind of coffee-pot, of silver or tin, furnished with a cock; it has an interior reservoir pierced with a great number of small holes; and in this sort of sieve the coffee in powder is put. Above this there is placed another piece of metal also pierced with small holes, and of the form of a saucer, which rests upon the edges of the coffee-pot. This second drainer, through which the boiling water passes first, by making it fall on the coffee in the form of rain, does not clot the powder, nor does it hinder it from penetrating the mass fast enough, and dissolving the principles it contains: we may, however, dispense with this last drainer, if we please, by taking care to pour the water upon the coffee by making it first fall on the sides of the vessel: a little practice will make this method familiar. The coffee-pot is furnished with a lid, which is hermetically closed during the filtration of the water through the coffee.

In order to keep the coffee constantly hot and ready, as prepared in this excellent method, one may apply a spirit of wine lamp to the apparatus.

We may safely say that coffee made with this apparatus is preferable in every respect to that prepared by any other method: the liquor is strongly saturated with the extractive, colouring,

colouring, and aromatic principles of the substance infused; and the amateurs have long ago decided, that there is no other way of obtaining it endowed with the most agreeable and pleasant flavour.

M. Disjonval, who lived a long time in Holland while the French troops occupied the camp at Zeist, was desirous of habituating the soldiers to the use of coffee: he attempted to prepare a quantity of it so large as to supply the consumption of an army of 20,000 men which was then encamped near Utrecht: for this purpose he contrived a coffee boiler of extraordinary dimensions; he even prepared the coffee with cold water, in order always to have a supply of it before hand: but he soon perceived that, independently of the weak action of a cold liquid on such substances as are submitted to its influence, the infusion of coffee was much weaker in principle, less aromatic, and that it required a second operation to bring it to the degree of heat necessary for using it: he also observed that this new method was always hurtful to the good qualities of the coffee; from which he concludes with good reason, that coffee, like many other things, when it is again heated, loses its value considerably.

The berries of the coffee tree are not the only part of the fruit which furnishes an agreeable liquor. Some travellers in Arabia Felix relate that the king of Hyemen, as well as the governors of his states, use only the envelope of the fruit of the coffee tree and the membranes which cover the berries; which they roast. This beverage, in great estimation among the Arabs, is said to be more agreeable and more delicate to the taste than that which is prepared with the seeds of coffee: the above is what is called in the East "Sultan coffee."

If, as we have already seen, the Dutch and the Flemish possess the true art of making coffee, they are also, perhaps, the first who have endeavoured to render this kind of beverage of general use in their own country, and who at the same time have tried the most methods of obtaining it at little expense.

Although the greatest part of the Asiatics, according to some

some historians, are great coffee drinkers, it is doubtful, in spite of their passion for this liquor, if they use it more frequently than the Dutch. Without knowing any thing of the processes of the Asiatics for preparing it, we may assert that the Dutch generally drink it in a bad state: it may be said that it is much less a refined taste which decides their attachment to this beverage, than the habit they have acquired of drenching themselves very frequently through the day with a water only coloured by its maceration with the grain of roasted coffee, or any other vegetable substance partly charred; for if, in reality, coffee were absolutely necessary for the people on account of the damp climate they inhabit, as some assert, they surely would not have employed a thousand methods of altering its goodness, and supplying its place by other vegetables, as we shall presently see.

Coffee, or an analogous infusion, is in such general use in Holland and the Netherlands, that it extends to the poorest classes of society: plenty of water, a little coffee and a little sugar, with some drops of milk, are all that a peaceful Dutchman desires several times a day, and sometimes he chooses the alternation of drinking some dishes of good tea when he can procure it: but he must have coffee, or some beverage resembling it, at all events; a necessity as imperious upon him as that of eating bread: it is not rare to see the simple mechanic, when coffee becomes too dear, pass from the true and solid alimentary nourishment, and exchange it for the beverage to which his ancestors have been accustomed.

Let us examine, however, the substances they prepare as substitutes for, or in order to mix with, true coffee.

The root of wild succory * is the plant which first appeared proper, when conveniently prepared, for furnishing, by means of water, infusions susceptible of supplying the place of coffee; and, for some years past, several manufactories of this new kind of coffee have been established in Holland.

Having had occasion, during some time, to observe atten-

* *Cichorium entilus* Linn.

tively

tively the process employed in the preparation of this root in one of the above manufactories, I shall here describe it.

The succory is gathered in the beginning of spring; the roots are then very thick, well grown, and tender: when carried to the workshop they are stripped of their leaves and washed, in order to take off the earth which adheres to them; they are then cut into four or six parallel slips*. Being thus prepared, they are cut into very minute portions by means of a very ingenious machine, which consists of a wooden trough, respresenting an oblong square, which is filled with roots, and to this trough is adapted a large knife with a lever handle: there is also a press-vice attached which pushes out the roots as fast as they are cut, so that, by means of this mechanical invention, one man can cut in an hour what ten men could scarcely do in the same time by the ordinary methods.

This machine is analogous to the straw-cutter; it is similar in every respect to that which is used for cutting the tobacco to which the name of Virginia is given, and so much esteemed by smokers. They proceed afterwards to dry the root: for this purpose it is carried to a kind of kiln, in which there are compartments or cases of mason-work, from 15 to 18 feet long by five broad, covered with large bricks pierced with different holes, and forming an enclosed plane of about 70 degrees. The number of these compartments, as well as the extent of the kiln, is always proportioned to the means of the manufacturer. This kiln is heated with coals by means of stoves very badly constructed, and which are intended to distribute the heat into each of the cases: in fact, this *dryer* (for so the workmen call it) resembles a good deal that made use of by brewers and distillers for preparing their grains for the saccharine fermentation: the temperature is constantly kept up at 45 or 50 degrees of Reaumur, so that the succory root is dried very speedily and very strongly. All the apertures of this kiln

* This is generally done by women and children, placed in rows upon benches: the face of each is parallel to the back of the other, to prevent them from over-straining themselves, or from speaking to each other.

are

are hermetically closed; and the atmosphere, being always damp, presents, in my opinion, a great obstacle to the desiccation.

When perfectly dried, the succory root is carried to the frying-place: it is here that the operation is almost entirely finished; it is roasted like coffee in large plate-iron cylinders, which are turned continually, upon a very strong turf fire, which soon reduces it to a charry state. It is also the more or less advanced state of this charring which establishes the difference we distinguish in the qualities of this pretended salubrious coffee; so that the three kinds known in commerce are only the same substance, approaching more or less the nature of the residue of the vegetable decomposition produced by the action of the fire. In order to obtain an uniform colour always, the workmen are guided in the work by specimens which are constantly before their eyes.

After being roasted, the root is reduced into powder by a mill; the powder is then passed through a coarse sieve, and distributed into parcels of four, eight, and sixteen ounces each, which are neatly sealed up, and the name of the manufacturer with his place of residence put upon the cover. This is the exact manner in which this marvellous coffee is introduced to the public as a substitute for the true kind.

Succory root, prepared as we have seen, reduced, in a word, to an almost charry state, is mixed with coffee, throughout all Holland, in very variable proportions; it is also the substance which communicates to the infusions of coffee that bitterness which is considered as very salutary by the vulgar, and at the same time refreshing, and as modifying the too heating virtues of the coffee. The favourable ideas thus formed of it have spread so much, that at present many are contented with this root alone, without the addition of any real coffee at all. It has been extended to the French provinces, where there is at present a great demand for this new produce of Dutch industry: it possesses, however, no other virtue than that of colouring, more or less strongly, the water in which it is boiled or infused, and of communicating to this liquid the bitterness of the saline substance

substance the root contains; but we ought not to forget to add that it has one great advantage, of being at a very low price in comparison with that of real coffee.

Succory root is not the only substance employed for altering coffee, by diminishing the goodness as well as the price: beans, pease, lupines, &c. are often employed: the culture of these last is pursued even on a large scale in the neighbourhood of Mons, Brussels, &c. for this very purpose.

In the manufactories where the succory is prepared as a substitute for coffee, carrots and beet-roots are also indiscriminately used. I saw in Holland a plantation of beet-roots raised for the purpose of obtaining sugar from them, and the proprietor informed me, that after he had expressed the juice from these roots he afterwards converted them into coffee; and that turnips and maple fruit had yielded him a similar result. It is probable from this that an infinity of other vegetable substances would serve the same purpose, since it is only necessary to obtain, by a last analysis, the most fixed products of vegetables, or of their different parts, still combined with a small portion of empyreumatic oil strongly charged with carbon.

LV. *Notice upon the Existence of Platina in the Silver Mines of Guadalcanal, in Estramadura, in Spain. By M.* Vauquelin *.

Platina has not been found hitherto, except at Santa-Fè and in the bailliage of Choco, in South America, among the gold mines. There has been a report in circulation, for some years past, that platina has been discovered in Siberia; but this report has been as ill confirmed as that which was circulated, fifteen years ago, respecting the existence of it in a ferruginous sand of St. Domingo.

Having been lately charged with the task of analysing the celebrated mines of Guadalcanal, in Estramadura, (mines which, after having been long abandoned, are again opened at

* From *Annales de Chimie*, tom. lix. p. 317.

at a different point from the former one,) I recognised in a variety of these mines the presence of a considerable quantity of platina. This species of ore is gray, and has a strong resemblance to that with which we are acquainted under the name of gray silver, the *fahlertz* of the Germans; it contains copper, lead, antimony, iron, sulphur, silver, and sometimes arsenic. Its matrix is generally formed of carbonate of lime, to which sulphate of barytes and quartz are united. I communicated this discovery to M. Fourcroy in October last: this learned coadjutor, whose genius and friendship have been of great service to me for twenty years past, urged me to verify the fact, which he thought very important, by multiplied and varied experiments, in order to put it beyond all doubt. I took his advice, and the following are the results I obtained; they leave no doubt in my own mind, although I have been able as yet to operate upon very small quantities of ores only.

The platina seems to exist in varied proportions in the silver ores of Guadalcanal; some specimens furnished me in the proportion of 10 of platina in the 100 of silver, while others yielded almost imperceptible traces only: this shows that this metal does not form an essential or truly constituent part of these ores, and that it is only mixed with them in unequal quantities in various parts of the vein. The silver seems to be in the same case; it varies much in its proportions also: I have found it in the gray silver mines of Guadalcanal from 2 up to 7 hundredth parts of the total weight.

The process I used, after several comparative trials, in order to extract the platina from these ores, consists in the following operations:—1. After having reduced the mineral into fine powder I roasted it by a gentle heat, stirring it continually. 2. I melted the matter with an equal quantity of common potash, by which means I obtained a metallic button composed of platina, silver, lead, copper, and sometimes a little antimony; iron and a part of the lead remained in the scoriæ. 3. I afterwards separated the copper, lead, and antimony, by cupellation; nothing except silver and platina then remained. 4. I freed this last metal from the silver by means

means of aquafortis, or the nitric acid of commerce, which dissolved the silver and left the platina: I washed the latter and melted it again, in order to give it a metallic lustre.
5. As the lead which exists naturally in the first metallic button is not in a sufficient quantity for taking up all the copper in the cupellation, I submitted this metal a second time to the same operation with a new quantity of lead.
6. As, on the contrary, the quantity of silver is too small to permit the aquafortis to attack the alloy, I added, as when gold is to be separated, a new portion of this metal.
7. I ought to say, that if we employ aquafortis a little concentrated, it dissolves at the same time with the silver a portion of platina, which may be easily perceived by the brown colour assumed by the solution.

If platina exists in the gray ore of Guadalcanal in a proportion which admits of its being turned to advantage, it cannot be doubted, after the above experiments, that we must dissolve it by means of aquafortis, as practised when we extract gold from silver ores; and even if we should have no occasion to do this with respect to the platina, we must always do it in order to procure the silver out of it; for, whatever process is employed, these two metals are united, on account of the similitude of their properties.

Platina seems to exist in the metallic state in these ores; for the simple acids do not dissolve the smallest quantity of it, and it is always found among the silex and sulphur when the former forms part of the matrix; it was even on examining these residues of ores, treated successively by the nitric and muriatic acids, that I first perceived the platina.

What is remarkable here is, that none of the four metals newly discovered, and which attend the platina of the ores of Peru, are to be found in those of Spain. This consideration is of great importance, since it will have a great deal of influence upon the methods of extracting this metal, and since it gives hopes of obtaining it in a state of purity, which we cannot obtain in the platina of Peru, except with great expense and after many difficult experiments.

If these hopes are realised, as every thing inclines us to think they will be, we shall have a precious metal in Europe,

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and quite at hand, and which will soon become extremely useful in natural philosophy, chemistry, the arts, and even in domestic œconomy, for the manufacture of several instruments, vessels, and utensils of every kind; since, to all the advantages of gold, it adds several properties which render it far superior to the latter.

LVI. *Upon the Formation of the Muriatic Acid. By M.* Pacchiani. *Extract of a Letter from Professor* Pfaff, *of Kiel, to M.* Berthollet *.

At the very moment I was occupied with inquiring how the muriatic acid was produced which I obtained in some operations, without knowing from what cause, I was informed of the labours of M. Pacchiani.

I therefore entered upon an extensive series of experiments, in order to examine how far his discovery was well founded. I took every possible precaution in my experiments, the circumstances of which I varied as much as possible. I submitted repeatedly distilled water in glass tubes of different diameters to the influence of the poles of the Galvanic pile, by establishing the communication between the water and these tubes, sometimes by syphons filled with water, sometimes by fibres of flesh, nerves, and linen threads, &c. I employed piles of from 60 to 300 pairs of metallic disks in order to vary the degree of electrical force, the difference of which changes chemical combinations so remarkably.

I obtained traces of acid in the water exposed to the positive pole; but this acid was by no means muriatic acid: it was always nitric acid (the formation of which by the Galvanic pile I announced five years ago) resulting from the combination of the oxygen disengaged from the water with the azote more or less contained in the water: the more I freed the water, by a long continued ebullition, of all the air it contains, and excluded the free access of the atmospheric air, the more also were the traces of the nitric

* From *Annales de Chimie*, tom. lx. p. 314.

acid

acid diminished. It is therefore an error in M. Pacchiani to say that this self-named discovery of his, of the formation of muriatic acid, is occasioned by the deoxidation of the water.

The German chemists, and among others Messrs. Ehrann and Simon, assert, that, by employing very pure distilled water, no trace of muriatic acid is discovered; but that it shows itself the instant *any animal substance whatever* is employed. This is not true; because, if we free this animal substance from the muriate of soda and ammonia it contains, by repeated ebullitions in water, no muriatic acid is obtained. In the water exposed to the influence of the negative pole, there is always formed a little ammonia by the combination of the hydrogen liberated from the water with the azote it also contains.

I pledge myself for the correctness of these results; I have taken every possible precaution in obtaining them: we may be the less deceived as to the nonformation of muriatic acid, by reflecting that 1-5000dth part of a grain of this acid may be detected by a slight white shade in any concentrated solution of nitrate of silver. I shall have soon the honour to transmit you the detail of all my experiments on this subject.

LVII. *Account of some Experiments upon the Decomposition of Water and the Production of Muriatic Acid by the Electrical Pile, made at the Literary Society of Milan. By M.* Pierre Alemani, *Apothecary to His Majesty, and Member of that Society**.

I have often verified, both at the house of M. Moscati, member of the legislative council of state, and at home, the experiments of M. Pacchiani upon the production of the muriatic acid by the pile of M. Volta; I employed the greatest exactitude in the distillation of the water used in the apparatus, and for wetting the disks, and I carefully excluded every animal substance: for this purpose I made

* From *Annales de Chimie*, tom. lx, p. 323.

use of simple vegetable paper for the intermediate disks, and I frequently moistened with distilled water the cloth used for corking the tubes; I was certain, by this means, that the substance which served as a conductor to the metal disks had no influence whatever upon the decomposition of the water, nor upon the formation of the muriatic acid and the alkali. In consequence of this, I did not think that I should deprive myself of the advantage I might obtain by moistening the disks with some saline solution, an abundant source of electrical fluid, and which for this reason wonderfully increases the activity of the pile.

On the 11th of November, about two o'clock, I constructed a pile of 900 disks of zinc, copper, and paper: the paper ones had been previously soaked in a solution of muriate of soda. I placed two wires of pure gold at the two poles of zinc and copper; each of them communicated with a particular tube filled with distilled water, closed up at the lower end by a piece of cloth several times washed in water equally well distilled: these tubes were plunged into a glass of the same water, and were closed in the upper part with Spanish wax: I had adapted to them a small crooked glass pipe, by means of which each of them communicated with a small bell glass, full of water, at the temperature of 15 degrees of Reaumur's thermometer. The atmosphere being very damp, the pile had done very little at the end of 48 hours. From the 13th to the 14th the air became drier; a quantity of air bubbles, which were disengaged around the gold wires, particularly towards the negative pole, indicated that the pile acted with much force. On the 14th, at seven o'clock in the morning, I looked at the two tubes: that of the positive pole presented a slight citron colour, and half the bell glass was filled with gas; towards the other pole there was no alteration. At eight o'clock a red powder, inclining a little to the violet, was suddenly precipitated, and in great abundance, in the tube of the positive pole. On the 15th, at one o'clock *p. m.*, I analysed the gas which was liberated from this tube in the presence of several members of the society: it was oxygen gas, with which I filled a bell glass that contained six scruples and a half of water; the

the tube which corresponded with the gold wire, and contained seven scruples of pure water, remained half full of a liquor with which I dyed turnsole paper of a red colour, and this paper resumed its colour by means of an alkaline solution: some drops of a solution of nitrate of silver, poured upon this liquor, gave in a moment a precipitate insoluble in the nitric acid; the piece of cloth which corked the lower end of the tube in question, appeared, in a great measure, of a violet red. I cut this coloured part into two pieces; I applied nitro-muriatic acid to the one, and oxy-muriatic acid to the other: a few minutes afterwards the colour disappeared, and the cloth resumed its whiteness. A solution of nitro-muriate of tin restored to these liquors, which had been thus discoloured, the violet colour. The gold wire of the same pole was worn away a good deal at every part of it, and resembled a needle at its extremity. An analysis of the gas liberated from the negative tube yielded pure hydrogen gas; it filled two bell-glasses and a half, each of which might perhaps contain about six scruples and a half of water. The tube of this pole, which had at the beginning of the operation about seven scruples of water, remained half full of a liquor, which reddened the tincture of turmeric, to which the acids again restored its yellow colour: the nitrate of silver applied to this liquor furnished an ash-coloured precipitate, perfectly soluble in the nitric acid*.

In order to dissipate the least idea that the muriatic salt, with which I moistened the disks in the experiment of the 11th of November, had the smallest influence upon the production of the muriatic acid at the positive pole, I recommenced the same experiment on the 16th, by employing other disks of paper soaked in a solution of sulphate of alumine, and by carefully wiping the metal ones: in a few days I obtained the same results †.

* The nitrate of silver, oxalate of ammonia, muriate of barytes, did not at all trouble the water which was used in these experiments.

† This sulphate of alumine certainly does not contain muriatic salts: wishing to ascertain this, I dissolved six scruples of it in distilled water, and I precipitated it by the nitrate of barytes. I filtered this liquid; and, having treated it with nitrate of silver, no precipitate at all appears.

We may therefore infer the following consequences and results from what I have now detailed:

In the first place, seven scruples of water submitted to Volta's pile, as I have indicated, after having furnished to the positive pole a quantity of oxygen equal to the volume of three scruples and a quarter of water, passed to the state of oxy-muriatic acid, which dissolved part of the gold wire, by thus forming a fluid of a citron colour; and, after having furnished a quantity of oxygen equal to the first volume, the oxy-muriatic acid becomes simple muriatic acid; and the gold, which in this manner had lost its menstruum, is precipitated in the state of oxide.

Secondly, the violet precipitate was a perfect oxide of gold, since it was dissolved in the oxy-muriatic acid, and as I obtained from it the purple of Cassius by means of the nitro-muriate of tin.

Thirdly, while at the positive pole the muriatic acid is formed by the disengagement of a certain quantity of oxygen, a true alkali is produced at the negative pole by the disengagement of double the quantity of hydrogen. This result agrees with that of M. Mascagni; but it differs from that of M. Pacchiani, in which the real existence of the hyper-oxygenated water he has announced remains yet to be proved.

In the whole course of these experiments, and others of the same kind, I was convinced that in order to render the pile active a very dry atmosphere is necessary, and a very high temperature, and, although several persons think otherwise, that the pile should not be isolated. To conclude: not only is it unnecessary that the water with which the intermediate paper disks are moistened should be distilled, but it is even very advantageous to dissolve some saline substance in it, which might speedily oxidate the zinc, the metal of the positive pole: the reason for this is, that the activity of the pile increases in proportion to the oxidation of this metal, and even that the muriatic salts do not in this case directly influence the production of the muriatic acid, but simply oxidate this metal; which several other salts do, more or less. I observed besides, that after having obtained acid as well

well as alkali, when the disks being dried the pile ceases to disengage the electrical fluid, the affinity of the acid of the positive pole with the alkali of the negative pole enters into action, a muriatic salt is formed.

The radical of the muriatic acid is therefore a fact as certain as it is novel in chemistry, and for which we are indebted to M. Pacchiani; as well as for many others which have presented themselves almost spontaneously to others, but which no person except M. Pacchiani knew how to lay hold of. Keir and Cavendish seem to have been in this predicament, since they mention a little muriatic acid in the water produced by the combustion of hydrogen with oxygen, without having ascertained the true origin of it. On this subject we may consult the Essay on Static Chemistry, by M. Berthollet, part ii. sect. 1. chap. ii.

LVIII. *Description of the Camera Lucida. By* William H. Wollaston, *Sec. R. S.**

Having, a short time since, amused myself with attempts to sketch various interesting views without an adequate knowledge of the art of drawing, my mind was naturally employed in facilitating the means of transferring to paper the apparent relative positions of the objects before me; and I am in hopes that the instrument which I contrived for this purpose may be acceptable even to those who have attained to greater proficiency in the art, on account of the many advantages it possesses over the common *camera obscura*.

The principles on which it is constructed will probably be most distinctly explained by tracing the successive steps by which I proceeded in its formation.

While I look directly down at a sheet of paper on my table, if I hold between my eye and the paper a piece of plain glass inclined from me downwards as an angle of 45°, I see by reflection the view that is before me in the same

* Communicated by the Author.

direction that I see my paper through the glass. I might then take a sketch of it, but the positions of the objects would be reversed.

To obtain a direct view, it is necessary to have two reflections. The transparent glass must for this purpose be inclined to the perpendicular line of sight only the half of 45°, that it may reflect the view a second time from a piece of looking-glass placed beneath it, and inclined upwards at an equal angle. The objects now appear as if seen through the paper in the same place as before; but they are direct instead of being inverted; and they may be discerned in this manner sufficiently well for determining the principal positions.

The pencil, however, and any object which it is to trace, cannot both be seen distinctly in the same state of the eye, on account of the difference of their distances, and the efforts of successive adaptation of the eye to one or to the other would become painful if frequently repeated. In order to remedy this inconvenience, the paper and pencil may be viewed through a convex lens of such a focus as to require no more effort than is necessary for seeing the distant objects distinctly. They will then appear to correspond with the paper in *distance* as well as *direction*, and may be drawn with facility, and with any required degree of precision.

This arrangement of glasses will probably be best understood from inspection of fig. 1. (Plate VIII.) in which *a b* is the transparent glass; *b c*, the lower reflector; *b d*, a convex lens (of twelve inches focus); *e*, the position of the eye; *f g h*, the course of the rays.

In some cases, a different construction will be preferable. Those eyes, which without assistance are adapted to seeing near objects alone, will not admit the use of a convex glass, but will, on the contrary, require one that is concave to be placed in front, to render the distant objects distinct. The frame for a glass of this construction is represented at *i k*, fig. 3, turning upon the same hinge at *h*, with a convex glass in the frame *l m*, and moving in such a manner that either of the glasses may be turned alone into its place, as may

may be wanted to suit an eye that is long- or short-sighted. Those persons, however, whose sight is nearly perfect, may at pleasure use either of the glasses.

The instrument represented in that figure differs moreover in other respects from the foregoing, which I have chosen to describe first, because the action of the reflectors there employed would be more generally understood. But those who are conversant with the science of optics will perceive the advantage that may be derived in this instance from prismatic reflection; for, when a ray of light has entered a solid piece of glass, and falls from within upon any surface at an inclination of only 22 or 23 degrees, as above supposed, the refractive power of the glass is such as to suffer none of that light to pass out, and the surface becomes in this case the most brilliant reflector that can be employed.

Fig. 2. represents the section of a solid prismatic piece of glass, within which both the reflections requisite are effected at the surfaces *ab*, *bc*, in such a manner that the ray *fg*, after being reflected first at *g* and afterwards at *h*, arrives at the eye in a direction *he*, at right angles to *fg*.

There is another circumstance in this construction necessary to be attended to, and which remains to be explained. Where the reflection was produced by a piece of plain glass, it is obvious that any objects behind the glass (if sufficiently illuminated) might be seen through the glass as well as the reflected image. But when the prismatic reflector is employed, since no light can be transmitted directly through it, the eye must be so placed that only a part of its pupil may be intercepted by the edge of the prism, as at *e*, fig. 2. The distant objects will then be seen by this portion of the eye, while the paper and pencil are seen past the edge of the prism by the remainder of the pupil.

In order to avoid inconvenience that might arise from unintentional motion of the eye, the relative quantities of light to be received from the object and from the paper are regulated by a small hole in a piece of brass, which, by moving on a centre at *c*, fig. 3, is capable of adjustment to every inequality of light that is likely to occur.

Since the size of the whole instrument, from being so near

near the eye, does not require to be large, I have on many accounts preferred the smallest size that could be executed with correctness, and have had it constructed on such a scale that the lenses are only three-fourths of an inch in diameter.

Although the original design and principal use of this instrument are to facilitate the delineation of objects in true perspective, yet this is by no means the sole purpose to which it is adapted; for the same arrangement of reflectors may be employed with equal advantage for copying what has been already drawn, and may thus assist a learner in acquiring at least a correct outline of any subject.

For this purpose, the drawing to be copied should be placed, as nearly as may be, at the same distance before the instrument that the paper is beneath it; for in that case the size will be the same, and no lens will be necessary, either to the object or to the pencil.

By a proper use of the same instrument every purpose of the pentagraph may also be answered, as a painting may be reduced in any proportion required by placing it at a distance in due proportion greater than that of the paper from the instrument. In this case a lens becomes requisite for enabling the eye to see at two unequal distances with equal distinctness; and, in order that one lens may suit for all these purposes, there is an advantage in varying the height of the stand according to the proportion in which the reduction is to be effected.

The principles on which the height of the stem is adjusted will be readily understood by those who are accustomed to optical considerations. For, as, in taking a perspective view, the rays from the paper are rendered *parallel* by placing a lens at the distance of its principal focus from the paper, because the rays from the distant objects are *parallel*; so also, when the object seen by reflection is at so short a distance that the rays received from it are in a sensible degree *divergent*, the rays from the paper should be made to have the same degree of divergency, in order that the paper may be seen distinctly by the same eye; and for this purpose the lens must be placed at a distance less than

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its principal focus. The stem of the instrument (which slides) is accordingly marked at certain distances, to which the conjugate foci are in the several proportions of two, three, four, &c. to one; so that distinct vision may be obtained in all cases by placing the painting proportionally more distant.

By transposing the convex lens to the front of the instrument, and reversing the proportional distances, the artist might also enlarge his smaller sketches in any proportion with every desirable degree of correctness; and the naturalist, by employing a deeper lens, might delineate minute objects in any degree magnified.

Since the primary intention of the *camera lucida* is already, in some measure, answered by the *camera obscura*, a comparison will naturally be made between them. The objections to the camera obscura are,

1st, That it is too large to be carried about with convenience; but the camera lucida is as small and portable as can be wished.

2d, In the former, all objects that are not situated near the centre of view are more or less distorted.

In this there is no distortion; so that every line, even the most remote from the centre of view, is as straight as those that pass through the centre.

3dly, In that the field of view does not extend more than 30, or at most 35 degrees, with distinctness.

But in the camera lucida as much as 70 or 80 degrees might be included in one view.

As it has been thought advisable to secure an exclusive sale by patent, those who are desirous of purchasing the instrument are informed that Mr. Newman, No. 24, Soho-square, has at present the disposal of it.

LIX. *On*

LIX. *On the Purple Violet Flower, and the different Shades of Colour which may be extracted from it.* By John Michael Haussmann *.

Water is not the only menstruum proper for extracting the colouring matter of plants, in order to make it adhere to the alumine and the oxide of iron fixed on any particular cloth. There are vegetables, such as the bugloss (*Anchusa tinctoria*), which only give up their colouring particles to alcohol. I shall not hazard a definition of the nature of the colouring substance of the bugloss; it is so susceptible of being decomposed by the continued action of heat, even below that of boiling water, that, after having extracted it by alcohol, it cannot be thickened or concentrated by evaporation, without being destroyed; so that it is impossible to make any further use of the spirituous part of the tincture of bugloss: I ascertained this by reducing a certain quantity of it to one-fourth by distillation. The alcohol I obtained from it appeared pure, and the residue was dirty, and improper for dyeing. I was to blame in not better examining it, in order to see if it contained any thing oily or resinous; my researches at that time had no other object than to procure the colouring parts of the bugloss, and I had reason to be satisfied with it.

By mixing a sufficient quantity of the spirituous tincture of bugloss with six or eight parts of pure water in a copper kettle, and by afterwards dyeing with it my skains of cotton which were prepared for the red tincture of Adrianople, according to my own process, and as adopted by M. Chaptal, I obtained at the end of an hour, and by directing the fire gradually until it produced a boiling heat, a beautiful colour of purple violet. In order constantly to produce this colour of the liveliest hue, it is only necessary that the cotton should not be spoiled by the preliminary preparations, and for this reason the practice of galling should not be made use of; the linseed oil I made use of for this preparation was boiled with white lead, taking care not to burn it, as that would have spoiled the cotton.

* From *Annales de Chimie*, tom. lx. p. 288.

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The great brilliancy which this purple violet colour produces upon cotton, and which surpasses that of the finest satin dyed in the ordinary manner, suggested to me the idea of producing it on the fine calicoes. The success so completely answered my wishes, that we soon manufactured some whole pieces of Turkish shawls, dyed of this colour, for Messrs. Soehné and Co. of Paris, who received them some years ago; but although they were greatly admired, they were too high priced for the present times. Formerly, when it was the fashion for the ladies to wear calicoes at all seasons, we were under the necessity of making a high priced article of that description if we wished to succeed in business: I had proofs of this 32 years ago, when I lived at Rouen; for, having then some pieces of ten ells length for making robes, a very rich fabric, I sold them for 22 louis d'ors apiece. These pieces came from the manufactory of the famous Jean Henry Schule, at Augsburg, whom I think the first manufacturer in Europe who has united the greatest possible perfection and beauty in the printing of calicoes: his productions made so great a noise in the mercantile world, that even the emperor of China requested to see them, and greatly admired them when compared with those of his own country.

The cotton stuffs destined for printing a ground of purple violet, and which is to preserve some white objects, require to be well bleached, in order that they may be dirtied as little as possible by the dyeing; for, although the purple violet colour is so solid that it bears very well, without being much weakened, the action of the alkaline ley of oxymuriate of potash, the white is re-established but with difficulty.

The alumine, fixed upon the stuff and saturated with the colouring parts of the tincture of bugloss, still admits of the application of the colouring parts of other animal and vegetable substances; which gives room for an infinity of other shades, which may be augmented in an indeterminate manner, by diluting or weakening the acetate of alumine intended for printing, and by dyeing the purple violets and the shades which belong to it, such as the violet, lilac, &c. &c., by the more or less weakening of the acetate of alumine, mad-

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der, cochineal, kermes, fernambouc, citron, Persian grains, &c. By mixing all these drugs in different proportions we shall considerably multiply the shades, the number of which may be also varied in a prodigious manner, by mixing more or less acetate of iron with the concentrated or weakened acetate of alumine.

The oxide of iron, printed upon cloth, or coming from a concentrated acetic solution of iron, is coloured of a greenish black by the tincture of bugloss; and by weakening the acetic solution of iron in different proportions we shall obtain a great variety of grayish shades, more or less deep and more or less greenish; these shades are equally susceptible of changes by the dyeing drugs already mentioned.

If, on the purple violet grounds, or the shades derived from this colour, we propose to produce other dyeing colours, without sensibly altering these grounds, before printing other mordants it will be necessary to pass the stuffs dyed in bugloss tincture through weak sulphuric acid, in order to take off the alumine from them which the colouring parts of the bugloss tincture could not touch; the purple, and the shades derived from it, will redden a little, without being much weakened, however, by the action of the acid.

Linen, prepared in the same manner with cotton, presents nearly the same colours and shades on dyeing them with bugloss tincture, producing also the same variations by means of the other colouring drugs and by the modification of the acetate of lead. It is the same case with silk properly alumed; it presents very brilliant colours and shades by being dyed with bugloss, which however will only dirty the silk, if, in place of aluming it, it is soaked some time in any solution of tin: this proves the little affinity of the oxide of this metal for the colouring matter of the bugloss, which produces no better effect upon linen and cotton treated with solutions or salts of tin. The same inconvenience would probably be felt with woollen, which I never treated with bugloss tincture; but there is no doubt that this stuff presents colours nearly similar to cotton, linen, and silk, after having been well alumed.

LX. *Ex-*

LX. *Extract of a Letter from M.* Gehlen, *of Berlin, to M.* Vogel, *containing some Remarks, 1st, Upon the Formic and Pyrotartarous Acids; 2d, Upon Carburetted Sulphur; 3d, Upon the Klebschiefer or Ménilite of Menil-Montant**.

I cannot adopt the opinion of Messrs. Fourcroy and Vauquelin, that the formic acid is analogous to the acetic acid. When we distil in B. M. the expressed juice of ants, we obtain a white liquid, which cannot contain malic acid. This distilled acid, combined with bases and afterwards disengaged by the sulphuric acid, or by any other method, does not resemble the acetic acid. Lowitz was not able to crystallize it under the most favourable conditions. To a specific gravity equal to that of the acetic acid, it requires a much greater quantity of bases for its saturation; it forms with them salts which enjoy particular properties; with copper, for instance, a *blue salt in cubes,* which melts in its water of crystallization; with alcohol it forms an ether quite different: lastly, it displaces the acetic acid from all its saline combinations.

It is the same case with the pyro-tartarous acid, which Messrs. Fourcroy and Vauquelin also maintain to be acetic acid. The acid liquor obtained from the dry distillation of cream of tartar, exposed to a slow evaporation, leaves abundance of brownish crystals as a residue, which cannot be acetic acid, neither are they tartarous acid, as my own experiments and those of M. Rose have proved.

M. Lampadius proved, some years ago, that carburetted sulphur, as he calls it, contained no carbon. He also proved that the combination of hydrogenated sulphur is not what it has been hitherto thought.

M. Klaproth has made a new analysis of the *klebschiefer* of *Menil-Montant* (common resinite quartz, or menilite). The results are different from those he gave in his

* From *Annales de Chimie,* tom. lx. p. 78.

preceding analysis; they differ still more from those obtained by M. Lampadius. M. Klaproth finds

Silex - - - -	62·50
Magnesia - - -	8·
Oxide of iron - - -	4·
Charcoal - - -	0·75
Alumine - - -	0·75
Lime - - - -	0·25
Water - - - -	22·
Total	98·25

When distilled in the pneumato-chemical apparatus, a liquid is obtained of a bituminous smell, and containing a trace of ammonia. There came over also eight cubical inches of gas, which consisted of carbonic acid and of carbonated hydrogen gas, proceeding from a part of the decomposed carbon. The acids decompose this fossil without effervescence and without loss of weight, although M. Lampadius asserted that he found 0·27 of carbonic acid.

LXI. *Notice upon the Formation of the Acetous Acid in the Stomachs of Persons who have a bad Digestion. By M.* PERPERES, *Apothecary at Azilles. Communicated by M.* PARMENTIER*.

IT is a fact upon which all chemists are agreed, that during digestion of certain substances the acetic acid is formed: the experiments I am now about to mention are therefore conformable to the phænomena that have been formerly observed. But it is not equally well admitted that the spirituous fermentation can take place in the stomach: this is only an assertion of M. Perperes himself. We are of opinion, however, that this subject is well worthy of his attention, and we invite him to pursue his researches.

For a long time every one has been convinced that fermentation

* From *Annales de Chimie*, tom. lx. p. 280.

mentation is necessary to digestion, and that this fermentation may be either of a spirituous, an acid, or a putrid nature. Some alimentary substances even produce all these three effects, as has been demonstrated by several observations. But, in general, each particular kind of food undergoes that kind of fermentation which is most analogous to its nature.

As we are acquainted with only one kind of spirituous fermentation, and only one kind of the putrid, I shall not speak of these two fermentations. But it is not the same case with the acid fermentation, because it gives rise to several acids of different natures, which it is important to know in order to fix the opinions of chemists on the subject. For this reason I determined to make the following experiments upon myself:

1st, Knowing that roasted chestnuts could not be digested by my stomach without great difficulty, and that they always created wind, followed, some moments afterwards, with an insupportable sourness on the stomach, I took eight ounces of them, which I ate without bread, after having been for thirteen hours without tasting any thing, and my stomach being perfectly empty. An hour and a half afterwards I felt a swelling in my stomach (the usual symptom with me after eating kernel substances): this announced the production of some gas, which I contrived to collect in the following manner:—I took a funnel with a long tube, which I bent into a semicircle; I placed the small end of it in the pneumatic tub, on the shelf of which there was a bell-glass filled with water; and I had the precaution to fill the tub with water, in order to cover the whole of the tube of the funnel, so that none of the gas might be lost which I might emit. Some minutes afterwards I felt the dilatation in my stomach increase, and I then belched up into the funnel the wind out of my stomach by applying my mouth to the funnel. I emitted, at different times, a cubic inch of a gas which had all the characters of the carbonic acid, which nothing belied, and a little atmospheric air, which we always swallow with our aliments, as being necessary to digestion.

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The swelling of my stomach having decreased in consequence of the evacuation of the atmospheric air and carbonic acid, and the acid fermentation having undergone all the usual periods, according to the sourness I felt on my stomach, I proceeded to follow out my experiments.

2d, It was necessary to ascertain the nature of the acid contained in my stomach; and for this purpose I had only one method, that of vomiting, in order to determine, by future experiments, its specific characters.

I resolved to take twenty grains of ipecacuanha diluted in three ounces of distilled water, at a single draught: a quarter of an hour afterwards I drank some warm water, to the amount of fourteen ounces, without vomiting; but three ounces more made me throw up, at two vomitings, all I had taken.

I weighed the whole I had evacuated, and had only two ounces less than what I had eaten and drunk. I do not know if the stomach had digested these two ounces of liquid, or if it had been absorbed.

A minute inspection of what I had thrown up resembled feculum diluted in water; which showed that fermentation had decomposed the nutritive substance I had eaten, and the more so as the smell was strongly acetous: this began to confirm the idea, which I had for a long time conceived, of the formation of vinegar in stomachs of bad digestion, and it encouraged me the more strongly to pursue my experiments.

3. I dipped in the evacuated matter turnsole paper, which was immediately reddened. I then put in some infusion of violets, which was also reddened. Being certain, from these trials of the re-agents, of the existence of an acid in the substance evacuated, I endeavoured to determine its nature, and had recourse to the following plan:

4. I took a glass retort, in which I put all I had vomited; I adapted a globe receiver to it, which was furnished with a tube of safety, and with a second tube which entered under a bell-glass filled with water, placed upon the shelf of the pneumatic tub, in order to receive the gases which might be dissolved in the substances which formed the sub-

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ject of my experiments. I luted the whole, and gradually increased the fire until the contents of the retort began to boil. I continued the boiling until the liquid in the retort had acquired a thick consistence. I took down the apparatus, and I found in my receiver sixteen ounces and a half of a very white liquid, the smell as well as the taste of which was like that of distilled acetous acid, and possessed all the properties of the acids. As a gaseous production I had only a very little carbonic acid, which was easily recognised from the rapidity with which the bubbles of it passed through the water, as well as by their size.

5. Although the smell and taste of the produce of the distillation had already furnished me with strong proofs of the existence of the acetous acid, there certainly must have been combinations. In order to ascertain this positively, I took soda, obtained by means of alcohol, and saturated the whole liquid until it was supersaturated. I filtered and evaporated to the necessary consistence for obtaining crystals of acetate of soda: I carried into a cool place the porcelain capsule which contained the saline liquor, and next day, to my great satisfaction, observed, upon a simple inspection, that the form of the crystals (which was that of striated prisms, resembling strongly the very small crystals of sulphate of soda) was in reality that which belongs to the acetate of that name, which I tasted, and the taste of which was bitter, pungent, yielding a sharp taste at the beginning, which ended by being alkaline; and, in short, quite similar to the acetate of soda in every respect.

6. Apprehensive that the above experiments were not conclusive enough, I was anxious to satisfy myself more precisely. For this purpose I took half an ounce of the saline substance which I had obtained, and dissolved it in six ounces of distilled water. I divided this solution into two equal portions: in the one I gradually poured very pure sulphuric acid, less, however, than was necessary for the entire decomposition; and in the other I poured my solutions of barytes. The first portion, which had been decomposed by the sulphuric acid, as having more affinity for soda than this alkali has for the acetous acid, was put into a

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small retort, to which I adapted a small receiver, and distilled in a moderate heat. The produce obtained in the receiver was acetous acid perfectly pure, and having a very fragrant smell; in short, it had all the properties of the above acid. In the second portion I poured a solution of barytes, until the soda was set free; I then poured into the bottle containing the acetate of barytes and the soda in solution, in order to make comparative experiments, a quantity of alcohol, which dissolves this last alkali, and allows the acetate of barytes to precipitate. I was instantly fully convinced that it was the acetous acid, and all my suspicions were realised.

It results from the experiments I have described, 1st, That the dilatation felt in the stomach in cases of bad digestion is occasioned by the formation of the carbonic acid, proceeding from a commencement of decomposition, which the nutritive substances taken as aliment undergo, particularly when they are of the nature of kernels;

2d, That the sourness, which injures the organs of digestion, and which is sometimes felt so far up as the œsophagus, proceeds from a quantity of acetous acid, which is formed by the complete decomposition of the aliments;

3d, That eight ounces of roasted chestnuts produced two ounces, six drachms of acetous acid, after having fermented an hour and a half in the stomach;

4th, and lastly, That the best method of remedying the disagreeable sensation, commonly called heart-burn, which persons of weak stomachs experience, is to take, after their meals, ten grains of columbine root with twelve grains of calcined magnesia, at one dose. This mixture constantly succeeded with me.

LXII. *On*

LXII. *On employing the Poor in Parish Workhouses* *By the late* BENJAMIN PRYCE, *Esq.**

SIR,

THE Bath and West of England Society having thought proper to offer a premium "for the best account, for publication, of the most practicable and profitable manner of employing the poor in parish workhouses," I beg leave to submit to their consideration such thoughts as have occurred to me; and which, however imperfect, are the result of much laborious investigation on this subject.

At a time when every necessary of life is uncommonly dear, the poor increasing, and the rates collected for their maintenance bear so hard on the industrious part of the community, every reasonable and humane exertion should be made to render their labour in some measure productive. For this purpose various schemes have in different workhouses been adopted, most of which have ended in disappointment and loss. In order to ensure better success in future, let us take a view of the persons to be employed, and we shall find that the greatest part of them are widows, and children too young to be apprenticed, persons labouring under some infirmity, and those who are rendered incapable by old age. The robust and healthy poor who are able to maintain themselves, should be admitted into workhouses with great caution, and be considered as temporary guests only, to be removed as soon as they can find employment elsewhere. The employment to be provided for the inhabitants of these receptacles of poverty and imbecility should be such as is suited to their strength and capacity: it should be something easy to learn, and in which they could instruct or assist each other. The articles should not be in much danger of being spoiled by the inattentive or unskilful; and they should also, as far as circumstances will admit, (for such poor at least as are not likely to remain in the workhouse,) be something in which, after their discharge, they can be employed with advantage to themselves in their

* From *Letters and Papers of the Bath and West of England Society*, vol. x.

own habitations, or for masters in the same parish or neighbourhood.

The conveniences and local situation of the place, and the manufactures, if any, or chief employment carried on in its vicinity, will generally point out the most practicable and profitable manner of employing the workhouse poor. If to the inability of the work-people we add the too frequent inattention of managers, we shall find but little encouragement to introduce any new manufacture into a parish workhouse. Could any thing be thought of which is sufficiently easy and profitable, it would soon be adopted by numbers, who would be enabled to undersell the workhouse manufacture by their superior skill and energy. Nor can it be reasonably expected that poor objects, who have not been able to maintain themselves by that sort of labour which they have been accustomed to, will make any considerable proficiency in a new employment which requires much ability or exertion.

Wherever a considerable manufactory is established, in any parish or neighbourhood, and is such as to admit any part of it being carried on in a parish workhouse, it will generally be found most eligible that the poor should be employed in the same sort of business. In such situations, part of the workhouse poor are generally reduced manufacturers, who can earn most at the business they have been accustomed to, and instruct others who are not capable of being more profitably employed. The best-regulated workhouses I have seen near the cotton manufactories in Derbyshire and Lancashire, and the woollen manufactories in Yorkshire and Wiltshire, hire out as many of their poor as they can to work for the master manufacturers; and employ those in the house in some easy part of the same business, namely, in picking and beating cotton, spinning wool, breaking and spinning worsted, carding and winding yarn, &c. At Leicester, where there is a large stocking-manufactory, the poor women in the workhouses are chiefly employed in spinning worsted, and the children in closing stocking-seams.

In sea-port towns, or where the carriage from a sea-port is is not expensive, perhaps there is no general employment so proper for the workhouse poor, who are least capable, as that of picking oakum. This employment can be performed by the blind, the lame, and the infirm, by the superannuated, and by children. A few years ago, on visiting the workhouse or spinhouse at Amsterdam, (which is under excellent management,) I found that spinning, weaving, and picking oakum, were the principal employments carried on there. Picking oakum is a principal part of the employment of the poor in the parish workhouses at York. I was informed there that they give 8*s.* per hundred weight, or 1*s.* per stone, for old ropes, and sell the oakum for 2*s.* per stone; and that a man can pick a stone a day. Suppose the average earnings amounted but to 8*d.* or 9*d.* a day, perhaps there is no business in which the infirm workhouse poor can be so beneficially employed.

The difference in local situations should be particularly attended to. The cheapness and ease with which materials can be procured, and ready demand for the produce, or for that sort of labour which can be performed by persons so situated, will generally determine the most profitable manner in which the poor in workhouses can be employed. For example: Bath is the resort of a great deal of genteel company: many thousand pounds a year, it is said, are paid there for *washing*, most of which is performed at small houses inconvenient for the purpose. At Glasgow, I have seen a public washhouse, where, by the saving of fuel and superior conveniences, the business can be performed at less than half the expense which it costs at private houses. Such an appendage may easily be added to a parish workhouse. Under a steady careful matron, washing would at Bath prove a very beneficial and proper employment for the women, and would prepare the girls for making good servants.

I am no advocate for workhouses in country parishes, having frequently seen their mismanagement and ill effects. But in such situations, part of the workhouse poor may occasionally be of some use in dibbling, setting, weeding, hand-hoeing, haymaking, harvesting, stone-picking, or repairing

pairing the public roads. Wherever ground can be procured, it would be adviseable to annex to the workhouse a large garden, or sort of garden farm, for raising potatoes and other esculent vegetables, to be cultivated by the poor. Part of the ground may be appropriated to the growth of hemp, to be manufactured in the workhouse. After hemp, turnips may be sown, as an useful and ameliorating crop. This practice generally prevails amongst the most industrious poor in Shropshire. About twenty perches of land thus cultivated will there find employment in spinning for a poor man's wife and children,—at times when other work is not to be procured,—who will by their industry furnish him and themselves with decent coarse linen, and pay the rent of his cottage.

The most general employment which can (more or less) be introduced into all workhouses, and is useful to the poor in all situations, is perhaps that of manufacturing such articles of wearing-apparel, bedding, sheeting, &c. as are necessary and proper for their own use, and that of other poor people. Picking, carding, and spinning wool; winding yarn; breaking and spinning worsted; knitting coarse stockings; spinning flax, hemp, and the refuse or coarse dressings, called hurds or hogs; are all proper employments for such of the poor in parish workhouses as cannot be more beneficially employed in other matters, agreeable to the principles hereby submitted to the Society. The linen may be woven for sheeting, shirting, bedding, towels, stockings, wrappers, &c. or part of it may be woven with woollen to make linsey-woolsey for different garments. Weaving coarse articles is not difficult to learn; with a fly shuttle it is perfectly easy. Lobby cloths and girth webs are woven by the blind at the Asylum in Liverpool. Young girls should be taught the use of the needle, so as to enable them to do common repairs, in which they should occasionally be employed; as also in the domestic business of the house, in order to qualify them for service, as is practised in the Shrewsbury house of industry. In some workhouses I have seen the poor employed in spinning mop-yarn, making mops, spinning shoe-thread, and winding candledle-wicks. At the Asylum for the Blind in Edinburgh, I found that part of the employment of those unfortunate objects was making shoe-mats, baskets, and picking hair for mattresses.

I must not omit to mention a manufacture of coarse hats, which has been established at the county gaol in Dorchester by a gentleman of great respectability*, whose unremitting attention to the proper management of the gaol is highly meritorious.

However promising the introduction of any particular manufacture in a parish workhouse might appear, I would earnestly recommend that it should be adopted with great caution, and not to the exclusion of another principle we should never lose sight of, which is, *to employ every man, as far as circumstances will admit, in that sort of business which is most habitual to him.*

On visiting the county gaol, house of correction, and penitentiary workhouse, at Gloucester, I was informed that some of the most able and attentive magistrates of that county† intended to have established a manufacture of sail-cloth there; but on the most mature consideration, it was judged expedient to carry on various employments, and that the several persons should be employed as nearly as may be in using the tools to which they had been accustomed. A shoe-maker can best use his awl, and a tailor his needle. At the large house of industry at Liverpool, the same idea is adopted and carried into practice in its full extent. The reduced ship-carpenters there are supplied with tools and timber, and a yard is set apart for them, where they are employed in building boats for sale. Employments of this sort in common parish workhouses are impracticable. It is not, however, necessary that the poor should all be employed *within* the workhouse, or in working up materials provided by the parish. The purchase of such materials in small quantities, the inferiority of workmanship, and the sale of the commodity, will all operate against the parish. It will therefore generally be found most beneficial and desirable to

* William Morton Pitt, esq., M. P. for the county of Dorset.

† The great merits of sir G. O. Paul, bart., are sufficiently known.

the

the poor themselves, that as many of them as conveniently can should work out for kind and humane masters.

At Sheffield, Nottingham, and some other places, I learnt that their workhouse poor are employed in the most healthy and profitable manner, when hired out to work at any business they are capable of performing. And at the Edinburgh workhouse, where the chief employment is spinning and knitting, I found that the same practice of hiring out is judged most beneficial, and generally adopted.

It is much to be wished that the managers of every parish workhouse would properly *discriminate* and encourage the poor in proportion to their respective merits. In most well-regulated workhouses they are allowed about 2*d.* in a shilling of their own earnings; and in some places they have a further allowance of all they earn beyond what is reckoned a reasonable task. I would recommend that the master of every workhouse should also have such an interest in the poors' earnings, as would stimulate him to provide the most beneficial business that the several individuals are capable of performing; but should not have power to correct, nor force them to work beyond stated hours. It is of great consequence that the poor should be properly employed. If it be known that they will not be permitted to remain in sloth and idleness, it would rouse many to industry, and prevent them from seeking parochial relief. A committee of respectable and intelligent persons should be selected to superintend the management of the workhouse, and some of them from time to time to visit it, and pay strict attention to what is going on there. To this committee the master of the workhouse should give in a weekly account of the employment and earnings of every poor person under his care. I have myself assisted in carrying such a plan into execution in a parish where the poor are numerous, and have witnessed its good effects.

I have now taken a view of the poor inhabitants of parish workhouses; and have endeavoured to establish some principles which should direct our choice in providing for them the most proper and profitable employment. What I have offered is the result of much observation and inquiry into the

the failures as well as the successful management of a great number of workhouses, which I have visited in different parts of the kingdom, besides others herein mentioned, but which are not noticed, as I wished to bring the most material of my information into as small a compass as possible.

Every employment recommended is *practicable,* and has been adopted with success.

If what I have submitted to the society be honoured with their approbation, it might, I trust, prevent the improvident squandering of parish treasure by the adoption of unprofitable schemes; and in some measure assist parish-officers in providing that sort of employment for the workhouse poor, which is best adapted to the peculiar situation and circumstances of the persons and the place.

To the Secretary. B. PRYCE.

*** In the foregoing essay, which obtained a small bounty from the society as an encouragement to useful communications, the reader will discover many remarks which can have no claim to originality. But in others there are ideas worthy of respectful attention. The recommendation of *public washing-houses* is not deemed proper either for Bath or any other city; as, although it may be possible to perform the work cheaper than in more detached places, by employing fewer hands, such œconomy goes to the lessening instead of supplying labour. And where the operation is often to be paid for by the affluent, the present more general practice seems to be the most favourable to the poor. The picking of oakum can be practised but in comparatively few places; but recourse will be best had in all districts to those objects which are most attainable.—*Editor of the Bath Society's Transactions.*

LXIII. *On the most profitable Size of Farming Cattle.* By CHARLES GORDON GREY, *Esq.**

A FEW hints from my own experience of fifteen years, submitted to the consideration of the society.

* *From Letters and Papers of the Bath and West of England Society,* vol. x.

The

The first inducement of the stock breeder, as well as the grazier, ought to be,—the one to breed that animal whose disposition is most inclined to feed; the other to produce the animal fat at an early age. By these means the supply will be greater for the consumer. The smaller animal (generally) has a more natural disposition to fatten, and requires (proportionably to the larger animal) less food to make it fat; consequently the greater quantity of meat for consumption can be made per acre. In stall feeding, whatever may be the food, the smaller animal pays most for that food. In dry lands, the smaller animal is always sufficiently heavy for treading. In wet lands less injurious. As to milk, the smaller animal produces more goods for the food she consumes than the greater animal. As to the yoke, it is by no means clear that oxen (taken generally) pay for their work. In heavy and clayey soils they certainly do not. And from experience in many sandy and dry soils (as in Norfolk) they are not so profitable to the farmer as horses. And where oxen are of service, the middling-sized animal is to be preferred.

As to sheep, I beg this society to look to the premiums given for South-Down sheep; where five South-Down sheep to three Wiltshire have been kept on the same quantity of acres, and on the same ground, and have annually consumed one-third less hay. This sufficiently proves the smaller animal is better for the stock breeder; and from my own observations of South-Down and other different sorts of sheep, I have ever found the smaller sheep pay most for their food. I am therefore led to believe the same argument holds as good with the smaller sheep, as in the smaller beasts. If this society will look to the low, wet, and rich soils of this kingdom, where large oxen have been usually fed; the graziers there (generally) are feeding Scotch, finding the smaller most profitable. And if we look to Smithfield, we find the smaller animal is always taken in preference, by the greater number of butchers. I beg also to mention pigs, (an animal by no means so much attended to as it ought,) that invariably the smaller kind come soonest to maturity, and ever pay most for their food at any profi-

table

table age. The consumer must be ever advantaged by the smaller animal, it having proportionably much less offal. Of horses, I need not observe the larger animal has but its particular use; the middling animal must, for general use, be ever preferred.

C. Gordon Grey.

Tracey-Park, 1804.

Among the different objects of improvements to which the attention of this society has been long directed, none has been more remarkable than that of improving, on sound and general principles, the various kinds of live stock; an object confessedly of great moment. The ardour which the society has evinced under this head, had been excited by the prevalence of an opinion, which in many instances seemed to be gaining ground, that the largest races of animals were the most profitable to the farmer, as paying most for the food they ate. And this opinion seems to have derived considerable countenance of late years from the frequent instances of premiums and bounties given by the amateurs in London for samples of large animals, produced at the Smithfield meeting. Strong suspicions of the soundness of this doctrine having taken place in the minds of some practical men concerned in fatting stock, very useful experiments have been accordingly made. In many instances it had been obvious that too many of the favourers of large animals, though professing to calculate on the profit of the food consumed, had not in reality so done; but were deceived by attending to the most striking feature of the business, the nominal profit per head, instead of closely calculating the aggregate advantage per acre, which is certainly the true criterion. This latter mode of calculation, requiring accurate comparison of one race against another, seems to have involved too much care and extent of comparative account, to have been pursued in general practice, and to general conviction. Some gentlemen may be of opinion, (which indeed seems to have been the fact) that differences of profit in favour of large animals, especially horned cattle, will be occasioned by local circumstances, as of very rich and luxuriant lands, or lands abounding with very strong grass.

grass. But admitting, for argument's sake, though not granting, that such may be the case in some few districts, it is obvious that the doctrine could not apply generally, because such lands are not generally found, but the contrary. The fact of such advantage may, however, be doubted on any land. And unless it could be proved that strong luxuriant feed cannot be so closely eaten down and consumed by a larger number of small or middle-sized animals, as by a smaller number of large ones, the preference of the latter to the former would remain doubtful in theory; while practice carefully conducted might prove the reverse. That such practice has so proved, wherever it has been fully and fairly tried, is the point now contended for. From such conviction in the minds of competent men has arisen a zeal for the further extension of their knowledge, founded on experience. To such experience of facts they have been induced to add what has appeared to them the *rationale* of the system they have adopted. Among such men the writer of the foregoing summary observations comes forward for the purpose of laying down axioms for general consideration, and of course for general benefit. The respectability of his name will not fail to add weight to his communication; and as such it is given to the public.—*Editor of Bath Soc. Tr.*

LXIV. *Proceedings of Learned Societies.*

ROYAL SOCIETY OF LONDON.

April 30. The right honourable the President in the chair. —Notes from Mr. Groombridge and the Astronomer Royal were read, containing their observations on the planet newly discovered by Dr. Olbers, on the 26th and 27th of April, as stated in our last.

The reading of Mr. Home's curious paper on the stomachs of animals was then resumed. Mr. H. took an extensive view of the comparative anatomy, or peculiarity of structure, of the stomachs, not only of ruminating animals, but also of the crop and gizzard of birds. He traced the analogy between the muscular stomachs of birds, whose bills serve to separate the husks from the seed, and those animals whose fore-teeth assist in seizing their food; between those of carnivorous and of granivorous animals, as in the whale, hippopotamus, beaver, water-rat, ass, horse, dog, and man. In the stomach of the horse, ass, and water-rat, much similarity appeared. The kangaroo exhibited a peculiarity in the great length of its stomach, which is covered with a thin cuticle, and supported by numerous muscles to revert the food, as it occasionally ruminates, according to the observations of Sir J. Banks at New South Wales, although those in the menagerie at Exeter-change have never been perceived to perform any such process. The author concluded from his numerous observations on this organ in various animals, and from the experiments of Spallanzani and Hunter, that the stomach is the only seat of the digestive process; that the gastric juice is secreted by glands immediately attached to the œsophagus; and that the pylorus is chiefly a receptacle for the milky fluid called chyle, which passes thence to form blood. Mr. Home then made a summary recapitulation of the particular structure of the various stomachs which he had examined, and divided them into six classes. 1st, Stomachs of ruminating animals; 2d, of non-ruminating animals; 3d, of animals ruminating occasionally; 4th, of carnivorous animals; 5th, of granivorous, and 6th, of herbivorous animals. In the conclusion Mr. Home expressed his opinion that all animals may ruminate; and after referring to the observations of several writers on this subject, related a case in his own practice of a blind man who ruminates all his food. This man has a most voracious appetite, and his attendants are obliged to give him only a fixed quantity every day. He usually eats one pound and a half of meat at once, which he swallows greedily; and in about ten minutes after he has finished his allowance, he regurgitates a mouthful, chews it, during which time he seems more tranquil and happy, then swallows it, then brings up another, and chews and swallows it in like manner. When he has finished ruminating all the food he has eaten, he retires to sleep, and enjoys his repose.

May 7. The President in the chair.—A paper from Mr. Carlisle was read on spontaneous mortification in the human subject, similar to the case detailed by him last year. A female about 19 years of age was seized with a slight pain, accompanied with numbness and insensibility, in her foot, which gradually ascended to the groin, and in six weeks occasioned her death. When she died her body was opened, and the valves of the heart were found so imperfect, as not to be capable of conveying the blood to the aorta, whence it might circulate to the extremities. During the progress of the mortification, the patient was occasionally in such a low state as to appear on the eve of expiring.

A letter from a gentleman at Penzance to Mr. Giddy was also read, detailing some singular appearances in the strata found in sinking a shaft for a tin mine in Cornwall. Pyrites, schist, and chlorite alternately occurred, at different depths; but the most remarkable circumstance was that of a stratum of pebbles found immediately contiguous to the tin, and at the immense depth of seventy-eight fathoms below the surface of the earth. The letter was accompanied with an accurate drawing, representing the relative position of the different strata, as they appeared on sinking to the vein of tin.

May 14.—The attention of the society was occupied with a letter to the President, from Mr. Knight, on some peculiarities not hitherto observed in the domestic œconomy of bees and wasps. The principal circumstances observed by our author were the excursions and examinations performed by bees previous to their hiving; their investigations on the bark and hollow parts of old trees; their residence there for some days; and their direct route to and from their hives. Hence Mr. Knight inferred that bees have a language of ideas. He observed that bees form political connections; that two hives will associate together in the same place for ten or eleven days as friends, and afterwards quarrel and separate. This fact, however, is equally as explicable on the supposition of the ignorance and stupidity of these insects, as on that of their sagacity. It appears, according to Mr. Knight's observations, that neither bees nor waps will

attack

attack any person that comes between them and their mansion, until some one has come from it to inform them of their danger. Bees collect the farina of plants, and transport it on their thighs to feed their young. The wax he considers, contrary to the opinion of Hunter, as a vegetable production, transported from the plant to the abdomen of the insect, and thence deposited in the combs. As a proof that wax is of a vegetable nature, it is observed that the combs made after autumn are hard, dry and white, whereas those made in summer are yellow and soft.

In consequence of the Whitsun-holidays the society adjourned over one week, till Thursday May 28.

SOCIETY OF ARTS, ADELPHI, LONDON.

On Tuesday, the 26th of May, this society held its annual meeting at its house in the Adelphi, for the distribution of the premiums and bounties awarded within the year,—his grace the duke of Norfolk in the chair.

The meeting was splendid, and was numerously attended. Dr. Taylor, the secretary, delivered the usual oration, in which he traced in a perspicuous manner the progress of this patriotic society from its foundation in 1754, through the laudable exertions of Mr. Shipley and others, until the present time, and went through a succinct review of the labours of the society, in the several departments of its business within the year past.

The presenting of the medals and bounties to the different successful candidates then took place, and his grace delivered an elegant address to each of the candidates upon receiving the prizes. When this business was over, Dr. Taylor concluded the reading of his address to the company, by acknowledging very valuable presents of scientific and useful books for the library of the society, of which the members have the use, to read at their own houses. He noticed the recent and additional privileges granted to ladies who are members of the Society of Arts, and, after recommending to the fair part of his audience to grace the list of the society's members with their names, he mentioned, that 142 new members have been elected within the year past, among whom were, the duke of Richmond, marquis of Stafford, earls of Bridgewater, Dundonald, and Percy; lords Valentia and Cochrane; miss Harriet Gouldsmith, miss Esther Macatta, &c. &c.

The business closed soon after two o'clock, by a short but neat address from the noble president, thanking the company for their numerous and splendid attendance, with particular acknowledgments to the Portuguese and American ambassadors, and other foreigners of distinction, who were present; and to the fair part of his audience, whom he hoped he should see again on the next anniversary, and many more of them, in the capacity of members of a society so distinguished for its public spirit and usefulness.

PATRIOTIC SOCIETY OF PHYSICIANS AND NATURALISTS OF SUABIA, IN GERMANY.

The above society has offered a prize of 100 florins for the best treatise in answer to the following questions:—Does there exist any particular treatment for the accidental maladies which are called rheumatic? How can such treatment be characterized? What are its connections with other general treatments? How does it determine the development of febrile maladies? How are we to distinguish the different modifications of acute rheumatism, accompanied by swellings in the joints, from gout and *arthritis?* Upon what does the character of these two last maladies rest? Are they identical? or rather, Can we point out their specific differences?

The Society intimates that they do not wish the candidates to venture upon any hypothetical views: they rather require a methodical detail of facts, which may serve to develop the above-mentioned diseases.

A prize of 100 florins is also offered for the best answer to the following question:—In what diseases, and under what circumstances, can we expect bleeding to produce good effects, simply of itself, or when conjoined with the remedies? What are the doubtful cases in which bleeding ought to be avoided? The Society wish for an accurate detail of facts in this case also, free from every thing like hypothesis; and they have intimated that a simple recapitulation of some technical rules, without connection with the general laws of the animal organization, will not answer their purpose.

The

The memoirs on the above subject must be transmitted before the month of October 1807 to the counsellor of state Mezler, at Siegmaringen.

LXV. *Intelligence and Miscellaneous Articles.*

THE NEW PLANET.

PROFESSOR BODE took advantage of the fine weather between the 23d of April and the 5th of May to view the new planet Vesta, which he did nine times at Berlin, from the royal observatory, with the mural quadrant. On the 5th of May at $9^h\ 2'\ 56''$ mean time, its right ascension was $178°\ 29'\ 56''$, and northern declination $12°\ 35'\ 49''$.

NEW METHOD OF CURING TETANUS.

The following new method of curing those dreadful convulsions, which carry off so many brave wounded soldiers, has been practised in the hospitals of Germany with great success. It was first resorted to by the late M. Stutz, a physician of eminence in Suabia, and he was led to this important discovery from the analogy of a simple fact. M. Humboldt had announced, in his work upon the nerves, that on treating the nervous fibre alternately with opium and carbonate of potash, he made it pass five or six times from the highest degree of irritability to a state of perfect asthenia. The method of M. Stutz, who has been employed with the greatest success in the German hospitals, consisted in an alternate internal application of opium and carbonate of potash. It has been seen that when 36 grains of opium, administered in the space of 24 hours, produce no effect, the patient was considerably relieved by 10 grains more of opium, employed after having given the alkaline solution. This new treatment of tetanus is worthy of the attention of medical men.

LECTURES.

Mr. Brookes will commence his Summer Course of Lectures on Anatomy, Physiology and Surgery, on Saturday the 6th of June, at 7 in the Morning, at the Theatre of Anatomy, Blenheim-Street, Great Marlborough-Street.

 In

In these Lectures the Structure of the Human Body will be demonstrated on recent Subjects, and further illustrated by Preparations, and the Functions of the different Organs will be explained.

The Surgical Operations are performed, and every Part of Surgery so elucidated as may best tend to complete the operating Surgeon.

The Art of Injecting, and of making the Anatomical Preparations, will be taught practically.

Gentlemen zealous in the pursuit of Zoology, will meet with an uncommon opportunity of prosecuting their researches in Comparative Anatomy.

Surgeons in the Army and Navy may be assisted in renewing their Anatomical Knowledge, and every possible attention will be paid to their accommodation as well as instruction.

Anatomical Converzationes will be held weekly, when the different Subjects treated of will be discussed familiarly, and the Student's views forwarded.—To these none but Pupils can be admitted.

Spacious apartments, thoroughly ventilated, and replete with every convenience, will be open from Five o'clock in the morning, till Four in the afternoon, for the purposes of Dissecting and Injecting, where Mr. Brookes attends to direct the Students, and demonstrate the various parts as they appear on Dissection. An extensive Museum, containing Preparations illustrative of every part of the Human Body, and its Diseases, appertains to this Theatre, to which Students will have occasional admittance.—Gentlemen inclined to support this School by contributing preternatural or morbid Parts, Subjects in Natural History, &c. (individually of little value to the possessors) may have the pleasure of seeing them preserved, arranged, and registered, with the names of the Donors.

The inconveniencies usually attending Anatomical Investigations are counteracted by an Antiseptic Process, the result of Experiments made by Mr. Brookes on Human Subjects, at Paris, in the year 1782; the account of which was delivered to the Royal Society, and read on the 17th of

June,

June, 1784. This method has since been so far improved, that the florid colour of the Muscles is preserved, and even heightened. Pupils may be accommodated in the House.—Gentlemen established in Practice, desirous of renewing their Anatomical Knowledge, may be accommodated with an Apartment to Dissect in privaely.

LIST OF PATENTS FOR NEW INVENTIONS.

To Rudolphe Cabanel, of Lambeth, in the county of Surrey, engineer; for improvements in the construction of wheels and axle-trees, by which will be obtained, amongst others, the following material advantages: the carriage will be less liable to overturn, and in consequence of the friction being almost wholly done away, will move with much less power or labour of the horses; the necessary oil or grease being supplied without separating the wheel from the axle, are so securely attached as to obviate entirely the frequent accident of the coming off of the wheels in travelling; and should they by any means be damaged or destroyed, any other wheel, whether of coach, cart, or waggon, may be immediately substituted as a temporary resource, and delays thereby prevented, as any single wheel or set of wheels may be shifted for others at pleasure.—May 5.

To James Woods, of Ormskirk, in the county of Lancaster, chair-maker; for a machine for churning milk and cream, and which may be used as a pump.—May 9.

To William Cubitt, of Walsham, in the county of Norfolk, engineer; for his method of equalizing the motion of the sails of windmills.—May 9.

To Francis Frome, of Spring Gardens, Westminster, in the county of Middlesex, gent.; for his improved portable boot-jack with a guard, to prevent the possibility of any accident to the legs or ankles in pulling off the boots.—May 11.

To William Bainbridge, of the parish of St. Andrew, Holborn in the city of London, musical instrument maker; for his improvements on the flageolet or English flute.—May 14.

METEORO-

METEOROLOGICAL TABLE,
By Mr. Carey, of the Strand,
For May 1807.

Days of the Month.	Thermometer. 8 o'Clock, Morning.	Noon.	11 o'Clock, Night.	Height of the Barom. Inches.	Degrees of Dryness by Leslie's Hygrometer.	Weather.
April 27	52°	72°	61°	30·11	70	Fair
28	60	71	59	·14	52	Fair
29	60	69	58	·05	40	Fair
30	60	70	54	29·93	40	Fair
May 1	62	76	61	·78	51	Fair
2	63	77	62	·75	66	Fair
3	56	76	58	·76	51	Fair
4	55	56	52	·65	0	Rain
5	53	69	52	·31	40	Fair
6	56	60	52	·02	30	Cloudy
7	54	57	46	·23	0	Showery
8	49	54	45	·65	10	Showery
9	46	53	45	·32	0	Rain
10	45	54	44	·50	9	Cloudy
11	45	53	48	·86	0	Rain
12	50	58	55	·55	0	Rain
13	55	63	54	·65	15	Cloudy
14	51	55	52	·78	0	Rain
15	54	68	54	·80	20	Fair
16	56	65	54	30·08	27	Fair
17	56	68	56	·11	41	Fair
18	57	72	46	·30	51	Fair
19	46	59	45	·32	32	Fair
20	45	58	51	·19	23	Fair
21	56	65	50	·06	70	Fair
22	53	67	52	·20	40	Fair
23	56	73	58	·17	62	Fair
24	60	78	64	·01	70	Fair
25	64	78	63	29·75	70	Fair
26	62	69	56	·76	43	Fair

N.B. The Barometer's height is taken at one o'clock.

INDEX TO VOL. XXVII.

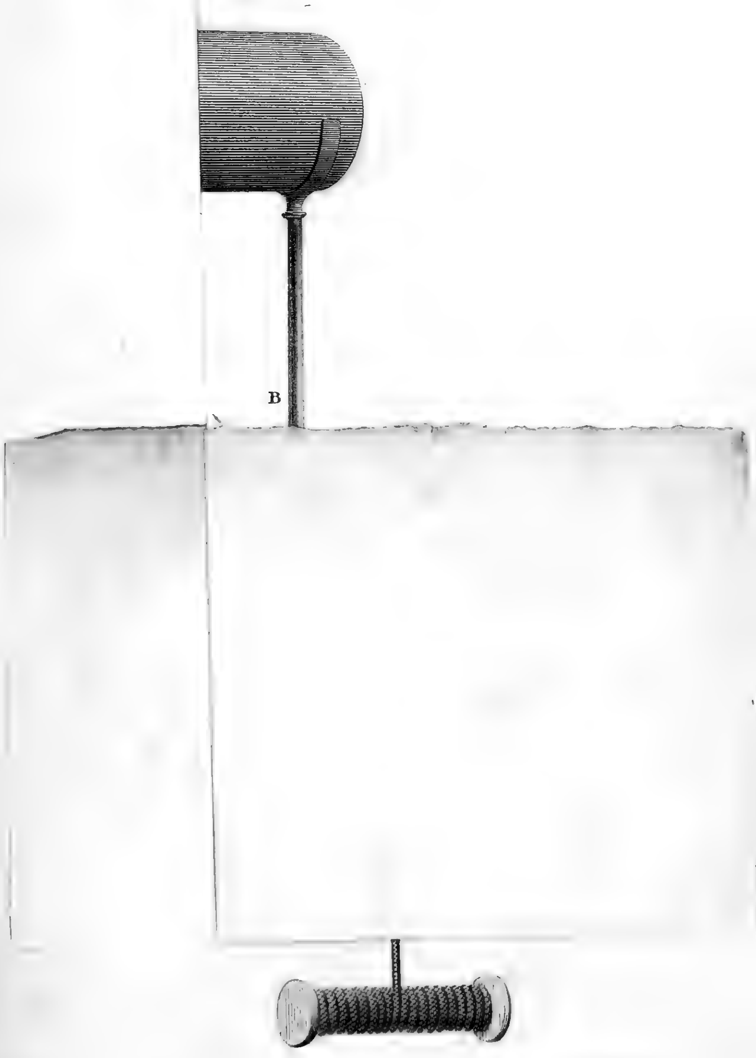
Comets.

Steam,

END OF THE TWENTY-SEVENTH VOLUME.

Printed by R. Taylor and Co., 38, Shoe Lane, Fleet Street.

Philo. Mag. Pl I. Vol XXVII.



Lowry sculpt.

Mr Stevens's Gazometer

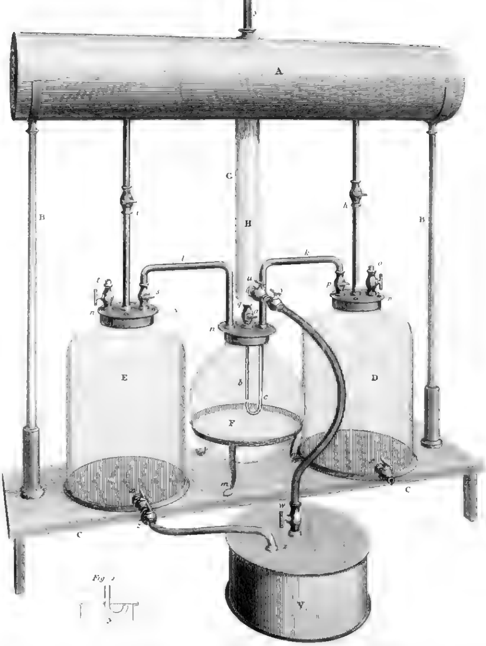
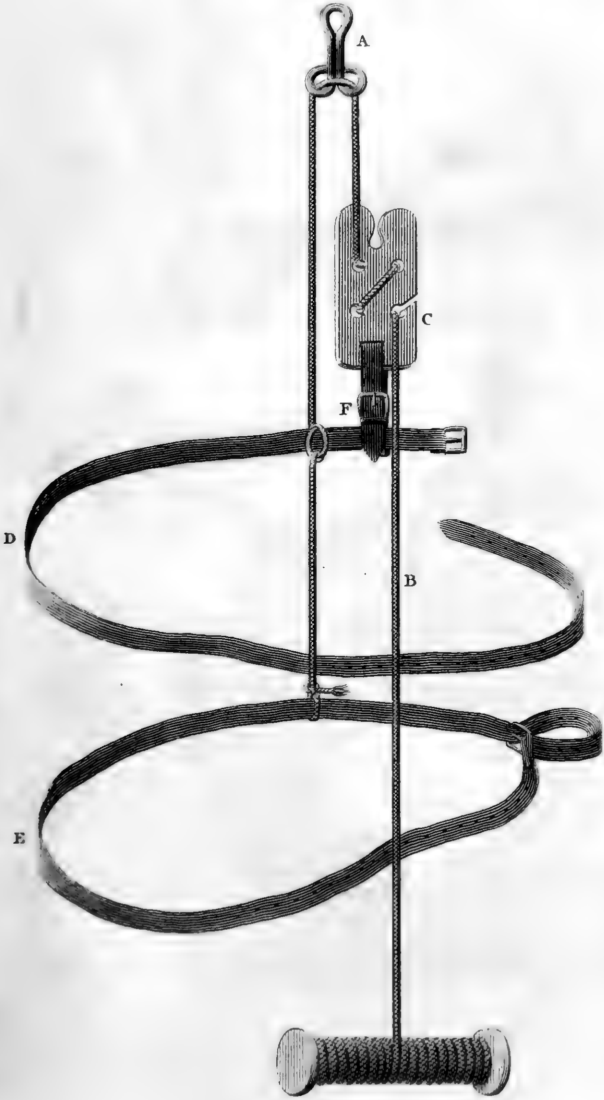


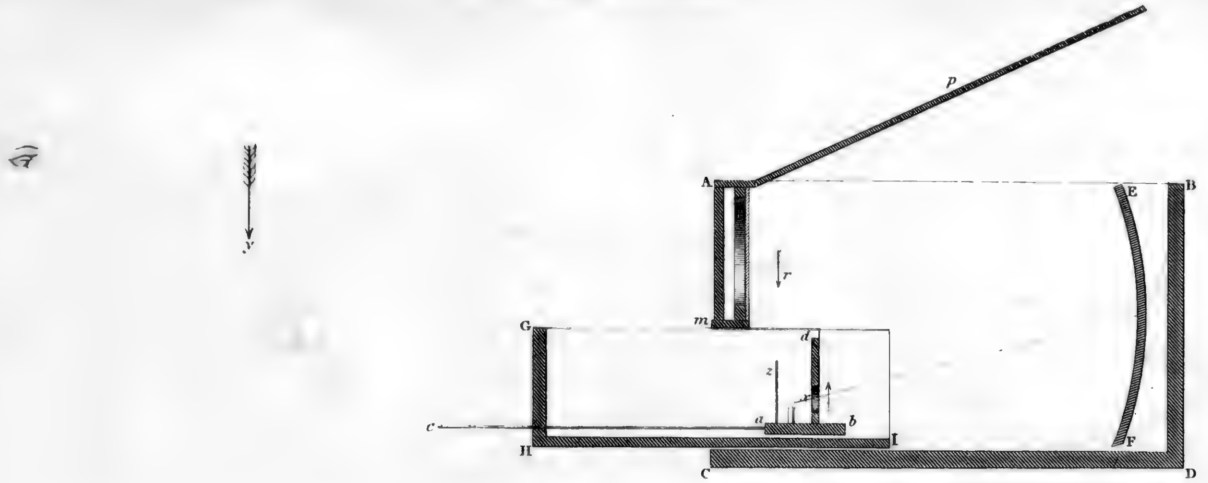
Fig 2

Mr. Maseres's Fire Escape.



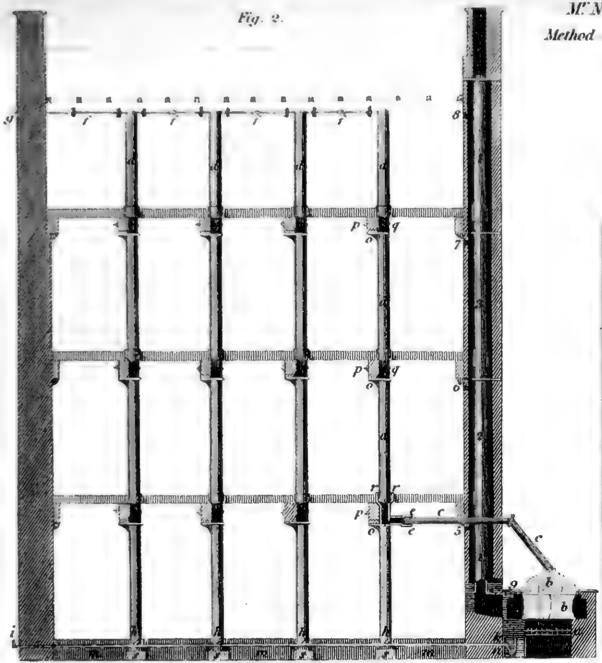
Lowry sculpt.

Mr. Ez.l Walker's Phantasmascope.



Mr. N. Snodgrasses,
Method of heating Rooms
by Steam.

Fig. 2.



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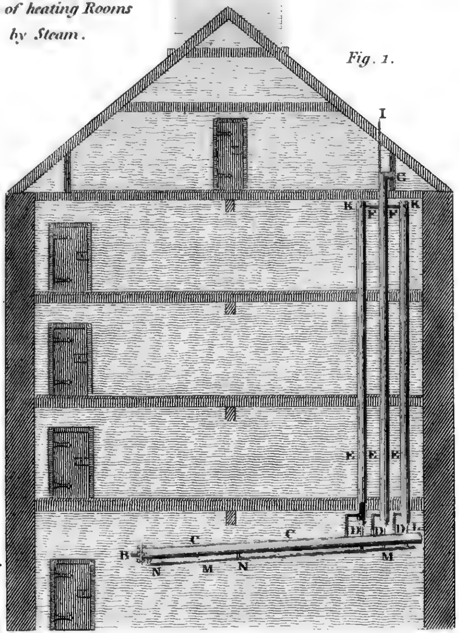
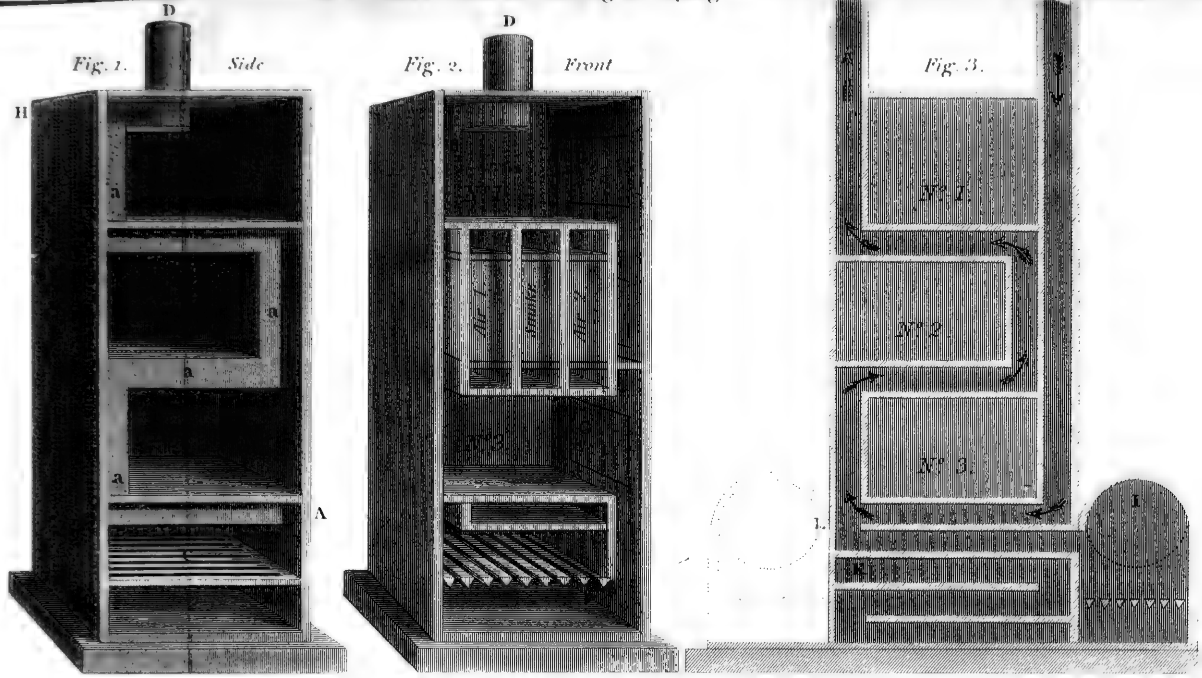


M. G. Field's Stove for heating or Drying.



Mr. J. Trotter's Curvelinear Saw.

Mr. J. Hardie's Book Binders Cutting Press.

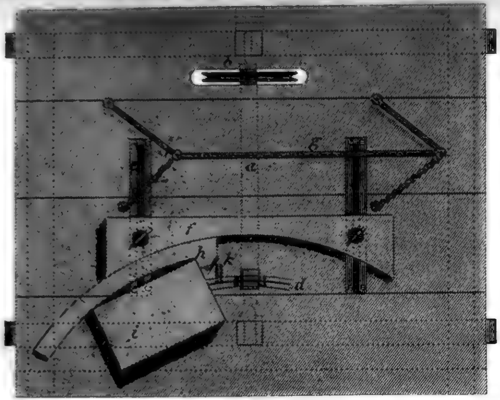
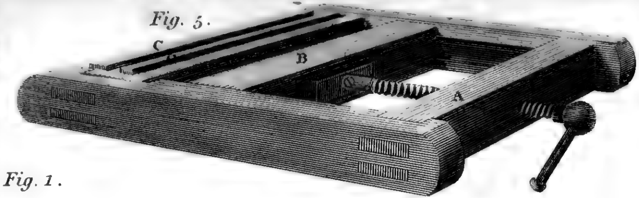


Fig. 1.



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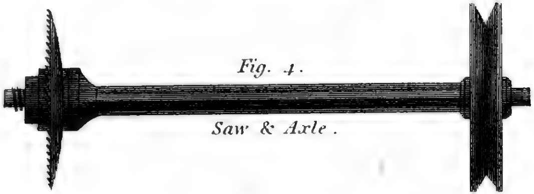

Fig. 4.

Saw & Axle.

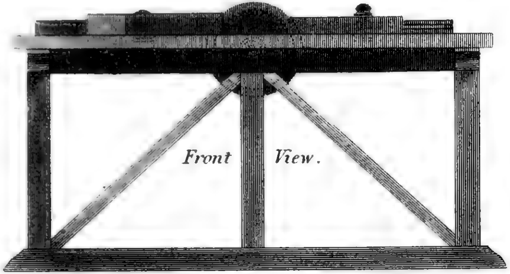

Fig. 2.

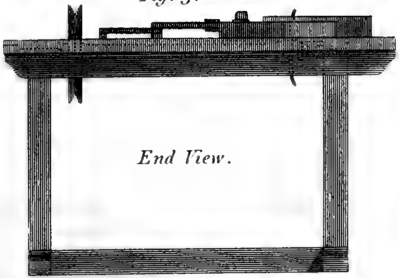

Fig. 3.

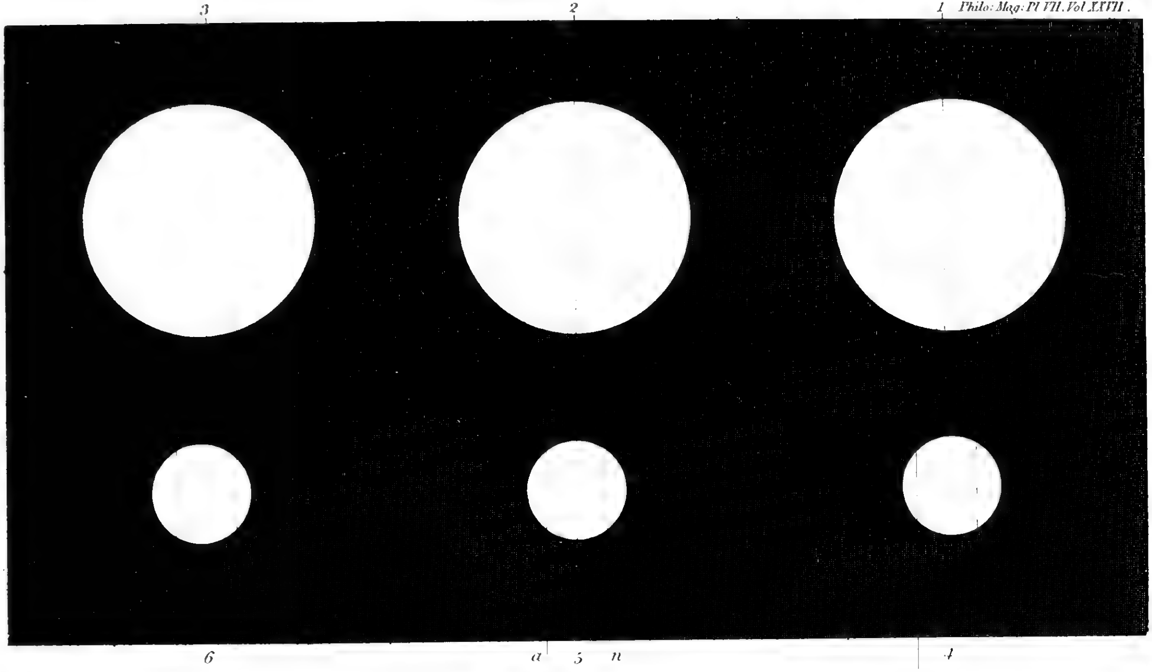
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Fig. 1.

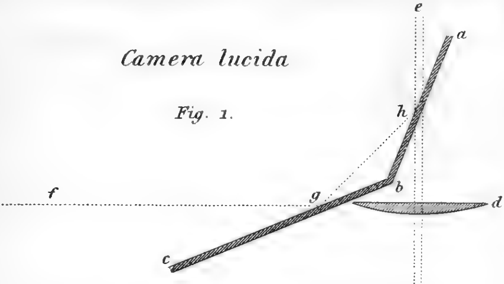


Fig. 2.

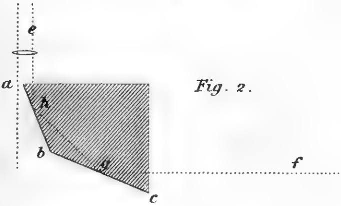
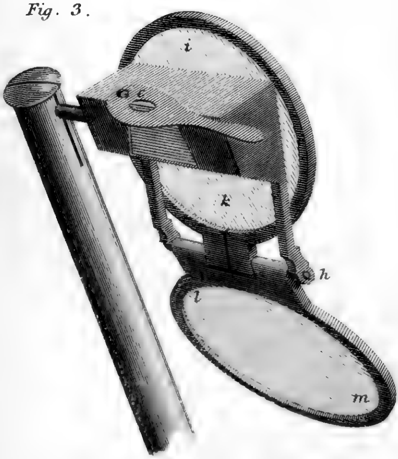


Fig. 3.



Katers Hygrometer.

Fig. 1.

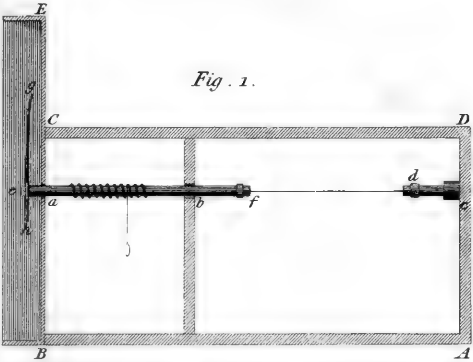


Fig. 2.

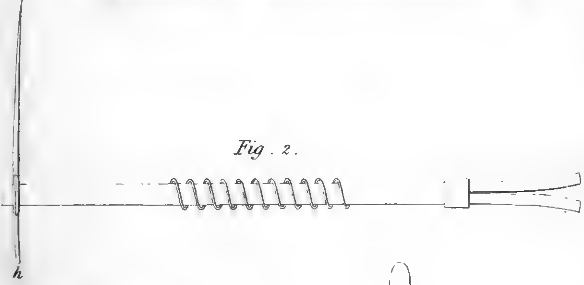


Fig. 3.

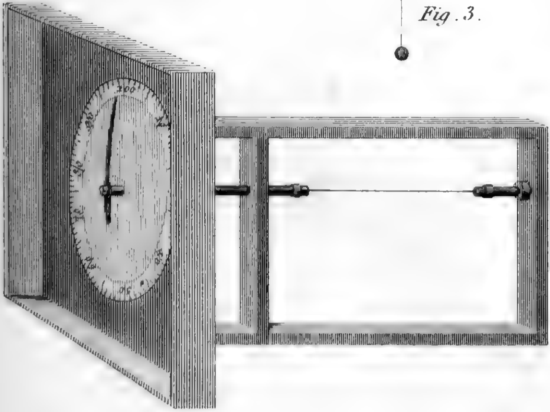


Fig. 4.

S. Porter sc.