THE

# MAGAZINE OF SCIENCE,

## SCHOOL OF ARTS:

INTENDED TO ILLUSTRATE THE MOST USEFUL, NOVEL, AND INTERESTING PARTS

Natural History and Experimental Philosophy,

ARTISTICAL PROCESSES

ORNAMENTAL MANUFACTURES, AND THE ARTS OF LIFE.

VOL. VI.

ILLUSTRATED WITH UPWARDS OF TWO HUNDRED ENGRAVINGS.

London:
PUBLISHED FOR THE PROPRIETORS BY W. BRITTAIN, PATERNOSTER ROW.
MDCCCXLV

# PREFACE.

Another volume of the Magazine of Science being completed, the agreeable duty devolves upon us of returning thanks to its numerous subscribers, not only for their continued support, but also for their occasional communications; this pleasure is greatly enhanced by the circumstance, that the circulation of the work during the past year has considerably increased, a manifest proof, that in the midst of the almost innumerable periodicals of the present day, the Magazine of Science still retains the high character which its merits at first procured for it, and also that the labours of the new Editor have been such as to insure general approbation.

As it must doubtless be gratifying to all lovers of Science to witness the prosperity of works calculated to promote the Knowledge of the Public on such subjects; we may mention as additional testimony to the interest taken in the one before us, the great increase in the number of correspondents, during the past year nearly three hundred enquiries have been answered, and although these have involved occasionally considerable labour and research, we trust our replies have at all times been tendered with a courtesy which has shewn an endeavour to treat all with respectful attention, even where we have not been able to procure perfectly satisfactory answers to the queries proposed to us.

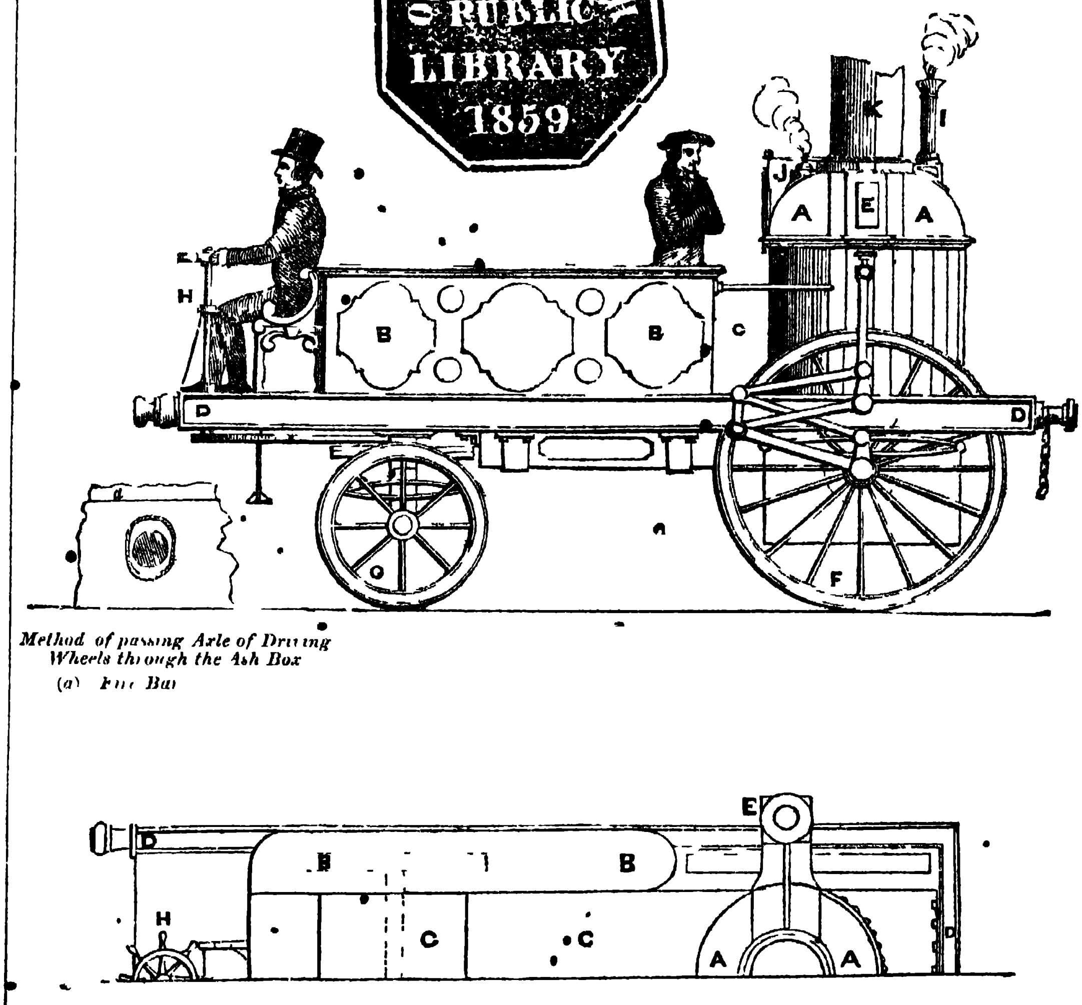
We have the pleasure of announcing, that we have engaged the services of a gentleman well qualified for the task, to furnish us with a translation of Jussieu's celebrated work on Botany, which will from time to time appear in our pages; it will be illustrated with explanatory wood cuts, and will, when complete, form a valuable treatise on this most interesting and useful Science.

And now while we heartily thank our contributors and readers for their past patronage, we beg to assure them that we shall use our utmost endeavours to place before them in the future Numbers of our unaspiring little work, such matters as will contribute both to their amusement and edification, and we trust that a still greater advance in its circulation will continue to encourage our labours, and bear testimony to our favourable reception by an enlightened public.

*March* 31, 1845.

# The Magazine of Science and School of Arts





*Method of passing Axle of Driving Wheels through the Ash Box*
(*a*) *Fire Bar*

NEW STEAM COACH FOR COMMON ROADS.

## Steam Coach for Common Roads.

The appliance of steam power on common roads was attempted to be carried into practice many years ago, but with an unsuccessful result; owing to the combined opposition of the furious railway mania, then epidemic, and the imperfections attaching to the various steam carriages then brought forward. The present juncture, however, promises greater success, as public feeling, as well as public opinion, is now beginning to run strongly and stedfastly against the railway system: in addition to which, we believe we shall be able to give a design for a common road steam coach, which, by its freedom from the vices attendant upon the plans brought forward heretofore, at once removes all difficulty to be apprehended on that score. In short, we are of opinion that the time has arrived when steam coaches on common roads may be employed with success; and we are anxious to be the herald of that blissful consummation.

The great obstacle heretofore experienced to the success of steam-carriages on common roads, has been the impracticability of hanging them on efficient springs. This is a more difficult thing to do than might at first sight appear; for at the same time that there must be a rigidity between the cylinder and the axle to transmit the engine power, there must be a flexibility to enable the springs to act. If the springs be impeded in their action, or be too strong and rigid, the machinery will be soon knocked to pieces in consequence of the concussion of the road: while again, if we suppose the springs to be sufficiently elastic to obviate this evil, and that the cylinder and axle are directly connected, the springs will yield to every stroke of the engine; and the alteration in the relative positions of the axle and cylinder, consequent on this movement, will cause the piston to strike with violence the cylinder top or bottom. This striking of the piston may, indeed, be obviated by making the cylinder of an extra length; but this, again, involves the evil of a great waste of steam, and introduces excessive complexity into the valve gearing. Here, then, steam coaches on common roads have stood, in a dilemma they have not as yet been able to surmount, —they have not been able either to avail themselves of efficient springs, or to do without them; and we are thoroughly assured that they cannot be successful until this difficulty has been surmounted.

The particular form of steam coach we would recommend is shown in the Engraving; and the nature of the contrivance by which a free play to the springs is made consistent with the right operation of the piston power, will at once appear on inspection. The variety of boiler we have adopted is that invented by Mr. David Napier, and used in a number of steam vessels. It is light, strong, and compact; carries little weight of water, and produces a plentiful supply of steam: it also admits of being easily repaired. Of the other parts of the plan we have no room to say anything; nor is it necessary that we should, for the drawing makes them abundantly plain, with the aid of the following references.—A A A, boiler; B B, tank for feed-water; C C, firing space; D D, frame for supporting boiler; E, cylinder; F, driving wheel; G, wheel for steering; H H, steering gear; I, lock-up safety-valve; J, spring balance; K, chimney.

Our limits only enable us, in addition to this, to explain, that the connecting-rod is attached immediately to a crank or link fixed on the upper carriage; and from thence the motion is conveyed to an intermediate crank or link, fixed neither to the upper nor under carriage, but to the extremity of a jointed iron, like a great pair of compasses, situated between them. From this last point, the motion is conveyed to the crank which turns the wheel; and a moment's inspection of the Engraving will show that the upper carriages may be depressed or elevated, or moved, indeed, in any direction, without vitiating the movement between the wheels and engine. The link joints are, of course, of the ball-and-socket description, and a socket and universal joint are introduced into the steering spindle. The accommodation of the power to the resistance, so that a greater power may be given out in ascending hills, is accomplished by a variation in the degree of expansion; an expedient presenting no difficulty, and already practised in steam navigation.

Such is the steam-carriage proposed by the conductors of that very popular work "the Artizan"; and which to our thinking, is highly recommended by its simplicity of construction, and its adaptation for remedying the imperfections in previous steam-coaches.

## The Earl of Dundonald's Improved Steam Engine.

The Earl of Dundonald has long been known to possess mechanical genius of a high order. He has been many years in perfecting an invention on which numbers have laboured, but hitherto with small success—we mean, a rotatory steam-engine. His lordship has just presented a petition to both Houses of Parliament, praying that his patent for this invention may be prolonged. The petition gives an account of the chemical discoveries of his father, which, although of great value to the public, were a source of great loss to himself. Lord Dundonald then proceeds to the subject of his own rotatory steam-engine, the merits of which are only beginning to be recognised as the patent is about to expire; the states that "unless he shall now obtain from the justice of your Honourable House an available extension of his patent right, the whole of his time, thought, labour, anxiety, together with the heavy expense of numerous experiments, to perfect the mechanical simplification of the steam-engine, so as to produce at once a revolving motion, must be lost to the petitioner." One of these revolving engines has been erected on the Well of Her Majesty's Dockyard, at Portsmouth; and the following is an abstract of the official report made to the Board of Admiralty, from repeated experiments made with this engine.

The method of testing the revolving engine has been by the use of a friction band and lever—the lever was six feet long; to its end were suspended weights in sufficient quantity to bring the mean velocity of the pistons to the best practicable condition. The amount of the weights and the speed at which the pistons were going per minute were noted; also, the number of entire inches of water evaporated per minute, in order to ascertain at what expense of steam the engine overcame the friction of the band. The observations were as follows:—

| | |
|---|---|
| Time the experiment lasted in minutes.......... | 90 |
| Number of revolutions per minute.............. | 50 |
| Weight raised in pounds, ...................... | 185 |
| Water evaporated in cubic inches .............. | 429 |
| Vacuum by the barometer in inches ............ | 27 |
| Steam pressure in the boiler.................... | 4½ |
| Steam by the indicator ......................... | 1 |
| Degree of temperature of the condensing water.. | 100° |

The above was the result of six consecutive experiments, the mean of which is taken as a data; by which it is obvious that this engine, with all its mechanical infirmities, (consequent on oversight and want of experience in the construction of the first rotatory engine ever made on low pressure principles), exerts a power of 10½ horses, at an expenditure of steam not exceeding per horse power that of Watt; deducting, as is the case in all investigations of the kind, the amount of steam consumed in overcoming the friction of the engine.

In my first report, says the superintendent engineer, I expressed considerable fear that the mutual attraction of parts would occasion speedy destruction. Judging from analogy presented by mechanical movements in various machines, I have now, however, carefully examined the interior of the engine, and find the pistons, cylinders, air-pumps, and valves in as good condition as they were in my last report; and to my great suprise, the flap valve which divides the plenum from the vacuum, and which has such an inconceivably small surface of contact with the piston, is now in as perfect order as on the first day of being set to work. The fact of this very important instrument being in such good order is further confirmed by the temperature of the condensing water from the hot well, and by the amount of the vacuum which, for several months before, and for six months since the last alterations were made, has been steadily and uniformly good—never has the quicksilver been below 27 inches, and frequently its altitude has been 28¼. There is not at present an engine under my superintendence in this Dockyard that can produce a vacuum superior to this.

The advantages this engine appears to possess are, its being compact, and occupying considerably less space than the common engine; it affords the means of employing the direct action of steam to produce rotatory motion, without the intervention of complicated machinery. The velocity of this engine under steam pressure is not circumscribed by reciprocating laws; but as its parts move in circular orbits, it possesses the means of attaining a higher velocity than the beam engine; and at the present time, even in this imperfect exhibition of the principle, its velocity has approached progressive accelerations.

In manufacturing this kind of engines, there are no difficulties present to the workmen which they cannot overcome. The chief parts, or those which require the most accurate attention, can be submitted to the unerring operation of the turning lathe and planing machine; hand labour, the most tedious and expensive of all processes, is scarcely required; therefore, the first cost of these engines may with propriety be estimated at less than that of reciprocating engines; and in restoring such parts as may be unavoidably broken or worn out, equal facility and economy present themselves. The weight also of the whole structure is considerably reduced.

Such peculiar properties as these give to this rotatory principle an adaptation worthy of attention, especially for services wherein compactness and lightness, vivacity of operation and precision, are paramount objects.

(Signed by the Superintendent Engineer, Her Majesty's Dock-yard, Portsmouth.)

We understand that the Janus steam-frigate, lately launched, is being fitted up with revolving engines on this principle; and that the boilers are on a new construction, also patented by Lord Dundonald, whereby very considerable saving of space and economy of fuel are effected.

## Fossil Organic Remains in Denmark, Australia, and New Zealand.

Some men in digging lately near the village of Pappenbuhl, in Denmark, discovered at the depth of 15 feet an antique bark, formed out of a single oak tree, and rounded at the bottom. It was much decayed by the moisture of its bed, but it is ascertained to have been 32 feet in length, 2 feet deep, and 2½ feet broad at the middle. There were on each side several holes made with a borer, but no trace of nails or any ironwork could be found. On the spot where it lay, there ran in ancient days a canal, which united the rivers Eider and Hever. This canal was dedicated to the god Oegir—the Neptune of the Scandinavians. but on the introduction of Christianity it was filled up. It is, therefore, probable that this boat had its existence in the eighth, or at least in the ninth, century. It has been purchased by the Government, with the intent of placing it among the northern antiquities of the public museum, which contains very few relics of the navigation of the aboriginals of Scandinavia.

It is a point of much interest in geology, to ascertain at what period the race of quadrupeds which immediately preceded the present, lived; and under what circumstances they disappeared. Mr. Lyell lately showed that the Falls of Niagara had receded four miles since certain strata of river sand were deposited, which contain the remains of the Mastodon. On the supposition, which he thinks most probable, that the falls recede at the rate of a foot per annum, it would follow that 20,000 years have elapsed since these strata were formed. From a second paper by the same geologist, it appears probable that this gigantic race existed after, perhaps long after, the disposition of the boulder clay of the United States, which is probably contemporaneous with a similar deposit in this country. Of course, the epoch of the boulder clay must be much more remote than twenty thousand or thirty thousand years. It follows, too, that the great current, *debacle* or whatever else it was, which swept this clay into the positions it now occupies, was not the agent which destroyed the mastodon. The other conclusion, which is deduced from the association of modern shells with the bones, is, that the disappearance of the animals is not the result of any change of climate. Mr. Lyell thinks that the face of the country remains nearly as it was when these quadrupeds wandered over it, and that they trod the very paths frequented by the buffaloes at this day. If neither a change of climate nor an eruption of water occurred, what has extinguished this race which once existed in both ends of the continent? The mastodon resembled the elephant in size and form; the mammoth, whose remains were found with it, was a true elephant, but of an extinct species; and the megatherium was a gigantic animal analogous to the sloth in structure. It is singular that the horse, which was unknown in America when the Spaniards landed, exists in the fossil state in both divisions of the continent.

Sir Thomas Livingstone Mitchell, Surveyor-General of Australia, announces the interesting discovery of large fossil mammalian remains in that continent. The specimens from the bone-caves in Wellington Valley, described in the second volume of Sir Thomas's work on Australia, were remains of extinct species of marsupial genera now existing in this continent, and of a genus very nearly allied to the existing ones; the largest fossil, which had been supposed to belong to the Hippopotamus or Dugong, indicating rather an extinct gigantic Phascolome; and there was not any conclusive evidence of a genus of placental mammal in that collection. The fossils, which Sir T. L. Mitchell has transmitted to Professor Owen incontestably establish the former existence of a huge proboscidian Pachyderm in the Australian continent, referrible to either the genus *Mastodon* or *Dinotherium*. These fossils consist of a portion of a molar tooth, and of the shaft of a femur, with part of the spine of a scapula, and some smaller fragments of a long bone. Sir Thomas states—

"These are not satisfactory specimens such as I hope soon to send you; but being the first from the locality, I am anxious you should first have them. I can tell you but little of the manner in which they occur; but such bones are found on the Darling Downs—those extensive plains which you will see marked to the S. W. of Moreton Bay on most maps of this country. They are at the sources of the Darling River, and at a great height above the level of the sea, upwards of 4000 feet. I am informed that these huge bones, of which I send you but fragments, are found in some abundance."

In a letter descriptive of these Mastodontoid fossils, written to the Editors of the *Annals of Natural History*, Professor Owen says:—

"The fossils cannot be contemplated without suggesting many interesting reflections. They tell us plainly that the time was, when Australia's arid plains were trodden by the hoofs of heavy Pachyderms; but could the land then have been, as now, parched by long-continued droughts, with dry river courses containing here and there a pond of water? All the facts and analogies which throw light on the habits of the extinct Mastodons and Dinotheres, indicate these creatures to have been frequenters of marshes, swamps, or lakes. Other relations of land and sea than now characterise the southern hemisphere, a different condition of the surface of the land and of the meteoric influences governing the proportion and distribution of fresh water on that surface, may, therefore, be conjectured to have prevailed, when huge Mastodontoid Pachyderms constituted part of the quadruped-population of Australia. May not the change from a more humid climate to the present peculiar dry one have been the cause, or chief cause, of the extinction of such Pachyderms? Was not the ancient *terra Australis*, when so populated, of greater extent than the present insular continent?

"The mutual dependence between large mammalian quadrupeds, and other members of the animal kingdom, suggest other reflections in connexion with the present fossil. If the extinct species ever so abounded as to require its redundancy to be subpressed by a carnivorous enemy, then some destructive species of this kind must have co-existed, of larger dimensions than the extinct *Dasyurus lanniarius*,—the ancient destroyer of the now equally extinct gigantic kangaroos, *Macropus Titan*, &c. whose remains were discovered in the bone-caves of Wellington Valley. Extremly few coprophagous beetles have hitherto, I believe, been found in Australia, and the scarcity of such is readily explained by the absence of native species of large herbivorous mammals; but the dung of the Mastodontoid quadrupeds which formerly existed in Australia must then have afforded the requisite conditions for a greater abundance of such Coleoptera."

Some bones of a gigantic bird were lately deposited in the Museum of Sydney, as a present from Mr. James Busby, of New Zealand. A more complete collection of them was at the same time sent to England by the discoverer, the Rev. Mr. Williams, and subjected to the investigation of the members of the Geological Society. By desire of Professor Buckland, W. J. Broderip, Esq., F.R.S., and Professor Owen were present at the opening of the box of bones (23 in number); and. to use the words of the former gentlemen, they "supped upon them." Mr. Broderip writes:—

"The bones consist of tibiæ, femora, pelves, cervical vertebræ, a coracoid or two, and above all a tarsal bone, which is the bone, and the key to the whole. We compared these bones with those of the ostrich, emu, rhea, and apteryx. It was not an ostrich, because the bird was not tridactyle, and it was not an apteryx, because there was no hind toe. Neither was it an emu, rhea, nor cassowary; in short it is a new genus, and the only question is, whether there is evidence of any more species than one. There are bones of all sizes, and we have scarcely a limit to the growth of the animal, as we have not yet the largest bone. From the bones already sent, the bird must have been about fourteen feet high,—but tremendously stout, and the condition of the bones is such as to make it far from improbable that the bird still exists.

"The *Dinornis Novæ Zelandiæ*, for such is the name Professor Owen has given the bird, must have been far stouter and broader in proportion to its size than any of the other trydactylous *Struthionidæ*, excepting *Apteryx*, and stouter, broader, and so to speak, more mammalian than even that bird. There is no end to the interest of this arrival, and mark well what a chapter it opens in the book of *Ornithichnites!* The largest cast of those footsteps is hardly, if at all, too large for the monstrous foot of this New Zealander."

The natives have a name for this bird, and traditions of its existence; and Mr. Williams's letter mentions a story of the captain and crew of an American vessel having seen a bird sixteen feet high stalking one night along the side of a hill adjacent to the sea, but not having courage or curiosity enough to give chase. It is therefore probable that a living *Dinornis Novæ Zelandiæ* may be soon seen striding among emus and ostriches in the Regent's Park.

Piles of human ossified remains, of sizes ascribed to the antediluvian creation, and remarkable thicknesess, have recently been found scattered about in various parts of New Zealand.

## Progress of Electrical Discovery.

We find the following excellent paper in a late Number of the *Artizan*:—

The rapid strides recently made by the science of Electricity, with its correlative science of Electro-Magnetism and Galvanism, have rendered it difficult for those not actually engaged in their study to keep pace with the progress of discovery; and a work which should comprise all that is known on the subject up to the present time has been long wanted. The Lectures on Electricity, by Mr. Noad, which have been just published, appear, in a great measure, to supply this deficiency. Mr. Noad undertakes to trace the progress of the science from its earliest development to the latest discoveries; and as he is fully possessed of his subject, and has no peculiar theories of his own to propound, he has done this in a clear and comprehensive manner, without perplexing the student by theoretical disputations. The work, is, indeed, remarkably free from theory, almost to a fault; for it would be desirable to have an impartial examination, by a competent judge, of the various theories which divide the philosophical world respecting the nature of electrical agency. The author commences with a brief sketch of the history of what is termed for distinction, "statical electricity," or that which is usually excited by mechanical means. He notices Dufaye's theory of resinous and vitreous electricity, which was for a long time supplanted by Franklin's more simple explanation, of all bodies having a certain capacity for electricity, and that it is only when they are in a *plus* or *minus* state in relation to surrounding bodies that electrical phenomena are exhibited; but Mr. Noad enters not into the discussion: he subsequently, however, pronounces in favour of the existence of two electricities, though the terms of Dufaye are repudiated and those of Franklin retained. Dr. Faraday is, deservedly, a great authority with Mr. Noad, who appears to adopt his views implicitly, even to the extent of agreeing with him that the friction of water is the most powerful known means of exciting electricity.

The disturbance of the electrical equilibrium by induction, is one of the most curious of the phenomena of electricity. The approach of a positively excited electric to an insulated body induces in the part nearest to it, without contact, an opposite electrical state; and the insulated body may, by temporary connexion with the earth, when within the influence of the excited electric, be left in a negatively electrical state after the electric is withdrawn, though the latter has not parted with any of its electricity. This phenomenon has been attributed by Faraday to a physical action occurring between contiguous particles, each particle of air intervening between the electric and the insulated conductor, for example, assuming a state of polarity, one pole being negative and the other positive; and this polarisation, it is assumed, is communicated to all the particles of metal in the body in which electricity is induced. This theory Mr. Noad adopts, and it is thus applied to the explanation of the action of the electrical machine: "On turning the handle of the cylinder or plate, the electricity naturally present in the rubber becomes decomposed—its positive adhering to the surface of the glass, and its negative to the rubber: the positive electric portions of the glass coming during its revolution opposite to the points on the conductor, act powerfully by induction on the natural electricities of the conductor, attracting the negative, which, being accumulated in a state of tension at the points, dart off towards the cylinder to meet the positive fluid, and thus reconstitute the neutral compound. The consequence of this is, that the conductor is left powerfully positive—*not*, must it particularly be understood, *by acquiring electricity from the revolving glass, but by having given up its own negative fluid to the latter.* The rubber is left in a proportionately negative state, and, consequently, after revolving the glass for a few minutes, can develop no more free, positive electricity, provided it is insulated." The more simple explanation on the hypothesis of Franklin is, that the rotation of the glass cylinder deprives the rubber of its natural share of electricity, which is conveyed to the conductor; and when the rubber is insulated, the action ceases, from the want of supply of further quantities of electricity to the rubber from the earth.

The question which has agitated the electrical world of late more than any other is that of *lateral discharge*, in reference more particularly to the safety of lightning-conductors; and, in consequence of its practical importance, Mr. Noad enters further on this debateable ground than is his wont. He states the question in dispute very impartially, mentioning, broadly, the objections that have been raised by Mr. Martyn Roberts, Mr. Sturgeon, and by Mr. Walker, to the efficacy of Mr. Snow Harris's lightning-conductors, which have now been generally adopted in the navy, and consist of strips of sheet copper let into the masts, and connected with the sheathing of the ship. It is objected to the use of these conductors, that in every electrical discharge there is a lateral emission of electricity; consequently that great danger might be incurred from the effects of that portion of the electric fluid which is not conveyed directly through the copper. These objectors, however, do not deny the efficacy of lightning-conductors in the abstract: it is to Mr. Harris's strips of sheet copper let into the masts that they demur, each one having a nostrum of his own for conducting the lightning with perfect safety. Mr. Walker is of opinion that the electricity of a Leyden jar is not in so high a state of tension as lightning, wherefore the experiments with discharges from jars cannot be taken to represent the effects of lightning. To properly estimate the conduction of lightning, he contends that the spark from the conductor of an electrical-machine affords the best criterion; and his experiments with the monster machine at the Polytechnic Institution lead him to infer that a division of the charge will take place among neighbouring conducting bodies. Mr. Harris, however, seems to have the best of the argument; for the fact appears to be, that though a lateral discharge will take place when the conductor is imperfect or inefficient, the electric fluid will not pass out of its course from a perfect and *sufficient* conductor into one that is less direct and more imperfect.

The important and mysterious effects of the continuous action of electricity, more particularly in reference to Mr. Crosse's experiments of the development of living insects, are considered at some length by Mr. Noad, who appears to think the acarus to originate from electrical agency. In some experiments, however, which he has himself continued uninterruptedly for sixteen months, no acari had appeared within the vessels carefully excluded from the atmosphere, though several had been observed on the outside. It appears, also, that Mr. Weeks, who had successfully repeated Mr. Crosse's experiments, admits that the acari generally appeared on the outside before any were observed in the closed vessels. In some experiments recently conducted by Mr. Weekes in vessels exposed to the atmosphere, after swarms of the usual electrical acari had appeared and continued for three or four months, *a host of other insects* followed, and all the acari disappeared; the latter having, as Mr. Weekes supposes, been eaten up by the succeeding generation. There is, truly, much mystery yet about this matter which requires solution.

There are many other points dwelt upon by Mr. Noad, to which we would willingly advert did space allow. We cannot conclude our notice of his book without again recommending it as one that supplies, and very efficiently, a vacuity that has for some time existed in scientific literature.

## The Mustard-Tree of Scripture.

PROFESSOR ROYLE has been induced to bring this subject before the Asiatic Society in consequence of having traced an Indian tree, by its Asiatic synonyme, to be the Mustard-tree of Scripture. Having referred to the passages in the New Testament, where the tree is mentioned, Dr. Royle stated, that it appeared to him essential that it should be indigenous in Palestine, and be strictly arboreous; have a small seed, be possessed of properties similar to mustard, and have a name in the language of the country of which the Greek *sinape* of the New Testament might be considered a correct translation. Our Saviour, in addressing the multitude on the shores of the Sea of Gallilee, no doubt employed a name familiar to them in the Syriac, or western Aramaic. The Professor stated, that his attention had been directed to the subject in consequence of having been asked by Dr. Lonsdale, the Bishop of Lichfield, whether he knew what tree was intended by the mustard-tree in Scripture, because Mr. Amueng, a native of Syria, at that time, and now, a student of King's College, had informed him, that he was well acquainted with a tree which answered to what was required by the parable. Mr. Amueng gave Dr. Royle the same information, and stated in addition, that he had often stood on horseback under the tree, which was in Syria considered to be the mustard-tree of Scripture, and that it was commonly called *khardal*. On this, Dr. Royle asked if that were the Arabic name of mustard; Mr. Amueng replied that it was so, and that the seeds were used for the same purposes as mustard was employed in Europe. Dr. Royle was long unsuccessful in finding any explanation of *khardal* as applicable to a tree of Palestine; though in his MS. Materia Medica of the East, three kinds are enumerated 1, *khardal*, common mustard; *khardal barree*, or wild mustard; 3, *khardal Romee*, or Turkish mustard. He then referred to the index of his 'Illustrations of Himaylayan Botany,' where he found the word *Kharjal*. This he was suprised to find applicable to the subject; for in the body of the work, it is stated to be the name of a tree in the north-west of India, with acrid bark and edible berries. It droops like the willow, and has leaves something resembling those of the *Salvadora Persica* of botanists, which Dr. Roxbergh describes as a moderate-sized tree, common in the Circars, growing well in every soil, and producing flowers and ripe fruit all the year round. These are in panicles, with the berries red and juicy, and much smaller than a grain of black pepper, having a strong aromatic smell, and a flavour much like garden cresses. Retz obtained it from Tranquebar, and called it *Embelia grossularium.* It was first obtained from the shores of the Persian Gulf. Forskål describes it under the name of *Cissus arborea*, as a native of Arabia, much esteemed by the Arabs, and as even celebrated by their poets. On inquiring of Dr. Lindley, he learned that it had been found, by Borè, in the neighbourhood of Mount Sinai. But still he could find no notice of the *Salvadora Persica* as occurring in Palestine, either among botanists or travellers. Captains Irby and Mangles, however, in their travels mention a tree which they suppose to be the mustard-tree of Scripture, and which Dr. Royle, even from the few characters given, has no doubt is the same tree, and which he had traced from India to Mount Sanai. These travellers mention that, advancing towards Kerek, from the southern extremity of the Dead Sea, they met, among many others, with one curious tree, which they observed to be in great plenty, and which bore a fruit in bunches resembling in appearance the currant, with the colour of the plum. "It has a pleasant, although a strongly aromatic taste, exactly resembling mustard; and, if taken in any quantity, produces a similar irritability of the nose and eyes to that which is caused by taking mustard. We think it propable that this is the tree our Saviour alluded to in the parable of the mustard-seed, and not the mustard-plant which we have in the north, and which, even when growing large, can never be called a tree; whereas the other is really such; and birds might easily and actually do, take shelter under its shadows." On further enquiring of Mr. Ameung, Dr. Royle found that this tree, called *khardal*, is found in the neighbourhood of Jerusalem; but most abundantly on the banks of the Jordan, and round the Sea of Tiberias,—that is in the very locality where our Saviour uttered the parable of the mustard-tree. There can be but little doubt that this is the same tree as that seen, a little further south, by Captains Irby and Mangles; and that it is to that the writers in the Talmud allude, under the name of *chardul;* one, describing a tree of which the wood was sufficient to cover a potter's shed; and another, that he was wont to climb into a *chardul* tree in his field, as men climb into a fig tree. The author concluded by stating, that though Captains Irby and Mangles had first indicated the tree, he thought he had been the first to ascertain that the *Salvadora Persica* was the precise tree; but he had since been surprised to find in the 'Flora Indica' of his friend Dr. Lindley the observation that "this plant is supposed to be the mustard-tree of Scripture." The reason for this opinion, and the sources of the information, he had not yet been able to ascertain. He presented the paper, however, as a result to which he had arrived by an independent mode of investigation, which would be useful, at all events, in confirming any conclusions arrived at by others; and give the additional and valuable fact of the name *Kharjal* being applied in N. W. India, to the same tree as *Khardal* is in Syria. Hence, even in the absence of authentic specimens Dr. Royle, stated that he felt no doubt but that the *Salvodora Persica* was the Mustard-tree of Scripture.

## Fermentation-Brewing.

In a recent communication to the Royal Institution, Professor Brande afforded a general view of that important class of chemical phenomena, of which Fermentation is a single example, viz. decompositions and combinations brought about by causes independent of chemical affinity. Having exhibited striking experiments illustrative of chemical affinity, Mr. Brande called attention to the fact that none of that interchange of the elements of the combining substances, which takes place under the influence of this force, occurs in *catalytic* or *contact-action*. The phenomena, resulting from catylisis are of two kinds; 1st, when the substance producing the effects is altogether passive. The agency of platinum on a mixture of hydrogen and oxygen gases, is a striking instance of this sort of catalytic action. Mr. Brande reminded the members of a communication made by Mr. Faraday some years since, on this subject. Mr. Faraday then drew attention to the fact, that a clean disc of platinum, immersed into an atmosphere of hydrogen and oxygen gases, mixed in the proportion, by weight, of 8 and 1, caused chemical union, with more or less heat and explosion. Here the acting substance undergoes no change:—But, 2nd, in organic catalysis, the substance producing the effects undergoes change in itself, but does not, as in the case of ordinary chemical affinity, form union with the substance on which it acts. Thus in the case of rennet coagulating milk, or yeast inducing fermentation in wort, each of these substances interchanges its particles with those of the liquid into which it is immersed, as happens when a plate of iron is plunged into a solution of copper; but the effect is obtained by the motion of the particles of the decomposing body among themselves, creating a corresponding movement in the body subjected to its influence. The decomposing body must be organic, contain nitrogen, and in a state of decay. This is the case with yeast when placed in a vessel of wort. It undergoes a change, connected according to some naturalists with the growth of a microscopic plant, and by this change splits the sugar of the wort into carbonic acid and alchohol. Having noticed the effects of this force of catalysis, Mr. Brande adverted to two theories respecting its nature—the doctrine that the particles of the decomposing body can communicate their motion to an indefinite mass of matter, and the doctrine that each particle of the decomposing body must be in its turn presented to every particle of the substances to be acted upon. After pointing out the difficulties inseparable from both these theories, Mr. Brande noticed, apparently with approbation, the simpler doctrine that, in these cases, the combining force travels from particle to particle, as happens when a train of gunpowder or an ordinary fire is lighted. Mr. Brande concluded by adverting to an economical method of brewing, practised, we believe, with much success in the family of Sir Thomas Marrable. In this method, yeast, as well as the expensive apparatus of coolers, is dispensed with. The wort, after the malt is strained off, is boiled with the hops, and together with the hops deposited in a barrel placed upright, arrangement being made for the escape of the carbonic acid, and for the barrel being com-completely closed, as soon as the fermentation should terminate.

## Cause of Rocking on Railways.

The attention of Mr. J. Heaton was first drawn to the subject of the principal cause of the Rocking Motion of Locomotive Engines and Carriages, in the year 1838, when employed to examine a steam-engine and machinery used for making boiler plates, rolled bars, &c. He found that the fly-wheels of the engine, when revolving rapidly, made a very rumbling noise, and the lighter one would jump as high as the gear would let it; indeed, the whole building rocked when the machinery was in motion. It was found that the fly-wheels were heavy sided, and that the smaller one, (16 feet in diameter), required 160lbs. on one side, and the larger one, (18 feet in diameter), 322lbs. to equipoise them. This having been done, the whole of the machinery moved easily and quietly. This result caused the author to turn his attention to the rocking and jumping motion experienced in locomotive engines and carriages. The difference of speed at which the different parts of a wheel in motion progress, or the speed at which bodies descend through short distances, does not appear to have been taken sufficient notice of by engineers, as the heavy side of a wheel has to fall at certain intervals during its revolution sixty times as fast as it would fall by gravity alone. When a railway engine is travelling at the rate of 33 miles per hour, the top of its wheel is thrown forward at the rate of about 92 feet, and downward at the rate of 46 feet in a second. Railway carriage-wheels are frequently 6 to 7 lb. heavier on one side than the other; it is no wonder, therefore, that the unpleasant motion experienced while travelling in carriages so circumstanced, is so often complained of. Without entering into detail with regard to the different machines used for the purpose of illustrating Mr. Heaton's views, it may be well to describe the most simple one, and the method of making the experiments. The model is made to represent the wheels and axle of a railway carriage, the axle being 16 inches long, and the wheels 6½ inches diameter. By placing some loose pieces of iron inside the rims, so as to represent wheels which are 1-6th of an inch thicker on one side than the other, the thick side of one wheel being placed opposite the thick side of the other, at the opposite ends of the axle, according to the common practice, and the wheels allowed to revolve,—the model will continue to jump about the table (on which it is placed) so long as the wheels are in motion. Again, if the pieces of iron be all placed on the same side of the centre, the model will not rock as before, but jump up and down and make more evolutions than in the last case. The wheels being perfectly equilibrated, will revolve without any oscillating movement and the frame remain quite steady, the number of revolutions, with the same power, being considerably increased.

We trust that, by the above simple means, the above Railway nuisance may be abated.

## Notions of the Heavenly Distances.

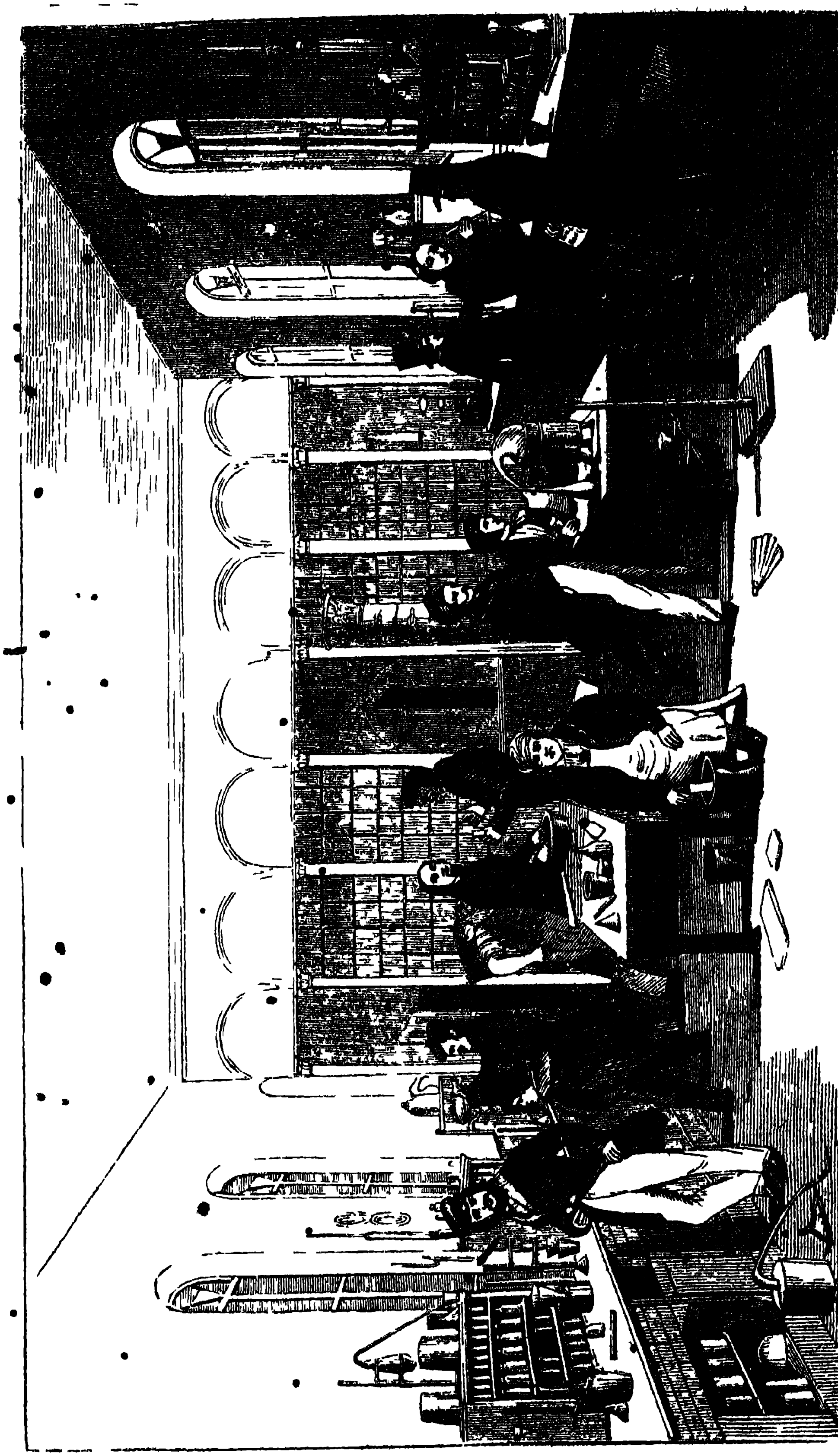
PROFESSOR MOSSOTTI strikingly observes: Astronomy, as if ensible of the smallness of the being that was creating it, was very slow and backward in discovering the immensity of the field that lay open to its investigations. The first astronomers, believing the earth to be immoveable in the centre of the universe, did not dare to extend the limits of the heavenly vault beyond a million of geographical miles. When the Pythagorean school gave forth the bold conception, that the earth was a planet revolving round the sun, it became necessary to consider the radius of the earth's orbit as of insensible magnitude with regard to that of the celestial sphere, and Aristarchus of Samos (who had adopted the ideas of the Pythagorean school) increased the radius of the latter six hundred and thirty-five times. The limits of the universe are how infinitely more remote: the depth of the heavens confounds itself with the immensity of space. In the last century astronomers determined with precision the distance that separates us from the sun, and, what is no less wonderful, the rapid velocity with which light is propogated. The eighty-two millions and two thirds of a million of miles between the earth and the sun are traversed by light in the short time of eight minutes and thirteen seconds. Now, according to the recent accurate calculations of M. Bessel, ten years and a quarter would scarcely be sufficient for the light from one of the stars which we may suppose the nearest, viz. 61 Cygni, to reach us. And, if we consider the smallest stars visible to the naked eye as those which are placed at an intermediate distance between the nearest and the most remote or telescopic stars, we may presume with Sir J. Herschel, without fear of departing greatly from the truth, that the light from many of them takes some thousand years in reaching us: so that, in the expressive style of that writer, when we observe those stars, when we note their changes, we are reading and writing their history of a thousand years ago. Yet, distant as they seem, these stars do not mark the limits of the universe; they are only those that constitute our sidereal system. There are in the heavens groups of stars and divisible nebulæ, which, according to all appearance, form separate sidereal systems. The distances at which these systems are placed must be as much greater than those of the common stars, as the distances of these are greater than the dimensions of our planetary system. Following out the increasing progression of these intervals, our imagination fails, and is bewildered in the conception of such an immensity of space.

## Steam Boat Ventilation.

ONE of the Addiscombe professors, Lieutenant Cook, R. N., F. R. S., has invented a method of ventilating steam-boats, which promises fair to add materially to the comfort of passengers by these vessels. Those who have merely crossed the Channel, especially by night in boisterous weather, are well aware of the impurity of the air which passengers, however delicate, are under the disagreeable necessity of inhaling, and which of itself is quite enough to produce sickness; but in a hot climate, the evil is of still greater magnitude. Even in large steam-boats, invalid passengers have been fairly driven upon deck in the night from the lower cabins, finding it impossible to remain in such an atmosphere. The evil being universally admitted, it remains to be seen how far the remedy will be applied, should it in practice prove as efficient as in principle it appears to be sound. A cylinder—in which a solid piston moves air-tight—has two valves at each end; through one, opening inwards, fresh air is admitted into a vacuum; which is by the next action of the piston, forced through the other valve at the same end, opening outwards into tubes, and by these conveyed to every cabin upon each deck; while the hot, or foul air, is at the same time drawn off from these cabins into a vacuum above the piston, through a valve opening inwards, from whence it is finally ejected through the fourth valve, opening outwards into the open air. The effect produced will, of course, depend upon the size of the cylinder, and this upon the size of the vessel. One two feet in diameter—the piston having a two-feet stroke—with tubes and valves sufficiently large, would force in about 100 cubic feet, or above 600 gallons, of fresh air (drawing off the same quantity of impure air) every minute! large steam-boats might have two cylinders. The machinery may, in an instant, be disconnected. The fresh air would be conveyed in a regular stream, and not be intermitting in its effect.

## Wright's Improved Barometer.

CONSISTS of a straight, inverted tube, with the cistern at bottom and the scale and vernier at top, so far similar to the ordinary pediment barometer: the area of the cistern is fifty times that of the tube, so that a fall of one inch in the tube will give a rise of 1-50th of an inch in the cistern; the divisions on the scale are accordingly made 1-50th less than an inch, and the tenths each 1-50th less than a tenth. Thus a large tube may be used, and the sliding scale dispensed with, and a more accurate result obtained by one observation only. As mercury is found to expand for every degree of Fahrenheit the 1-9990th part of its volume at 32° the expansion of a column 30 inches long—from 32° to 100°—will at this rate amount to ·205 inch. If the horizontal line opposite 30 inches in the scale of the ordinary barometer be raised ·205 inch at one end, it will form an inclined line, representing the expansion of a column of mercury 30 inches long, from 32° to 100°, the lower point being that at 32° and the upper that at 100°; this line being divided into 68 parts or intersecting lines (being the number between 32° and 100°), which lines will indicate the expansion of a 30-inch column for all the degrees between 32° and 100°. This inclined line is transferred to the scale, and all the other inches and tenths are calculated in the same manner.



PROFESSOR LIEBIG IN THE LABORATORY, AT GIESSEN

## Professor Liebig, in the Laboratory, at Giessen,

THE prefixed sketch represents the celebrated Chemist, Professor Justus Liebig, in the Laboratory of the University at Giessen, surrounded by distinguished experimentalists, assistants, &c. The figure with curly hair, towards the centre of the sketch, at the end of the left hand table, is that of Liebig, the author of "The Organic Chemistry of Agriculture."

The fame of Liebig, says Mr. J. S. Muspratt, of the Giessen Laboratory, (in a letter to Dr. Murphy, of Liverpool,) is more than European; for it is equally as well known through the vast continent of America. Giessen, as a university, is as much indebted to Liebig for its present fame, as Leyden was to Boerheavan, or Pavia to Scarpa. Mr. Muspratt found Liebig sitting in his studio, making experiments upon soils, plants, &c., The apartment is furnished with an excellent library, and is hung round with portraits of Berrelius, Humboldt, Lavoisier, Davy, Berthollet, Vauquelin, Dalton, Gmelin, Faraday, Theard, &c. In stature, Professor Liebig is above the middle size; he is of slight and delicate make: his head is large, the forehead is exceedingly high and broad, the eye intellectual and expressive, but sunk in the socket, complexion rather sallow; and his countenance, although sharp and anxious, is animated and agreeable. In short, you may have an exellent idea of him by turning to the engraving, taken from the painting by Trantschold.

But no painting or engraving, says Mr. Muspratt, can convey that "all-searching glance," so characteristic of most men of genius, and most essentially so of Liebig, when any important subject calls for a consideration of thought. Of England, he spoke in the highest terms of praise, and gratefully remembered its sumptuous hospitalities towards himself; but he regretted, in common with every enlightened Englishman, the low ebb of the science of chemistry, and that, in the country which produced a Priestley, a Davy, and even now possesses a Dalton, a Faraday, a Graham, and a Keene.

The time of Professor Liebeg is principally occupied in reading, writing, lecturing, and conuucting the laboratory. His private pupils are from almost every part of the civilized globe; there are more than sixty; he visits them twice a day—in the morning, and again in the afternoon, and they are employed in investigating various subjects. He must have a most retentive memory, for he can remember every important experiment that is made during the term. He has three assistants, Drs. Wills, Hoffman, and Fresenius, all well known to the scientific world.

Professor Liebig lectures daily in summer, and twice a week in winter. His style of delivery is peculiar: he uses a good deal of action, speaks slowly, and appears anxious to make himself fully understood by his audience. His language is fluent, and his theories are rapidly conceived and beautifully expressed. His friends fear that he is overworked, and the energy of the mental is evidently too much for the physical powers. The pupils are very much attached to him, and he fully merits it, independent of his intellectual acquirements, for his manner to them is kind and conciliating, and he seems quite unconscious of his high position. His works upon Agriculture and Physiology are in such great estimation, that they have been translated into most of the European languages, and already have gone through several editions. In *Silliman's Journal*, it is well remarked, upon his work entitled "Chemistry and its applications to Agriculture and Physiology:"

"It is not too much to say that the publication of Professor Liebig's Organic Chemistry of Agriculture constitutes an era of great importance in the history of agricultural science. Its acceptance as a standard is unavoidable. In following closely in the straight path of inductive philosophy, the conclusions which are drawn from its data are incontrovertible. We can truly say that we have never risen from the perusal of a book with a more thorough conviction of the profound knowledge, extensive reading, and practical research of its author, and of the invincible power and importance of its reasoning and conclusions, than we have gained from the present volume."

The following is a notice of his letters "On Chemistry and its relations to Commerce, Physiology, and Agriculture."

## Liebig's Letters on Chemistry.

PROFESSOR LIEBIG has in a series of "Familiar Letters," developed his views on "Chemistry and its relation to Commerce, Physiology, and Vegetation" with such success, that the appearance of the work has already had the effect of inducing the foundation of several new chemical professorships in Germany. The translation is in its second edition in this country; and the work is, at once, so sound and popular, that we are persuaded our readers will thank us for the following synoptical glance at its contents.

We may first, however, mention that the work contains sixteen letters in all, of which the first five treat of the Chemistry of the Arts; the next five of the Chemistry of Nutrition; and the remainder of the Chemistry of Agriculture. Letter I. treats of the materials employed for chemical apparatus; the chief of which are glass, caoutchouc, cork, and platinum.

This letter adverts to the wide field opened up to the chemist in the production of valuable substances synthetically, that is, by uniting their elements in the due proportions which has now, in many cases, been accomplished with success. One of the most remarkable of these cases is the production of artificial Lapis Lazuli, by combining silicia, alumina, soda, iron, and sulphur, in the proportions determined by analysis; and out of this artificial mineral an ultramarine is made, quite as beautiful as the natural product, and at a fiftieth part of the cost.

Letter II., among a variety of other interesting disquisitions, explains a very curious phenomenon —the condensation of air and other gases in the pores of charcoal. The explanation, which is most ingenious, and in our eyes perfectly satisfactory, is as follows:—

"The smallest amount of a gas,—atmospheric air for instance,—can be compressed into a space a thousand times smaller by mere mechanical pressure, and then its bulk must be to the least measurable surface of a solid body, as a grain of sand to mountain. By the mere effect of mass,—the force of gravity,—gaseaus molecules are attracted by solids and adhere to their surfaces; and when to this physical force is added the feeblest chemical affinity, the liquifiable gases cannot retain their gaseous state. The amount of air condensed by these forces upon a square inch of surface is certainly not measurable; but when a solid body, presenting several hundred square feet of surface within the space of a cubic inch, is brought into a limited volume of gas, we may understand why that volume is diminished, why all gases without exception are absorbed. A cubic inch of charcoal must have, at the lowest computation, a surface of one hundred square feet. This property of absorbing gases varies with different kinds of charcoal: it is possessed in a higher degree by those containing the most pores, *i. e.* where the pores are finer; and in a lower degree in the more spongy kinds, *i. e.* where the pores are larger."

Letter III. speaks of the manufacture of soda from common salt, and displays, in a striking manner, the numberless innovations which have flowed from that single improvement. The diminution in the price of soda gave a vast impetus to the soap and glass manufactures; and the muriatic acid, which, in the earlier stages of the discovery, was dissipated in the atmosphere during the process as a worthless product, found very soon a profitable application in the production of chlorine for bleaching. The vast consumption of sulphuric acid in the production of soda from common salt, has caused the sulphur trade to assume an importance far beyond what was to have been anticipated in the case of such a material, and that single article is now the source of great wealth to Naples.

Letter IV. discourses of the connection of Practice with Theory, and also says something of the applicability of zinc as a moving force through the agency of electricity. Of this application Mr. Liebig computes that as much fuel is spent in the production of the zinc from the ore, as would produce the whole mechanical effect the zinc is able to generate.

Letter V. treats of the atomic constitution of bodies; and with Letter VI. begins the subject of Chemistry as allied with Physiology, wherein it is shown that all food consists of materials for nutrition and materials for warmth; the one compensating for the wear and waste of the organic tissues, and the other, by a species of combustion, keeping up the vital heat. We here again indulge our readers with an extract:—

"Our clothing is merely an equivalent for a certain amount of food. The more warmly we are clothed the less urgent becomes the appetite for food, because the loss of heat by cooling, and consequently the amount of heat to be supplied by the food, is diminished.

"If we were to go naked, like certain savage tribes, or if in hunting or fishing we were exposed to the same degree of cold as the Samoyedes, we should be able with ease to consume 10lbs. of flesh, and perhaps a dozen of tallow candles into the bargain, daily, as warmly clad travellers have related with astonishment of these people. We should then also be able to take the same quantity of brandy or train oil without bad effects, because the carbon and hydrogen of these substances would only suffice to keep up the equilibrium between the external temperature and that of our bodies."

We see from this, that the cold and hunger to which our poor in severe winters are subjected greatly aggravate one another; and by means of this key, we are also able to understand why hepatic diseases which arise from an excess of carbon, prevail in warm climates. This subject is pursued in the several succeeding letters up to Letter XI., where commences the Chemistry of Agriculture.

The grand secret of success in Agriculture seems to lie in returning to any soil originally prolific, the materials of which it has been deprived by the crops taken from its surface, or in giving those materials to soils destitute of them. A part of the constituents of agricultural produce is returned by the atmosphere—such, for example, as carbon and nitrogen—the former in the state of carbonic acid; and some of the rest, as, for example, sillcia, are probably to be found in the soil. But the phosphates, which are among the most essential elements, can neither be returned by the atmosphere, nor do they exist in any large quantities in the soil; and the gradual approach to sterility, or, as it is termed, the progressive exhaustion of land, is generally attributable to the loss of the ingredients.

The end, therefore, of all agriculture, is to recruit the soil with the elements abstracted from it: and in order that the atmosphere may yield its proportion of these elements, it must have free access to the soil. To afford this free access is the purpose of ploughing: and the more minutely divided the soil is by the operations of husbandry, the more effectually will the atmosphere perform its functions. The phosphates are contained in great abundance in animal exuviæ, and the efficacy of those materials in agriculture is due almost exclusively to the phosphates in them. The efficacy of bone-dust, as well as of guano, is also due to the same elements: nor is there any reason for supposing that the fertilizing property of bones is due to the gelatine they contain; the fact being, that their virtue hangs almost entirely upon their phosphate of lime, The high price, however, of bones and guano, is well nigh a barrier to their employment. A far cheaper source of the phosphates is to be found in the refuse of large towns, which might be collected if proper arrangements were made to that end.

There is, however, another source of fertility to our fields revealed to us by the recent discoveries of Geology. In the rocks about Clifton, and in a great number of other places, there are found vast beds of coprolithes (the fossil exuviæ of antedeluvian animals) which there is every reason to believe will furnish an abundant and cheap supply of excellent manure. In addition to this fossil guano, the limestone marl of Lime Regis, the lias of Bath, and numerous other formations, contain vast quantities of bones. Some of these specimens have been analysed, and have been found to contain about 18 per cent. of phosphate of lime; and if these limestones be only burned, they will constitute one of the best manures we can posses. Here, then, we have an inexhaustible source of fertility, under the influence of which our agriculture may again prosper; and as England, by the power of her coal—the remains of a former *vegetable* world—has risen to the rank of queen among the nations, may she now, by the remnants of an *animal* world, be enabled to maintain that proud position!

## What is the worth of Mathematics.

SIR WILLIAM HAMILTON, in his profound work, entitled, "Fragments of Philosophy," asks: "Do mathematics favour the superior development of the mind? Do they form it by enlarging its faculties?" Such is the question treated of in this Memoir, and answered in the negative. Adducing the testimony of a great number of authors, and the support of numerous examples, Sir William Hamilton undertakes to prove, in opposition to the authority of the Professor Whewell, that mathematics do not afford a general education to the mind, This opinion, which is maintained by modern German professors of celebrity, is likewise that of Voltaire and Franklin, both of whom had cultivated this science. It will probably excite surprise to see the authority of Descartes himself likewise turned against mathematics, a science which he had cultivated with so much success; this is shewn by a fragment of his life by Baillet, and in which the French philosopher acknowledges that his own experience had convinced him of the small utility of mathematics, especially when cultivated on their own account, and without applying the means which they afford us to the acquisition of other kinds of knowledge. Sir William Hamilton then compares philosophy with mathematics, and examines the aids which they respectively afford to the intellect. Claiming the whole preference for philosophy, he affirms that a too exclusive study of mathematics renders the mind incapable of observation, whether internal or external, of abstraction and of reasoning; to these disadvantages he adds that of precipitating the mind either into a state of blind credulity, or of irrational scepticism.

But, again, if the study of the mathematical sciences cannot, like logic, fortify the reason against the errors of thought, may it not at least strengthen the reason itself? Sir William Hamilton does not think that it can. According to him, the principles of mathematics being self evident, every step which the mind takes in the process has the same degree of evidence; every step in a mathematical demonstration can be easily made, and requires only an easy application of thought; and as a faculty is always developed in proportion to its degree of exercise, it thence follows, according to him, that mathematics, by submitting the intellectual powers to a very feeble degree of activity, develop them in a very limited manner. Further, relying on the opinions of different writers of distinguished character, he undertakes to shew that the study of mathematics is accessible to all, and requires no special adaptation. The testimonies cited are those of Berkeley, S'Gravesande, D'Alembert, Gibbon, Mme. de Stael, and others, who, although less celebrated, nevertheless lend their authority to countenance this conclusion. He exposes the double tendency to credulity and scepticism, which often lead the individual astray who gives himself up exclusively to sciences of calculation. We cannot help thinking that there is somewhat of exaggeration in this assertion, which is very like a paradox skillfully defended; but it is pleasant to follow the animated pen of a writer fully master of his subject, while he draws deductions always well connected, and supported by an accurate acquaintance with the history and minute analysis of human intelligence.

Sir William Hamilton concludes by blaming the University of Cambridge for giving too much encouragement to the study of mathematics in preference to the other sciences. Resting his views on the principles already explained, he points out the impropriety of directing the minds of youth to this in preference to every other kind of instruction, seeing that it is of importance to fortify the intellect with resources adapted to be useful in every circumstance of life, and not one in particular.

---

## Chemistry of Sugar.

*(From a Lecture, by Mr. Fownes, at the Royal Institution.)*

THE sugar-cane itself, originally a native of India or China, was introduced into Sicily, by the way of Egypt and Syria, at a period antecedent to the Crusades. It was carried, in 1420, by the Portuguese to Madeira, and subsequently, by the same people and the Spaniards, to Brazil and to the West India Islands. The process of sugar making in the British West India colonies has, probably, undergone but little change for two centuries or more, except in the improvement of the machinery for the crushing the ripe canes and extracting the juice. The tempering with lime, clarifying by heat, and quick evaporation in a series of open pans, still remain. Under the most favourable circumstances a large quantity of molasses is always produced; and as we know from the experiments of M. Peligot that nothing but crystallizable sugar exists in the juice of the cane, this production of treacle must be ascribed to an alteration of the sugar from the high temperature of the liquid in the open pans towards the termination of the boiling. The excellent plan now adopted by the refiners of the raw Muscovado sugar, for concentrating their purified and bleached syrup by evaporation in vessels from which the air is exhausted, patented in 1813 by the Hon. C. E. Howard, is strongly recommended in the sugar islands, for concentrating to the necessary degree, the clarified cane juice. Under this system, the product of sugar would be greatly increased, and its quality much improved, while little uncrystallizable syrup would be produced. This is, however, but a part, although an essential one, of the improvement of which the sugar cultivation and manufacture are susceptible. The East India sugars are made in part from the juice of a palm; the crude product, or *jaggery*, is subjected to a kind of refining process before exportation. These sugars are softer and less crystalline, and inferior in sweetness to those of the West Indies. The cause of the latter fact is to be sought for in the quantity of *grape sugar* they contain, which, indeed, is found more or less in every sample of raw sugar, having been produced in the first boiling at the expense of the crystallizable portion. For the purpose of detecting the presence of the grape sugar recourse may be had to a beautiful experiment of Trommer, described in the "Annalen der Chemie und Pharmacie," for 1841, p. 360. The sugar to be examined is dissolved in water mixed with a solution of sulphate of copper, and then a large excess of caustic potash added. The blue precipitate at first thrown down is re-dissolved with intense purplish-blue colour by the excess of alkali. So far, both cane and grape-sugar behave alike; but on heating the liquid to the boiling point, the cane sugar solution undergoes but little change, while that containing the grape sugar yields a copious precipitate of brilliant red suboxide of copper. It is suggested that this experiment might possibly be put into a form applicable to the *assay* of sugars, in which the proportion of grape sugar—that is, worthless sugar—should be inferred from the quantity of suboxide of copper produced from a given weight of the sample. The cheaper kinds of raw sugar, chiefly consumed by the poor, are sometimes cruelly adulterated by an intentional admixture of grape sugar, manufactured on a large scale for the purpose from potatoe-starch. This is a fraud which should be suppressed.

## Valves of Shells.

An interesting paper, by Mr. Quekett, has just been read to the Microscopical Society, "On the Structure of the Ligament uniting the Valves of Conchiferous Molusks." After some preliminary observations on the nature of univalve shells, in which he considered the operculum as a step towards the second shell of Bivalves, Mr. Quekett stated that the usual opinion was that while the strong adductor muscles inserted into the inner part of the valves served to keep the shells closed, the ligament attached to the hinge performed the office of opening them by its elasticity. But, upon examining shells of different *genera* such variations in the position of the ligament were found, as to render this solution of the mode in which it performs its office in many instances incorrect. Thus in the oyster and cockle the ligament is situated without the hinge, while in the mussel and scollop it is within. Now it is evident, that to produce the same effect, a power behind the fulcrum must operate in a contrary manner to one before it. The former can only do it by expansion after compression produced in shells by the closing of them by the adductor muscles, while the latter can only effect the same end after having been elongated by the same means. This contrariety of action induced him to examine the structure of this ligament in various shells, and he found in addition to these differences which may readily be observed without the assistance of the microscope, that while in many cases no perceptible structure can be perceived in the ligament placed before the hinge, in the common mussel (*Mytilus edulis*) it appears, under a high magnifying power, to be composed of a dense tissue without any particular structure, in which appear certain small channels or lacunæ filled with fluid. Hence it would appear, that when the ligament is compressed by the adductor muscles closing the valves, the fluid in these lacunæ being incompressible, renders the ligamentous structure more tense, and thereby increases its elasticity. The external ligament, again, has long been known to be composed of two layers of substance possessing different organization, as stated by Dr. Roget, in his 'Bridgewater Treatise,' vol. 1, p. 217. Upon examining these as they exist in the oyster, cockle, &c., by the aid of the microscope, the external layer exhibits no marks of structure, whilst the internal one is seen to be composed of numerous fibres, each about one five thousandth of an inch in diameter, running parallel to each other, and apparently crossed by others at right angles; but under a very high power these cross fibres are no longer seen, and each fibre appears to be composed of a cylinder, so formed as to present more or less transparent markings at regular distances from each other, giving a transversely striated appearance. These striæ are apparently produced by an analogous method to those on the primary fasciculus of muscle, and there is but little doubt of the contractile nature of this arrangement, inasmuch as it assists in the opening of the shell when the ligament is behind the hinge, which otherwise could never be effected. Mr. Quekett concluded with various observations on the mode of action of these different structures, and on the astonishing power exhibited by the peculiar arrangement of the structure of the external ligament in opening valves of immense weight, as in chama gigas, whose shells frequently weigh as much as one hundred weight.

## Ships' Fastenings and Steam Boats.

Mr. Enys, in the Annual Report of the Cornwall Royal Polytechnic Society, remarks the necessity of great strength in the hulls of steam boats has long been acknowledged, in consequence of the concentrated weight of the engine and boilers. In recent instances, however, a portion of this weight has been removed by the introduction of wrought iron framing in lieu of cast iron, more especially in large direct action engines. This objection to cast-iron framings increases with the size of the engine, since a framing formed of this material is liable to break when subjected to a variety of cross strains, at the junction of different masses of cast iron, at which points unequal contraction in cooling is apt to produce weakness.

Engineers have been accustomed to guard against injury from the weakness of the ship, by placing the engine on the floors in a framing as independent as possible of the hull of the vessel, and left the ship-builders to provide a remedy against the sagging, or sinking of the centre part of the hull.

Though much has been done to strengthen steamers, yet enough remains undone to render it a legitimate object of inquiry whether the limit of strength has been reached in shipbuilding, while the severe and rapidly increasing competition of iron vessels renders it of importance to the builders of timber ships to consider every practicable means of improvement and reduction of cost. Conceiving the iron strap used by miners in connecting together the main rods in shafts, and common in all framing designed by engineers, stronger than the shipbuilder's knee fastening, a frame was formed for the midship section of a steamer, in which a strap was used for the purpose of connecting the deck beams to the side; this strap passes round one or more timbers, and is then bolted to the deck beams.

A similar method was adopted for strapping an internal series of timbers to the floor heads and deck beams (forming two internal sides at the position of the bunkers). The arrangement of the coal-boxes of large steamers on each side of the engine and boilers, would facilitate the adoption of a plan of this nature without the loss of space exceeding one foot in the internal breadth of the vessel. The plan of four sides in this portion of the vessel could be adopted in iron vessels with the greatest ease in consequence of the facility with which the fastenings could be effected.

As regards the strength of the strap, it may be remarked that the straps connecting together the main rod employed in pumping water from deep shafts in the Cornish mines, have been known to bear the sudden repetition, for thirty million times, of a steam strain exceeding eighty tons (six strokes per minute average during ten years).

The difficulty of effecting repairs will be made an objection to the employment of the iron strap in shipbuilding. Important as such secondary objections are, yet they are too often brought forward as the prominent features in opinions that are given against the success of proposed alteration in shipbuilding. Time would alone prove whether the less tendency to require repair where the iron strap is used would equalize their average cost in repairs.

## To Remove Chemical Marking Ink Stains from Linen.

NITRO-MURIATIC acid has been recommended for this purpose; but, without entering into the obvious demerits of this agent, which is neither fitted for general use, nor suited for cambric or fine linen, Boettger proposes *a concentrated solution of Liebig's cyanide of pottassium, as a sure and harmless means* of removing the stain of marking ink from linen textures. In the preparation of this salt, it is essential that the ferrocyanide be as free as possible from sulphate of potash, to prevent the generation of a combination with sulphur during the process of heating, which would entirely defeat the object. Names and marks on linen or wearing apparel, of *many years standing, may be totally and effectually removed from the finest cambric, even without the slightest injury to its texture,* by rubbing the marking gently with a rather concentrated solution of this cyanide of potassium. If a stain of common writing-ink have been used in addition, in marking the linen, a hot concentrated solution of oxalate of potash must be afterwards applied. The red and black stains produced on the skin by the solutions of the salts of silver and gold, may be perfectly removed by a solution of the above mentioned salt. It is necessary, however, to observe, that the skin should be intact, as this salt produces ill effects, if applied to open sores.—*Annalen der Chemie und Pharmacie.*

## Mr. Babbage's Calculating Engines.

MUCH misapprehension having arisen as to the circumstances attending the invention and construction of Mr. Babbage's Calculating Engines, it is necessary to state from authority the facts relating to them.

In 1823, Mr. Babbage, who had previously invented an engine for calculating and printing tables by means of *differences*, undertook, at the desire of the Government, to superintend the construction of such an Engine. He bestowed his whole time upon the subject for many years, refusing for that purpose other avocations which would have been attended with considerable pecuniary advantage. During this period, about £17.000 had been expended by the Government in the construction of the Difference Engine. A considerable part of this sum had been advanced by Mr. Babbage for the payment of the workmen, and was, of course, repaid; but it was never contemplated by either party that any portion of this sum should be appropriated to Mr. Babbage himself; and, in truth, not one single shilling of the money was in any shape whatever received by Mr. Babbage for his invention, his time, or his services; a fact which Sir Robert Peel admitted in the House of Commons in March 1843,

Early in 1833, the construction of this engine was suspended on account of some dissatisfaction with the workmen. About twelve months after the progress of the Difference Engine had been thus suspended, Mr. Babbage discovered a principle of an entirely new order, the power of which over the most complicated arithmetical operations seemed nearly unbounded.

In the engine for calculating by differences, such simplifications affected only about a hundred and twenty similar parts; while in the new, or Analytical Engine, they might affect several thousands. The Difference Engine might be constructed with more or less advantage, by employing various mechanical modes for the operation of addition. The Analytical Engine could not exist without inventing for it a method of mechanical addition possessed of the utmost simplicity. In fact, it was not until upwards of twenty different modes for performing the operation of addition had been designed and drawn, that the necessary degree of simplicity required for the Analytical Engine was ultimately attained.

These new views acquired great additional importance from their bearings upon the Difference Engine already partly executed for the Government; for if such simplifications should be discovered, it might happen that the Analytical Engine would execute with greater rapidity the calculations for which the Difference Engine was intended; or that the Difference Engine would itself be superseded by a far simpler mode of construction.

Though these views might, perhaps, at that period, have appeared visionary, they have subsequently been completely realized.

To have allowed the construction of the Difference Engine to be resumed while these new views were withheld from the Government would have been improper; yet the state of uncertainty in which those new views were then necessarily involved, rendered any written communication respecting their probable bearing on that engine a matter of very great difficulty.

From the year 1833 to the close of 1842, Mr. Babbage repeatedly applied to the Government for its decision upon the subject. These applications were unavailing, Years of delay and anxiety followed each other, impairing those energies which are now directed to the invention of the Analytical Engine.

Amid such distractions the author of the Analytical Engine has steadily pursued his single purpose. The drawings and the notations have been freely shown; and the great principles on which the Analytical Engine is founded have been explained and discussed with some of the first philosophers of the present day. Copies of the engravings were sent to the libraries of several public institutions; and the effec of the publicity thus given to the subject is fully proved by its having enabled a distinguished Italian geometer to draw up from these sources an excellent account of that engine*

Throughout the whole of these labours connected with the Analytical Engine, neither the Science, nor the Institutions, nor the Government of his country, have ever afforded him the slightest encouragement When the invention was noticed in the House of Commons, one single voice† alone was raised in its favour

*(To be continued.)*

## Centipedes of Australia.

*(From a Newspaper published at Adelaide)*

THESE much dreaded *vermin, reptiles, &c*, for by such names have the Centipedes been called, by those who have been startled and often needlessly alarmed on their first arrival from England by the appearance of these insects—form the subject of the following remarks For fear there is no real cause though their formidable size compared with those of the Mother-country, cannot fail to be noticed at first‡ There, in the land of moist vapours, icy winters, and clouded skies (but dear to every true Englishman) this insect is known but as one of a tribe of harmless inoffensive little creatures, which seldom annoy us, unless found preying on the dainties of our orchards, when we are aroused from our examination of some fine fruit which we have just plucked from a loaded tree, or which has perhaps fallen to the ground from perfection of ripeness, by seeing one of these many legged insects make its way from the core where it has probably been feasting like some sweet toothed wasp But here the case is different, though, by many, too much magnified, these insects being almost held in as much dread, which their singular gliding motions rather favours, as young serpents In England, those seen are always of small size, the largest of the little group seldom shewing itself

Our common large species which is often turned up by the spade in maiden ground, being surprised, and no doubt dazzled from the sudden appearance of the full light of day, immediately tries to make good his retreat, moving his numerous legs in quick succession but whose number seems rather to impede than aid his flight I have more than once said in my former accounts of these insects, that the bite, I believe is not of venomous nature, no poison being ejected into the wound, at least in any species with which we are acquainted The wounds caused by them though I have heard no authentic instance of any one having so suffered, would doubtless be of but little consequence, were they not rather longer healing in a warm climate

Being found principally on the first turning up of the ground, the common species of centipede is gradually getting less numerous, though the scarlet legged and dark bodied kind, which does not yield to the latter in size, (sometimes exceeding four inches in length), is, from its flaming hue, not less *terrible* to the uninformed in its appearance. This, and a smaller species, similar in colours, being fond of moisture, are found secreting themselves under various substances which have remained on the ground for months or years From this circumstance, they are less commonly observed than the subterranean species Living on, instead of under the ground, and constantly showing a desire to shun the light of day, even the naked-footed native does not fear their attacks

In England, where they are by no means remarkable for variety of colouring, some are found in trees, at different elevations on the branches. Our native centipedes are less aspiring in their natures. There is but one small species of a greenish hue and silvery gloss, that seems to take up its abode beneath the bark of the Eucalypti, and this never more than a few feet above the ground others are occasionally found among the roots.

* Of M Manabrea's treatise, which appeared in the Bibliotheque Universelle de Geneve for October last a translation is given in the 12th part of the Scientific Memoirs, with copious and valuable explanatory notes by the translator

† That of Mr Hawes, M P for Lambeth

‡ Our species again cannot bear any comparison in size with those of intertropical climates

## The Prince of Wales Steamer.

THIS fine vessel made a trip down the river on Tuesday, the 26th March, previously to going on her station between London and Margate for the ensuing season She is an iron vessel built last year by Messrs Miller, Ravenhill & Co, the well known engineers, who also constructed the engines, which were originally a pair of side lever engines, taken out of another Margate steamer During the experimental trip, the Prince made several trials in Long Reach, to test her capabilities as to speed, which may be calculated at not less than 12½ knots through the water She ran down below the Nore and could find no competitor with whom to try her comparative speed, on her return she again tried her speed at the mile distance in long Reach when she met the *renowned* Princess Alice, with the tricoloured flag flying at the mast-head, notifying the presence of Belgian royalty on board The *Princess* had been announced to have outstripped all vessels she came near This was a fine opportunity to test the capabilities of the annular engines of the *Princess* and the beam engines of the *Prince* The helm of the *Prince* was ordered to be brought about but before the vessel was fairly turned, her sister, the *Princess*, had got a head a full mile, nothing daunted, the *Prince* moved on, when it was very soon discovered that he was making way fast upon the *Princess*, and in about 30 minutes he went right a-head of her (not very gallant to her highness) All on board of the *Prince* pronounced it a decided victory of at least one-and-a-half to two miles per hour faster than the *Princess* we may, therefore, pronounce, without fear of contradiction, that the *Prince* is the champion of the river, until any other vessel is found that will eclipse her This we must own was to us a fine trial here we had the skill of one of the first builders of iron vessels, Messrs Ditchburn and Mair, with the annular engines of Messrs Maudslays and Field, against the iron steam vessel and engines of the *Prince of Wales*, both constructed by Messrs Miller, Ravenhill, and Co, another firm equally celebrated for the excellency of their workmanship and the success of all their vessels

## Gas Power.

Mr. James Neville of Walworth has recently obtained a patent for a mode of obtaining power from gas and steam conjoined. The apparatus is, however, too complicated to be described without diagrams; and the principle appears to us so decidedly erroneous, that we hesitate to bestow upon it that amount of attention. The principle—if principle it may be called—consists in the decomposition of the rough nitrates of potash or soda, combined with carbonaceous matter by heat, and making the gases liberated to pass through the water in the boiler in which they mix with the steam, and are used along with it in the cylinder of the engine. The patentee expects that the high temperature of the gases when liberated will, on being passed through the water, increase correspondingly the vaporization. We have no doubt that he has been studying the subject of specific heats, and believed himself to have made a discovery.

## Bassemer's Gold Paint.

A very elegant specimen of painting with this article has been submitted to us, which we are assured has sustained all the ordinary exposure of internal decoration during nine months, without losing perceptibly anything of its original beauty. The paint is intended to supersede the use of gold-leaf for such purposes as house and ship-painters and decorators employ it, and from its cheapness compared with that article, should its durability prove equal, we may infer that it will allow of the introduction of that species of embellishment where gilding could not be adopted on account of the expence. The paint has all the beauty of unburnished gold, and we have no doubt of its being at least as durable as any variety of oil-paint both for interior and exterior work. When used on wood and iron, the surfaces are first required to have a coat of paint—yellow being preferred, but for plaster-work the double size is considered preferable to oil, and is less costly and more easy of application. Composition ornaments, as picture-frames, require no preparation.—"Exterior work should be varnished with clear copal."

## A New Constant Battery.

M. le Prince Pierre Bagration has invented a new and simple constant galvanic battery, the particulars of which have been communicated by M. Jacobi to the Academy of Sciences at St. Petersburgh. Its elements are zinc, copper, and sal ammoniac; common earth saturated with the latter acting as a porous diaphragm. A plate of copper and a plate of zinc, placed at a distance the one from the other in a flowerpot, or any other water-tight vessel, filled with earth saturated with a concentrated solution of sal ammoniac, form a voltaic pair, whose action will, after a short time continue constant, and be maintained for whole months, and to every appearance, for years; the only care necessary being from time to time to remoisten the earth and renew the zinc. Before putting the copper-plate into the earth, it should be plunged for some minutes in a solution of sal ammoniac and then left to dry, until it receive a greenish coating. This operation renders the effect of the battery much more prompt; and in regard to it, brass may be preferrable to copper. The plates should not be too near to each other, nor too small, because the earth opposes great resistance to the current. This form of battery is susceptible of many applications, but it will chiefly be useful where a constant and prolonged action, rather than energetic effect, is required—as, for example, in the reduction of metals, chemical decomposition, &c. It may be extended, however, to any quantity or intensity. Whenever a series of numerous elements be used, the vessels should be well insulated. M. Jacobi has had one of the sal ammoniac batteries of twenty-four elements in action for six weeks, without the necessity of making the least change in it.—*Literary Gazette.*

## Moire Metallique.

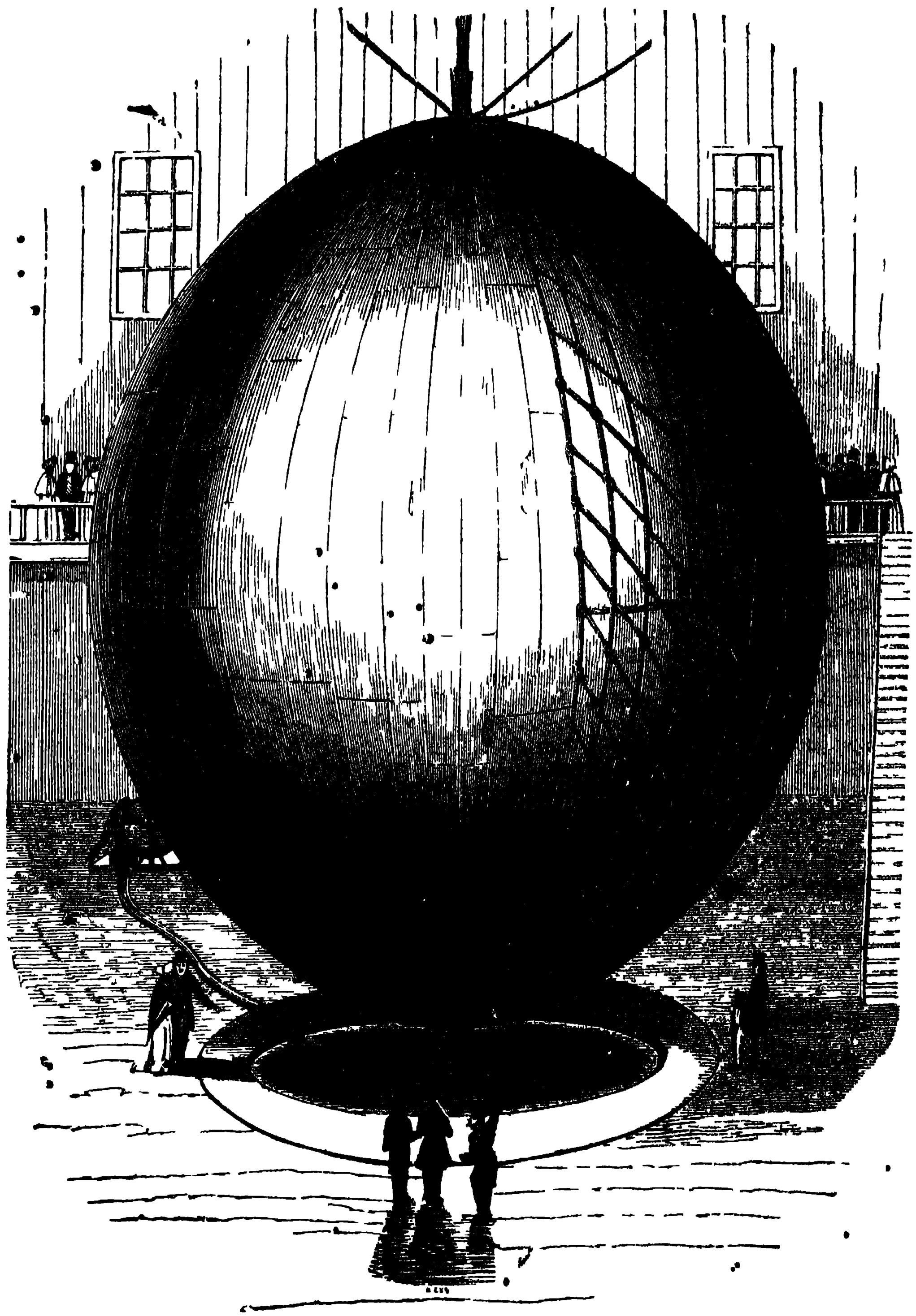
Herberger recommends the following process for obtaining most beautiful Moire Metallique – The plate iron to be tinned is dipped into a tin bath, composed of 200 parts of pure tin, 3 parts of copper, and 1 part of arsenic. Thus tinned, the sheet-iron is then submitted to the seven following operations:—1, Immersing in ley of caustic potassa, and washing. 2. Immersing in aqua regia, and washing. 3. Immersing in ley of caustic potassa, and washing. 4. Quickly passing through nitric acid, and washing. 5. Immersing in a ley of caustic potassa, and washing. 6. Immersing in aqua regia, and washing. Immersing in a ley of caustic potassa, and washing. Every time that the sheet-iron is placed in aqua regia the oxide of tin thereby produced must be entirely removed, since otherwise spots would form. The quickly passing through nitric acid softens the unpleasant metallic glare which at certain angles of refraction, renders the design invisible. The copal resins deserve the preference for coating the sheet iron after the crystallization has been thus obtained.

## Varieties.

*India Rubber Pavement* has just been laid down in the court-yard of the Admiralty. In the stables of Sir Francis Collier, at Woolwich, this pavement has been, for a considerable time, in satisfactory use.

*The Tessellated Pavement* appears to answer well. The fine specimen in the grand corridor of the Reform Club House, and the older piece at Messrs. Hilditch's, on Ludgate Hill are in excellent preservation.

*New Gas Stove.*—A few days since, we inspected M. Soyer's New Gas Stove for cooking, in the Reform Club House. By this improvement the gas is diffused through a layer of pumice-stone, instead of being in separate jets, as heretofore; consequently, the heat is more equable, and answers better for stewing and other culinary operations; whereas, the jet of gas threw the heat so intensely upon one part of the stew-pan, as often to burn the contents, whilst the other portion was comparatively cool. The kitchen otherwise abounds with proofs of M. Soyer's inventive genius.



THE GREAT COPPER BALLOON AT PARIS.

## THE GREAT COPPER BALLOON AT PARIS.

A VAST deal of interest has been excited in Paris by the near completion of an immense balloon of copper, which is so far constructed as to be exhibited to the public. M. Marey Monge, is the *artiste* of this vast work; and considerable importance is attached by scientific persons to the promised result, viz. the employment of this balloon in the determination of electric and magnetic phenomena. In this case, M. Arago, will introduce the matter to the French Institute.

"The balloon, (it is stated in *The Illustrated London News*,) is entirely composed of sheets of copper, the 200dth part of an inch in thickness. The idea of the construction of a metal balloon originated with Laus, in 1763; and, subsequently, in 1784, another metal balloon was constructed by Guyton, de Morveau. In the present balloon, the sheets of copper, united by bands, like the ribs of a melon, have been soldered by Richemont's antegenous proçess. They occupy an extent of about 1,500 yards. The balloon itself is about 10 yards in diameter, weighs 800 pounds, and will contain 100 pounds of hydrogen gas."

It is promised in the Parisian journals, that M. Depuis Delcourt, the celebrated French aeronaut, will shortly ascend in this balloon. M. Marey Monge, states, that by its use he shall be enabled to steer through the air, by a system which he has already developed in a memoir submitted to the French Academy. He maintains that by substituting copper for silk, he shall be able altogether to prevent the escape of the gas, so that the aeronaut may remain in the air for any length of time, and thus be enabled to study the atmospheric currents better than he could do during such ascents as have been made in silk balloons. Again, by keeping the copper balloon for a long time in the atmosphere, and connecting it with the earth by a metal wire, M. Marey Monge, expects to *conduct* the electrical matter from the clouds, and thus prevent the formation of *hail*, which is so destructive to agriculture.

## SIMPLICITY AND GRANDEUR OF NATURE.

*(From M. Dumas' Lectures.)*

THESE words will bring to your minds with what amazement we discovered together, that of all the elements of modern chemistry, organic nature made use of but three or four; that of those vegetable and animal substances which are now multiplied almost to infinity, general physiology requires no more than some ten or twelve species; and that all the phenomena of life, so complex in appearance, may be referred in their essence to a single general formula, so simple, that in a few words every thing seems stated, every thing having been recalled to mind, every thing foreseen.

Have we not, in fact, found, by a multitude of results, that an animal, in a chemical point of view, constitutes a true apparatus of combustion, by which carbonaceous matters, burnt incessantly, are returned to the atmosphere in the shape of carbonic acid; in which hydrogen, burnt incessantly, is returned as water; whence, in fine, free azote is ceaselessly exhaled in the breath, and, in the state of oxide of ammonium, is thrown off in the urine?

From the animal kingdom, therefore, as a whole, carbonic acid, watery vapour, and azote or oxide of ammonium, are continually escaping,—simple substances, and few in number, the formation of which is intimately connected with the history of the atmosphere itself.

Have we not, on the other hand, found that vegetables, in their natural and healthy state, decompose carbonic acid incessantly, fixing the carbon, and setting free the oxygen; that they decompose water, seizing on its hydrogen and disengaging its oxygen as before; lastly, that they either abstract azote directly from the air, or take it indirectly from oxide of ammonium, or nitric acid; thus acting, in every particular, inversely or in opposition to animals? If the animal kingdom constitute an immense apparatus of combustion, the vegetable kingdom, in its turn, constitutes an immense apparatus of reduction where carbonic acid decompounded, leaves its carbon, water its hydrogen, and oxide of ammonium and nitric acid their ammonium or their azote.

If animals incessantly produce carbonic acid, water, azote, and oxide of ammonium, vegetables consequently consume, without ceasing, oxide of ammonium, azote, water, and carbonic acid. What the one gives to the atmosphere, the other takes from it; so that, surveying these facts from the loftiest point of view, and in connection with the physics of the globe, it would be imperative on us to say that, in so far as their truly organic elements, are concerned, plants and animals are the OFFSPRING OF THE AIR; that they are but condensed or consolidated air; and that, to form a true and accurate idea of the constitution of the atmosphere at the epochs which preceded the birth of organized beings, it would be necessary to restore to it, by calculation, the whole of the carbonic acid and azote, the elements of which were appropriated by vegetables and animals when they appeared.

Vegetables and animals, therefore, come from the atmosphere, and return to it again; they are true dependants of the air.

Vegetables, then, assume from the atmosphere the elements which animals exhale into it; viz. carbon, hydrogen, and azote, or rather carbonic acid, water, and ammonia.

But how do animals procure the elements which they give to the atmosphere? Let us inquire particularly into this point. Now it is impossible to contemplate, without admiration, the sublime simplicity of the laws of nature here, as every where! Animals always derive their elements primarily from vegetables.

We have found, in fact, by results beyond the reach of question, that animals do not create any of the truly organic substances, but that they consume or destroy them; that vegetables, on the contrary, habitually create these substances, and that they destroy but few, and this only for particular and determinate ends.

It is, in the vegetable kingdom therefore, that the great elaboratory of organic life is found; it is there that both vegetable and animal substances are compounded: and they are all alike formed at the cost of the atmosphere.

From vegetables these substances pass ready-formed into the bodies of herbivorous animals, which destroy one portion of them, and store up another in their tissues.

From herbivorous animals they pass ready-formed into the bodies of carnivorous animals, which destroy or lay them up, according to their wants.

Finally, during the life of these animals, or after their death, the organic substances in question return to the atmosphere from whence they originally came, in proportion as they are destroyed.

Thus is the mysterious circle of organic life upon the surface of the globe completed and maintained! The air contains or engenders the oxidized substances required,—carbonic acid, water, nitric acid, and ammonia. Vegetables, true reducing apparatuses, seize upon the radicals of these, carbon, hydrogen, azote, ammonium; and with them, they fashion all the variety of organic or organizable matters which they supply to animals. Animals, again, true apparatuses of combustion, reproduce from them carbonic acid, water, oxide of ammonium, and azotic or nitric acid, which return to the air to reproduce the same phenomena to the end of time.

And if, to this picture, already so striking by its simplicity and grandeur, we add the indubitable part performed by the solar light, which is alone possessed of power to bring into play this immense, this uparalleled apparatus, constituted by the vegetable kingdom, in which the oxidized products of the atmosphere are subjected to reduction, it is impossible not to be struck with the import of these words of Lavoisier: "Organization, sensation, voluntary motion, life, only exist on the surface of the earth and in places exposed to light. It might be said, indeed, that the fable of Prometheus was the expression of a philosophical truth, which had not escaped the penetration of the ancients. Without light, nature were without life and without soul: a beneficent God in shedding light over the creation, strewed the surface of the earth with organization, with sensation, and with thought!"

* * * *

As it is from the mouths of volcanoes, whose convulsions so often make the crust of our globe to tremble, that the principal food of plants, carbonic acid, is incessantly poured out; so is it from the atmosphere on fire with lightnings, from the bosom of the tempest, that the second, and scarcely less indispensable aliment of plants, nitrate of ammonia, is showered down for their behoof.

Might it not be said, that we have here a remembrancer of that chaos mentioned in the Bible, of those periods of tumult and disorder, which preceded the appearance of order and organization upon the earth?

For, scarcely are cabonic acid and nitrate of ammonia formed, than a calmer, though not less energetic force begins to act upon them for new purposes: this force is LIGHT. By the agency of light, carbonic acid yields up its carbon, water its hydrogen, nitrate of ammonia its nitrogen. These elements combine, organic matters are formed, and the earth is clothed with verdure.

It is, in fact, from absorbing incessantly a true force, the light and heat of the sun, that vegetables perform their functions, and produce the vast quantities of organized or organic matter, which are the destined food of the animal creation.

And then, if we add that on their side animals engender heat and elicit force in consuming that which vegetables have produced and slowly accumulated, would it not seem that the ultimate intent of all these phenomena, that their most general or comprehensive formula, was laid open to our view?

The atmosphere presents itself to us as including the primary materials of all organization. Volcanoes and thunder-storms meet us as the laboratories in which are compounded the carbonic acid and nitrate of ammonia, which life requires for its manifestation and extension.

Light arrives, and with the concurrence of carbonic acid, and nitrate of ammonia, the vegetable world, the grand producer of organic matter, is developed. Plants farther absorb the chemical force which reaches them from the sun, and enables them to decompose carbonic acid, water and ammonia; plants are embodiments of a reducing power, of greater virtue than any other that is known, for no other will decompose carbonic acid in the cold.

Then come animals, consumers of matter, and producers of heat and of force, true instruments of combustion. It is in them, unquestionably, that organized matter acquires what may be called its highest expression. But it is not without detriment to itself that it becomes the instrument of sensation and of thought. In this new capacity organized matter is burnt; and in giving out the heat, or electricity which constitutes and is a measure of our force, it is destroyed and returned to the atmosphere from whence it had originally come.

## MR. BABBAGE'S CALCULATING ENGINES.

*(Continued from page 15.)*

During nearly the whole of a period of upwards of twenty years, Mr. Babbage had maintained, in his own house, and at his own expense, an establishment for aiding him in carrying out his views, and in making experiments, which most materially assisted in improving the Difference Engine. When that work was suspended, he still continued his own inquiries, and having discovered principles of far wider extent, he ultimately embodied them in the Analytical Engine.

The establishment necessary in the former part of this period for the actual construction of the Difference Engine, and of the extensive drawings which it demanded, as well as for the formation of those tools which were contrived to overcome the novel difficulties of the case, and in the latter part of the same period by the drawings and notations of the Analytical Engine, and the experiments relating to its constructions, gave occupation to a considerable number of workmen of the greatest skill. During the many years in which this work proceeded, the workmen were continually changing, who carried into the various workshops in which they were afterwards employed the practical knowledge acquired in the construction of these machines.

To render the drawings of the Difference Engine intelligible, Mr. Babbage had invented a compact and comprehensive language (the Mechanical Notation), by which every contemporaneous or successive movement of this machine became known. Another addition to mechanical science was subsequently made in establishing principles for the *lettering* of drawings; one consequence of which is, that although many parts of a machine may be projected upon any plan, it will be easily seen, by the nature of the letter attached to each working point, to which of those parts it really belongs.

By the means of this system, combined with the Mechanical Notations, it is now possible to express the forms and actions of the most complicated machines in language which is at once condensed, precise, and universal.

At length, in November 1842, Mr. Babbage received a letter from the Chancellor of the Exchequer, stating that Sir Robert Peel and himself had jointly and reluctantly come to the conclusion that it was the duty of the Government, on the ground of expense, to abandon the further construction of the Difference Engine. The same letter contained a proposal to Mr. Babbage, on the part of Government, that he should accept the whole of the drawings, together with the part of the engine already completed, as well as the materials in a state of preparation. This proposition he declined.

The object of the Analytical Engine (the drawings and the experiments for which have been wholly carried on at Mr. Babbage's expense, by his own draftsmen, workmen, and assistants) is to convert into numbers all the formulæ of analysis, and to work out the algebraical development of all formulæ whose laws are known.

The present state of the Analytical Engine is as follows:—

All the great principles on which the discovery rests have been explained, and drawings of mechanical structures have been made, by which each may be carried into operation.

Simpler mechanisms, as well as more extensive principles than were required for the Difference Engine, have been discovered for all the elementary portions of the Analytical Engine; and numerous drawings of these successive simplifications exist.

The mode of combining the various sections of which the Engine is formed has been examined with unceasing anxiety, for the purpose of reducing the whole combination to the greatest possible simplicity. Drawings of almost all the plans thus discussed have been made, and the latest of the drawings (bearing the number 28) shows how many have been superseded, and also, from its extreme comparative simplicity, that little further advance can be expected in that direction.

Mechanical Notations have been made both of the actions of detached parts, and of the general action of the whole, which cover about four or five hundred large folio sheets of paper.

The original rough sketches are contained in about five volumes.

There are upwards of one hundred large drawings.

No part of the construction of the Analytical Engine has yet been commenced. A long series of experiments have, however, been made upon the art of shaping metals: and the tools to be employed for that purpose, have been discussed, and many drawings of them prepared. The great object of these enquiries and experiments is, on the one hand, by simplifying as much as possible the construction; and on the other, by contriving new and cheaper means of execution, at length to reduce the expense within those limits which a private individual may command.—*Taylor's Scientific Memoirs*, vol. iii. part 12.

## MAGNETICAL AND METEOROLOGICAL OBSERVATIONS AT GREENWICH.

From the large quarto volume, (just published,) of observations made at the Royal Observatory, in the years 1840 and 1841, we gather that the magnetic needle is subject to great daily fluctuations at all periods of the year, but the greatest westerly variation is decidedly marked at 2h. P.M., Gottingen, meantime all the year round. The extreme easterly is in October and November at 8 hrs. P.M., and in June and July about 14 hrs. The mean variation for the year 1841 was 23° 16′ 8″ west. With regard to the barometer, it appears that the greatest fluctuations are in November and December, and the least in July and August; the fluctuations being nearly three times as much at the former as at the latter period. The character of the fluctuations is exceedingly variable. The lowest state of the barometer is about 4, 6, and 12 in the morning, and its highest for all the year round at 10 and 12, P.M. Its mean height is about 8 A.M. and 2 P.M. The fact of the moon's influence on the barometer is pretty well established, and it would appear that the main maximum height is, when the moon has passed the meridian about 2 hrs. The greatest difference between the temperature of the atmosphere and that of evaporation is at 2 hrs. P.M., and the difference is greatest in the months of June and July, and least in November and December. The temperature of the air is greater above that of the dewpoint, or that at which dew is formed at about 4 hours P.M., than any other time of the day; and greatest in June and least in January. As respects the winds, the south-west exceeds all the others, both in time and force. In other words, there are both more hours from the south-west, and stronger gales, than from any point of the compass; and least from the E.S.E. The greatest quantity of cloud prevails during the day throughout the year, and the least at night. As respects the quantity of rain at the several seasons, it is obvious that one year is not enough to come to any thing like even an approximation.

---

## THE ATMOSPHERIC RAILWAY.

Mr. Herapath, in the *Railway Journal*, thus sums up his inquiry into the merits and capabilities of the Atmospheric Railway, and his observations on M. Malletti's report lately published in Paris.

"We think we may fairly conclude that we are in possession of all the circumstances necessary to estimate the powers, capabilities, and degree of applicability of the atmospheric railway, such as there is on the Dalkey Railway, to other lines. To go into the whole question of its cost and working expenses would require more time than I have before me; but, as to its powers and capabilities, they may very shortly be summed up in the following abstract. A 170* efficient horse-power engine is required to do under the work of a 77 horse power, and that with this sacrifice of power, not more than 30 miles an hour can be averaged, whether on a level or not. Lightening the load does no good towards increasing the velocity. Improvements in the machinery might improve the velocity, but nothing would enable them—unless it be some contrivance to increase and diminish the number of strokes of the pump in a given time—to regulate the rate of speed. There could, therefore, be no such thing as fast and slow trains, nor special

* I have been since informed, by an eminent engine-maker, that in pumping engines, such as this, they estimate only from a twelfth to an eighth, for loss of power arising from friction, &c. Putting it at the outside, or an eighth, and the efficiency of the engine is above a 210 H.-P.

trains, with extraordinary speed, for special purposes. It is the imperfection of the present apparatus which gives a difference in the velocities of different loads, but the more the apparatus is improved the more that difference will disappear. No saving can be effected, as in locomotives with a less load, nor any increase of velocity acquired. Light loads and heavy must all be worked at nearly the same cost and same speed. Any increase of the length of the present main, without a corresponding increase in the motive power, must be at the expense both of speed and load. To carry a greater load, or to have a greater velocity, the length of the main must be shortened. It is not true that any load can be carried up any incline by the atmospheric railway, on the contrary the loads carried are governed by the steepness of the inclines, as with locomotives; but the atmospheric has this advantage over the locomotive system, namely, that it can mount steeper inclines than locomotives, and whatever load it can take it does not lose velocity by the incline, if the apparatus be perfect; and imperfect as it is, the loss is not to the same extent. As a set off, however, it must be observed that no loss of speed in ascending an incline by the atmospheric can be made up by greater speed on a level, as with the locomotive. The atmospheric has another advantage, in the motive power not adding to the load, especially in ascending inclines; but it has this serious per contra, that the atmospheric can never be under the same control as locomotives, and that if an accident happen, or any thing give way, there is no possibility of stopping the train, as the power, I apprehend, could not be arrested, and the train would continue to be dragged on, breaking and tearing every thing away with it. Though the atmospheric is not exposed to the breaking down of locomotives, it is to breakages of the main by small stones or pieces of iron being put into the main, and many other casualties obvious enough, the consequences of which may be equally bad. Carriages are just as likely to get off or be thrown off the line with one system as with the other, and if such an accident should happen, the consequences would be more serious with the atmospheric than with the locomotive, because of the inability to govern the power. In cases of emergency, railway trains on our present plan, can be started by the score, one within a minute of the other, without any danger, or loads to any extent can be carried by one train; but with the atmospheric, successive trains are limited to intervals of at least 10 minutes, and no load can be carried by a single train beyond a certain extent, namely, that for which the apparatus has been made. Collisions with different atmospheric trains, it is affirmed, cannot happen; it may, perhaps, to a great extent be so, but collisions of the members of a train from breakages or accident, which are the most frequent and equally disastrous when they do occur, are just as liable upon the one as upon the other, and of the two, more dangerous probably upon the atmospheric, for the often recited reason, a want of command over the motive power.

Such are a few of the leading mechanical and some other features of the systems, between which I have endeavoured to do even-handed justice, and upon which I think the reader will come to this conclusion—that the atmospheric has an incomparably greater waste of power, is much less manageable, much less convenient and efficient than the locomotive, and is equally liable to accident. Its comparative cost and working expenses I have not yet touched on, nor its applicability to long and short lines.

## THE TRADES OF BIRMINGHAM.

To describe the process by which Birmingham has increased its productive powers during the last fifty years would occupy more space than consists with our limits; suffice it here to say, that the practically scientific genius that has long characterized English mechanicians, has here, as at Sheffield, been actively at work, inventing, applying, modifying, and improving various mechanical contrivances; the whole town and its neighbourhood have long been the scene of enterprising, persevering, constantly increasing industry; and now (with the exception of slight occasional stagnations, caused partly by over-speculation, but principally by illiberal laws affecting foreign trade) wealth, the reward of successful labour, has for years been flowing in from all sides in a large, rapid, and bounteous current.

We purpose giving some particulars of the *leading* trades carried on at Birmingham; but we first present a list of such as we have been able to separate into distinct classes, premising, that it is far, perhaps, *very far*, from including the endless ramifications into which the businesses are divided.

*Gold, Silver, Gilt, and Plated Goods.*—Jewellers and gilt toy makers, watch chain, key, and gold band manufacturers, gilt ring and seal makers, army and gilt button makers, ring turners, medal and coin makers, bright engravers, sword hilt makers, toy burnishers, filligree workers, plated snuffer chasers, pencil case and toothpick makers, makers of silver and plated spoons, knives, forks, teapots, plates, sugar-basins; chain makers, thimble stampers and piercers, pencil case makers, &c., &c.

1. *Iron and Steel Goods.*—Fire irons and swords, gun and pistol makers, gun makers, gun lock and furniture filers, stockers and stock sinkers, gun-polishers, gun charger and furniture makers, bayonet-case and powder-flask makers, ramrod makers, bayonet cutlers, sword cutlers, scabbard makers, &c., &c.

2. *Tools.*—Die sinkers, engine cutters, saw-tool, vice, hammer, plane, auger, awl-blade, gimblet, and other tool makers, smiths' bellows-pipe makers, screw-plate workers, coach-spring makers, braziers' tool makers, scythe, sickle, and spade makers, &c.

3. *Other Iron Hardware.*—Makers of bits, stirrups, curbs, bridles, spurs, spur rowels, cock heels, horse and dog collars, fetters and dog locks, dog and cart chains, nails, sprigs, tacks, screws, scale beams, steel chains and toys, ferrules, pattern rings, forks, iron spoons, snuffers, thimbles, inkstands, steel keys, mouse traps, spring latchets, mortice and other locks, pendants, hinges, pin makers, warming pans, fire irons, cruet frames, corkscrews, gridirons, buckle ring forgers, and buckle chasers, &c. &c.

4. *Brass and Mixed Metals.*—Brass-founders, saddlers' brass-founders, lamp makers, makers of candelabra, tea-urns, white metal teapots, albata spoons, forks, and other domestic furniture, albata pencil case makers, button and button shank makers, and button soldering, brass nailers, pocket locksmiths, brass moulders, gas ornament designers and moulders, gas-pipe drawers, gas tap makers, and other gas fitters, brass cock workers, iron and brass wire

drawers, coach-harness forgers, bed and coach screw makers, printers' typefounders, malleable zinc plates, clock hand, coffin nail, lead toys, and match box makers, &c., &c.

5. *Miscellaneous.*—Glass blowers, looking-glass makers, glass stainers, makers and grinders of watch and optical glasses, glass moulders, makers of glass beads and doll eyes, glass seal makers, glass button makers, japan wares, &c. Bone, ivory, tortoise-shell, and pearl box makers, paper spectacle case makers, comb and spectacle frame makers, pearl button turners and cutters, papier-maché moulders and japanners, umbrella makers, air-pump and machine makers, smoke-jack makers, &c., &c., &c.

Among these multifarious occupations—estimated before the House of Commons, in 1825, at *two hundred*, each quite separate from its neighbour—we select only a few for particular description, and shall then make some remarks on the workshops, general condition and average wages of the work-people.

1. *Gun Making and its Branches.*—This manufacture, at once the oldest and most important of those carried on in Birmingham, was introduced at the beginning of the last century; since which time it has gradually, but so immensely increased, that Birmingham may now be termed the great emporium of the world for all destructive weapons, including muskets, pistols, and fowling pieces. During the last war, the government contract for muskets alone averaged 30,000 per month; and in the fifteen years between 1804 and the termination of the war, Birmingham furnished upwards of *five millions of fire arms!* The number manufactured in the next fifteen years (1814—1828) was estimated at three millions, and the demand for these articles up to the present time is perhaps less fluctuating than for any other product of industry. A proof-house has been established by Act of Parliament, where the excellence or imperfection of all gun and pistol barrels is proved by a heavy charge determined by the Board of Ordnance. If they stand this test they are marked by a stamp, to counterfeit which is felony, and the sale of unstamped guns is punishable by a heavy fine. The manufacture of swords may also be regarded as one of the staple trades of Birmingham, but since the peace it has much declined.

2. *Gold and Gilt Toys.*—The toy and trinket trade in its various ramifications is so immense, that surely Mr. Burke was not far wrong in designating Birmingham as "the toy shop of Europe." Vast quantities of beautiful articles, fancy seals, brooches, clasps, rings, and innumerable other trinkets, are made of gold, silver, gilt, and plated metal, mosaic gold, and other alloys, as well as of polished steel and iron, the workmanship being by aid of the stamp, the press, the lathe, the draw-bench, and other ingenious mechanical contrivances, of a quality often combining beauty of appearance and solidity of texture with an extraordinary lowness of price. The impressions on glass seals, made to imitate engravings on stone, which would themselves cost thirty shillings, are admirably executed at 1½d. each, their production giving employment to some hundreds of hands, chiefly women and children.

*Button and Buckle Making.*—To the invention and manufacture of these articles Birmingham may lay undoubted claim, inasmuch as it has witnessed all its fluctuations, from the small iron plain buckle, and the horn button covered with metallic foil, through all the innumerable and capricious varieties of shape and embellishments which prevailed when gentlemen wore powder and bob wigs, looped hats, embroidered coats and swords, and through the still more fantastic, quickly-varying changes of fashion required for the foreign markets. The boot and the shoe tie have now entirely supplanted the shoe buckle, the use of trousers also rendering the knee buckle wholly needless; the trade of the buckle maker is now, therefore, confined to few hands, chiefly for ladies' wear, and thousands who once depended on it for support have turned their industry into more profitable and useful channels. The manufacture of buttons, however, is still most extensively carried on, and is divided into many branches, according as the article is of metal, wire, or bone, as well as into several departments, stamping, gilding, burnishing, chasing, shank-making, &c. The machine used for making button shanks is one of the most ingenious that Birmingham furnishes, a single revolution of the machine sufficing to cut the required length from the wire, to bend it into its proper curves, and so flatten the extremities as to prepare them for being soldered on the surface of the button. The fashion of buttons is now for the most part plain or slightly raised; and the art of gilding, which within the last few years has been called into much greater requisition for fancy buttons than for some years before, is carried to such perfection, that three or four pennyworth of gold is said to be sufficient for gilding a gross of buttons. The immensity of this apparently trifling business may be conjectured from the fact that the leading manufacturers keep each from 10,000 to 12,000 different sets of cut steel dies for livery, military, and cut buttons!

4. *Gold and Silver Plating, and Albata Goods.*—Birmingham, though inferior to Sheffield in the value and magnitude of this manufacture, enjoys a high reputation for the beauty and variety of its plated goods, and so long back as 1772, wardens, and an assay-master, were appointed by Act of Parliament for superintending the trade, and stamping all silver articles weighing more than five pennyweights. The quantity of silver used in these manufactures—*i. e.*, in the plating of spoons, knives, forks, plates, dishes, breadbaskets, candlesticks, &c., cannot be much less than 40,000 ounces a-year, while the consumption of the same metal for pencil cases and trinkets may average about 190,000 ounces. The quantity of silver plate made here is comparatively insignificant, having been estimated at 121,400 ounces in 1837. The whole of this business, however, has received a great and, we suppose a fatal check, by the introduction of albata metal, which from its superior durability to plated goods, as well as its extreme resemblance to silver, has become so extensively introduced into families as almost to supersede the use of spoons, knives, and forks, either of silver or plated on steel, which had hitherto been made in large quantities. The albata is a compound of tin, the regulus of antimony, copper, and brass; the articles made of it are extremely cheap, beautifully wrought, and, when care is taken to purchase those that are sufficiently massive, they are very durable and have a handsome appearance. The stamp and press are extensively used in these manufactures, aided by the chasing tool and hammer for ornaments in relief.

[*To be continued.*]

## METEOROLOGY OF SOUTH AUSTRALIA.

PERHAPS, there are few points in the natural economy of a new country more important than its meteorology; and, with this impression, we present to our readers the following synopsis of the weather in the vicinity of Adelaide, for the quarter ending September 1843.

July was remarkable for the evenness of its temperature, the mercury never rising at mid-day above 63, nor falling below 55° or 56°. The mornings and evenings were generally but a few degrees cooler, the thermometer never in the former falling below 18°. Besides a *lunar* rainbow observed on the 8th, perhaps the most brilliant *solar* rainbow that has been noticed for many years appeared on the 22nd, at a quarter to 5 P.M.; it lasted more than a quarter-of-an-hour, increasing in brightness for the first ten minutes. It was encircled by its attendant *watercall*, showing the seven reversed colours very distinctly. By the 26th, the low lands were under water, and the river very high. On the 30th, after midnight, a hurricane of wind came on, which lasted till daylight the following morning, but did no damage worth mentioning.

A few degrees of increase in the heat of the atmosphere were observable through the month of August, the thermometer in one or two instances attaining 70°. The temperature of the mornings and evenings, especially the former, was nevertheless colder than in the last month, the mercury being down to 45° and 44° on the 21st and last days. On the 1st, the low grounds were again under water in several places, and all thoroughfares in Adelaide were deeply covered with mud. On the 12th, another lunar rainbow bore witness to the humidity of the atmosphere. By the 16th, rain, if not really wanted, would have been quite acceptable, so dry does the surface of the exposed lands become after a few days of sunshine. On the 18th, the first frost occurred, which was expected much earlier in the season. The following morning was misty; a rather rare occurrence in our climate at any time. These mists are never of sufficient density or continuance to bear the name of *fog*.

In September, the meridian heat was often 70°; and on the 27th rose to 88°, though for a few days in the middle of the month it had been as low as in July. This was a gradual increase in the temperature from the latter month, which was therefore the coldest or mid-winter month, but this was reversed by the singular and unexpected coldness of the mornings and evenings, a tendency to which was shown in the previous month of August. In July, the temperature was never less than 58° before midnight, and that only on two occasions in the succeeding month; but, in September it was nearly as often below as above 50° at that hour. From the earlier rising of the sun, the atmosphere was less frequently kept at a low temperature than in August; but from the same cause, the greater coolness which occurred on the mornings was not looked for.

On the morning of the 5th, the mercury stood at 41°. This may be considered the coldest morning of the year. On the 11th, there was a sudden fall in the thermometer of 18 degrees in two hours—this is not so uncommon on some of the summer days—the sky was then overcast, and after a heavy shower of hail, (rather a rarity in our southern clime,) the wind blew with great violence, accompanied by some lightning and thunder till near midnight, when it fell calm. The increase of temperature experienced all day on the 27th, seemed almost a change from winter to summer; but it was evidently not a settled heat, merely a warning of what might be expected in the approaching summer season. This was altogether a very variable month in temperature, many of the approximating days showing great contrast in this respect at all times, the mercury during each day being continually on the rise or fall.

Though the season was advanced,—Spring having commenced,—before the coldest portion of the year, that is during the silent hours, had arrived, yet, the hot winds, (as they are called,) and the heated atmosphere of summer, were not at all delayed.

## RAIN IN EGYPT.

IT has been asserted that there is no rain in Egypt, and both ancient and modern travellers from Herodotus and Diodorus down to Mr. Silk Buckingham have recorded the assertion. It is well to have the facts in all cases: and with regard to this question, let us listen to the statements of Mr. Gliddon, who in his lectures has frequently put us right upon many misconceptions regarding that interesting country.

Mr. Gliddon states that in Lower Egypt and the Delta it rains a great deal in the winter; and this rain increases in the exact ratio of your descent towards the Mediterranean. "I have," he says, "known it to rain at Alexandria twenty days successively, and almost incessantly, whilst from the 15th of October to the 1st of April the rains are frequent—the winter is proverbially wet. So it is at Atfe, the junction of the Canal and Nile. Here is the focus of rain in winter, and it is the most sloppy, muddy, and drizzly spot in those latitudes."

In Middle Egypt it rains every winter, but merely sharp showers. The average at Cairo will be three rainy days a year—perhaps twelve hours of rain in the whole year.

In Upper Egypt it rains in some part every winter, but otherwise, is rare. Yet Mr. Gliddon observes, "I can say with Herodotus, that in *our* time, it rained in Upper Egypt; for we had rain at Dendera, at Esne, and rain at the first cataract—sharp, but passing showers." The word *seldom* will apply to rain from Cairo to Dongola, but *no rain* is all nonsense. Of course the farmer in Egypt is quite independent of rain; it never enters into his calculation, for the Nile saturates the ground for two months by inundation; for six months by filteration; and the agriculturists supply the rest by irrigation, water wheels, dippers, and other methods.

In the Deserts, to the east and west of Egypt, all along the Nile, the hills collect clouds; and there the rain is more uncertain, but more frequent. Violent thunder storms are common, and there is not a ravine in the Desert but bears marks of the tremendous force of the occasional torrents, particularly towards the Red Sea. So much so, that the tomb of Ramses III, at Biban-el-melock, Thebes, having been injudiciously placed at the foot of a Seyeleh, as the Arabs term a torrent's bed, was never occupied by the King, for it was destroyed by rain in ancient days; and this would explain why the Great Ramses was interred probably in his own palace, the Ramsessium, miscalled the Memnomium.

## THE BALANCE OF ORGANIC NATURE.

The primitive atmosphere of our globe has formed itself into three great parts or masses:—

One, constituting the atmospheric air of the present time; a second, represented by plants; a third, by animals.

Between these three masses continual exchanges are effected: matters descends from the air into vegetables, penetrates in this way into animals, and returns to the air in proportion as they consume or apply it to their purposes.

Green vegetables constitute the grand laboratory of organic chemistry. They are the agents which, with carbon, hydrogen, azote, water, and oxide of ammonium, slowly form the most complex organic substances.

Under the form of heat, or of chemical rays, they receive from the sun the force which enables them to accomplish this great work.

Animals assimilate or absorb the organic substances which plants have formed. They alter them by degrees; they destroy or decompound them. New organic substances may arise in their tissues, in their vessels; but these are always substances of greater simplicity, more akin to the elementary state than those they had received.

They decompose, then, by degrees, the organic matters treated by plants. They bring them back by degrees towards the state of carbonic acid, water, azote, and ammonia, a state which admits of their ready restoration to the air.

In burning or destroying these organic substances animals always produce caloric, which, radiating from their bodies into space, goes to supply that which vegetables had absorbed and fixed.

Thus all that the atmosphere yields to plants, plants yield to animals, animals restore to the air. Eternal round, in which death is quickened and life appears, but in which matter merely changes its places and its form!

The crude and formless mass of the air, gradually organized in vegetables, passes, without change, into animals, and becomes the instrument of sensation and thought; then vanquished by this effort, and, as it were, broken, it returns as crude matter to the source from whence it had come.—*Dumas.*

## VARIETIES.

*Wax Painting.*—M. L. Mausion is now exhibiting in the metropolis, some exquisite specimens of Wax Painting, executed upon a new principle.—It appears that the art was known to the ancient Greeks, and it was with them called Encaustic Painting, from the process which they adopted in using heat in working, the colours being amalgamated simply with the wax and laid on the surface in a liquid state. The process as practised by M. Mausion is different. A surface of the purest wax is fixed and smoothed to the uniformity of a sheet of ivory; the colours are then mixed with a liquid medium, that from its affinity converts the ground surface into an absorbent body, and renders permanent the painting. M. Mausion says the pictures are executed with much less trouble than that of oil pictures or on ivory, and occasions much less inconvenience because the work can be left off and begun again at any time without detriment to the work. They are imperishable, but from violent dilapidation, because they are not affected by the atmosphere—heat or cold having no effect upon them. This style of art has been recently introduced, and very much admired in monumental decoration.

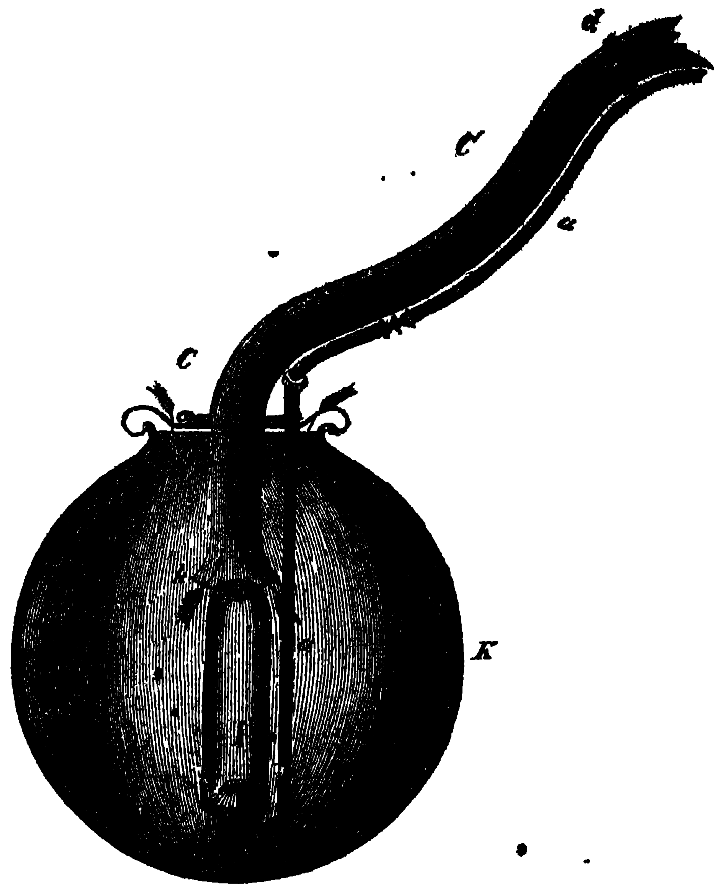
*Self-regulating Ventilator.*—At one of the recent *soirees* of the President of the Royal Society, there was shown a new self-regulating ventilator, which operates by the expansion and contraction of spirits of wine and mercury by heat. The instrument is so arranged that, as the heat of an apartment expands the fluids, they open the ventilator, which is again closed as they contract. The apparatus, we should fear, is too delicate to be applicable for general use, but it has the merit of considerable ingenuity.

*Volcano at Taal, in China.*—In the peninsula of Bongbong is a volcano, with a circular crater of considerable size, from which a white sulphureous smoke is constantly emitted; it bears a considerable resemblance to the annular mountains of the moon, as traced upon the map of Lohmann.

*Man the best-constructed Steam Engine.*—To reach the summit of Mont-Blanc a man spends two days of twelve hours each. In this time he burns, on an average about 9½ oz. avoirdupoise of carbon, or an equivalent quantity of hydrogen. Were a steam engine employed to carry him thither, it would consume from 2 lb. 8 oz. to 3 lb. 2 oz. avoirdupoise of carbon in the service. Considered as a machine then, deriving the whole of its power from the carbon it consumes, the body of man is at least three or four times more perfect in its mechanism than the most perfect steam engine. Our artificers and engineers have, consequently, much still to accomplish.—*Dumas.*

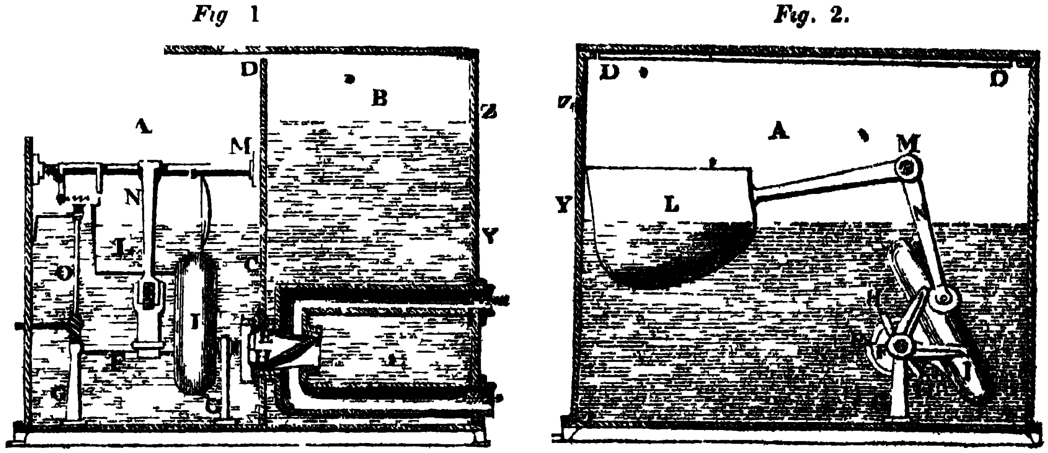
*Smoke.*—In the voluminous report on smoke, lately made in the House of Commons, by a select committee, some curious facts are mentioned; for example, Mr. Chandler, camellia grower at Wandsworth, states that on account of the great increase of chimnies from manufactories in that vicinity, plants which formerly might be handled without any bad effect, now soil the hands. Among other plants which formerly flourished, but will not now grow in the neighbourhood of the metropolis, are China roses, rhododendron hirsutum, rhododendron virginium, and many others of the prettiest varieties, now quite extinct. Mr. Anderson, the curator of the Physic Gardens at Chelsea, testifies to the noxious effects of what he calls the "bitter smoke" upon the trees of that establishment, particularly on evergreens, and on two magnificent cedars which have so long been an ornament to the gardens, and form a very conspicuous object from the river. It appears that the sooty particles are attracted to and attached by the resinous exudations of the leaves, while the large surface of the foliage above prevents their being washed away by the rains, so that the functional action of the leaves is disturbed, if not entirely destroyed.

*Proposed Iron Bridge at Westminster.*—Mr. Barry has brought out a design of an iron bridge, as a substitute for the stone structure at Westminster, respecting the repairs of which there has been much controversy. Mr. Barry's proposed bridge spans the river with five arches. Its structure is in the gothic style, to assimilate with the Houses of Parliament; and its estimated cost is 185,000*l.*, "be the same a little more or less." Mr. Walker's repairs, it is affirmed, will cost more than a new bridge, and make but a patched-up affair at the best; whilst Mr. Barry's new iron Gothic structure would be more durable, as well as more ornamental.




RUTTER'S GAS-LIGHT AND LAMP VENTILATOR.

Fig 1 Fig. 2.




EDGE'S WATER METER.

## RUTTER'S GAS-LIGHT AND LAMP VENTILATOR.

THIS apparatus, the invention of Mr. J. O. Rutter, Gas Works, Black Rock, Brighton, effects the perfect ventilation of gas-lights and lamps, by conveying the whole of the heated air, vapour, and other products of combustion arising therefrom, out of the apartment in which the lights are burning. It also further promotes the salubrity of the atmosphere within the room, by causing the withdrawal of a portion of air which may have been rendered impure by respiration, or other sources of contamination.

*Description*:—A A is a tube for supplying gas to the (double-cone) burner B. C C is a tube of metal, which may be straight or curved in any required direction; the internal area of which is proportioned to the size of the burner. In the tube C C, at a convenient distance from the light, a valve D is fixed for the purpose of controlling the egress of hot air, and also for preventing the ingress of cold air when the apparatus is not in use.—The lower end of the tube C C is enlarged to receive a short tube E, which slides up and down within it, and is adjusted and fixed at any required distance by set-screws on each side. To the short tube E is attached, by means of two or more indents, the glass ventilator F, having a (flatted) flanch at G, and being trumpet-mouthed at H. The gas (or lamp) chimney I is contracted at the top, so that the diameter of the opening thereat is as near as possible equal to that of the upper end of the ventilator F, and of the tube C C. At its upper end the tube C C is prolonged, so as to extend through the wall or ceiling of the room in which the gas-light (or lamp) is used, and thence by suitable arrangements it is made to communicate with a flue or chimney, the roof of the building, or the external atmosphere, as may be most convenient. K K is a spherical glass moon or globe, which is especially applicable to gas-lights. It has a circular opening at the top, around which is a projecting flanch or rim. To the flanch a metal collar is adapted, and by means of three equi-distant hooks or rings the globe is suspended from the tube C C, inclosing and softening the effects of the light, which projects scarcely any shadow downwards.

As shown in the annexed engraving, the gas-light and lamp ventilator is divested of ornament for the more ready explanation of its several parts. It is exceedingly simple, and not liable to be put out of order; it is susceptible of adjustment to particular situations and circumstances; it can be manufactured economically as respects cost, and in a great number of instances the essential parts of the apparatus may, at a comparatively trifling expense, be adapted to fittings now in use.

In skilful hands the apparatus will speedily assume a variety of forms for pillars; brackets, pendants, chandeliers, and lustres; and whether for purposes of utility only, or of utility and ornament combined, the designs will be as novel and elegant in appearance, as they will be appropriate and beautiful in general effect and execution. The ornamental parts may be light and tasteful, or rich and massive, as may be desired; and these being affixed by screws to the main body of the fittings will be removeable at pleasure to be cleaned, re-lacquered, or altered, without interfering with any of the other arrangements.

The glass globe K K, (see the engraving,) in no respect interferes with the operation of the ventilator, but it is considered a suitable mode of fitting up a depending light. The only opening in the globe being at the top, where a current of cold air is constantly entering, the principle of the apparatus is by its means very strikingly illustrated—a portion of the air descending to the burner to support combustion, and the remainder passing off between the chimney I and ventilator F in the directions indicated by the arrows.

The advantages to be derived from the use of the gas-light and lamp ventilator may be thus briefly enumerated;—

First. Health and comfort.—All the heated air and products of combustion being conveyed out of the room.

Second. Economy of gas and of light, which is consumed under the most favorable conditions; the access of air being controlled so as to produce a tranquil flame, with perfect, but not vivid combustion. The gas is heated before it enters the burner, and a saving thereby effected equal at least to 10 per cent. The body and arms of brackets, pendants, and chandeliers, being above the burners, there will be no shadows projected against the walls and floor as by ordinary fittings; and hence a smaller quantity of light will suffice whilst it will be diffused more uniformly.

Third. Cleanliness.—The walls, ceilings, furniture, or embellishments of a room, however delicate or costly, will not be soiled or in any other respect injured by the lights. If by sudden increase of pressure, or from any other cause, too much gas should pass the burner, not a particle of smoke will enter the apartment, but the whole pass off through the ventilator without breaking, or even discoloring, the glasses.

Fourth. Safety.—As just mentioned, should the gas be burning in excess it cannot inflame goods, furniture, or clothing in its immediate vicinity; or if, by neglect or mistake, it be extinguished without being turned off at the burner, it will escape by the ventilator and not diffuse itself in the apartment.

## EDGE'S WATER-METER,

AT a recent meeting of the Society of Arts, the following description was read of Mr. Edge's newly-invented machine for the measurement of water, which is now being tested in several parts of England, and may be seen at Mr. Edge's manufactory, Great Peter Street, Westminster.

For many years past, the want of a machine to measure liquids, while being transmitted through tubes, seems to have occupied public attention, and more recently water companies, and practical engineers, have become desirous of the existence of such an instrument; the former to ascertain the quantity of water supplied, (more particularly to their large consumers,) the latter to ascertain the amount of water passed into their steam boilers, and by inference the amount of steam generated, the comparative advantages of different fuels, and the attention of the engineer to his duty,

It was with a view to supply the wants of the two latter classes, that the present machine was invented; although there is no doubt that if modified in a particular way it would as effectually answer the purposes of the former. Before entering upon a description of this machine, it may be as well remarked that several others for the same purposes have been from time to time brought before the public without much success; these, however, are liable to one or two very important faults, either that they cannot measure liquids while acted upon by pressure, or that they will measure any air which may pass through them, as if it were liquid. These objections are entirely overcome by the present arrangement; and also, it is believed, a greater degree of accuracy and simplicity is obtained.

Fig. 1 is a sectional elevation showing the chambers A and B, and the machinery therein.

Fig. 2 is a section of chamber A, taken at right angles to Fig. 1.

The outer casing is rectangular, and is made of cast iron; this, however, may be varied to zinc or tin plates, if the pressure of the liquid be not too great. This case is divided in the middle by a partition C, thereby forming two chambers A and B, communicating through the slit D in the top of the partition C. In the partition C there is a four-way cock E, the larger end of which opens into chamber A, and the smaller into chamber B; the water is conducted to and from this cock by means of tubes, shown by arrows passing through chamber B. This cock transmits the liquid to and from the chambers A and B, in the same manner as the slide valve conveys the steam to and from the cylinder of the steam engine. Parallel with the centre of the cock E is a spindle F, working in the upright standards G G; this spindle carries a driver H, which acts upon projections on the plug of the cock E, and it also carries a metal cylinder I, hermetically sealed, in which is a heavy metal ball K, less in diameter than the cylinder, so that it may roll freely in it. In the upper part of chamber A there is a float L, working upon the axis M, which carries a pendant arm N, having upon the end of it a friction pulley. As the float rises and falls by the action of the water, this arm vibrates, and acting alternately upon the inner sides of the two teeth on the spindle F causes the lower end of the cylinder I, (in which is the metal ball,) to be raised, the ball rolls to the opposite end of the cylinder; and by its weight moves the spindle F suddenly round, which motion is communicated to the plug of the cock E, thereby causing a change of inlet and outlet.

The action of the meter is as follows:—The water enters the inlet pipe, and (from the peculiar position of the plug of the cock,) passes into the chamber A, until it has risen to the dotted line Z; the float will by this time have been raised to its highest position, and the pendant arm N will have raised the lower end of the cylinder I by its action upon one of the teeth on the spindle F. The ball will then suddenly roll to the other end of the cylinder, causing the spindle to move round, which motion is conveyed to the plug of the cock, and its position being reversed, the water then passes into the chamber B through the four-way cock. Now the air which was in chamber B, and the upper part of chamber A, becomes compressed, and its expansive force acting upon the surface of the water in A expels it through the outlet by the four-way cock, until the water falls to the dotted line Y Y, when the float will also have fallen, and by its action upon one of the teeth on the end of the spindle, have raised the opposite end of the tube, causing the metal ball to roll to the other end, which force being conveyed to the plug of the cock by the driver suddenly moves it into its original position. The water will again rise into the chamber A, and acting on the compressed air expel the water from B through the four-way cock. Thus each chamber receives and discharges distinct portions of water; the pressure exerted to fill the one being communicated by a column of air to discharge that in the other—each stroke being equal to the area of the chamber A, from dotted line to dotted line, (minus the bulk of the float and other machinery in that part of the chamber.) It may here be remarked that the bulk of chamber B has nothing to do with the measurement: for B can only receive as much water as A discharges, and can only discharge as much as is received by A. The only exception to this rule is when an additional pressure takes place; at this time a longer stroke is given, which is again repaid by a short one, which exactly compensates for it when the pressure is removed.

Upon the axis M there are two teeth, taking into a crown wheel, similar to a clock escapement; thus the vibrations of the axis M give rotatory motion to the upright spindle O, from thence to the counting apparatus, which is of a novel description.

---

## IRISH BUTTER.

Irish Butter appears, recently, to have obtained a bad name in the markets; the cause of which is stated by the Earl of Erne, who has minutely inquired into the matter, to be as follows:—

"You will never have your Butter fetch a good price, or bear a good character in England, if you do not work a reform among the coopers. Tubs should be made of *well seasoned* oak, sycamore, or sally; the staves should be made much thicker, otherwise they do not hold the brine. The hoops should be always peeled, as the bark will give a taste to the butter; they should be strongly put together, as the casks are liable to be knocked about. The coopers also put in green wood in the heads and bottoms of the casks, to make up the proper weight for the casks, which gives a peculiar taste to the butter, and, of course is injurious. The Tub. when sent home to the farmer, should be filled with boiling brine, and closely covered, to stand 24 hours before it is emptied out for packing with butter. When the milk is brought from the cow, it is strained into proper vessels, and *never removed* until ready for churning, which state, in warm weather, it will be in the course of four days. The practice of mixing hot water with the milk to raise the temperature is *bad;* it causes the butter to be pale, which renders it nearly unsaleable, except at low prices. The proper method for country people, in winter, is to place the churn in a tub of hot water until its contents acquire the temperature which experience proves to be best for the production of good butter, viz., from 58 to 60 degrees. A few potatoes, given raw with other food, will raise the colour of the butter in winter, and are good for increasing the quantity. It is of importance that the butter should undergo as little handling as possible. When the butter is taken from the churn, it should be washed with brine, and the buttermilk completely extracted from it, and never put aside a lump without being salted, which is the custom in some dairies, where they wait for several churnings before they put any into a cask. You should be most particular in buying your salt; purchase none but the best; the salt manufactured from sea-water only, contains much bitterness, and spoils the flavour of the butter. Pure salt is known by its taste, and the absence of any bitter flavour, and should be rolled, it becomes a fine powder, and finer the better. The butter having been well washed in a wooden bowl with cold water, should then be salted, one pound of salt to twelve pounds of butter, well mixed, and again washed with cold spring water, until the salt is just perceptible.

"A very particular part is in expelling the milk, which is done by taking the butter in small pieces and clapping it well with a butter spoon. In putting it into the cask it must be well pressed, to exclude the air between the *makings*; the butter should be covered with a cloth soaked in strong pickle, wrung out each time in cold water, and again steeped in brine to cover the cask; and when the cask is full, it is covered with pickle made of half a pound of salt, and one of nitre, dissolved in a pint of water, and allowed to remain twenty-four hours before closing it for market."

---

## THE TRADES OF BIRMINGHAM.

(*Continued from page 22.*)

5. *Japanning.*—Japanned articles of great beauty and variety are very extensively manufactured. The art had a very humble origin with tobacco boxes, small trays, and various insignificant articles; but Taylor and Baskerville—the former by painting, the latter by introducing the *papier-mache*—raised it to a degree of excellence before unknown. Great talent is now called forth, and some of the best painters of the country have been engaged in the earlier part of their career in painting the teaboards and waiters of Birmingham. These articles are susceptible of great elegance, and, when produced in perfection, are beautiful specimens of the painter's art. The coarser, and consequently the more extensively conducted branches of the trade, are carried on at Bilston and Wolverhampton.

6. *Steel Pen Making.*—This branch of industry has sprung up in Birmingham, as well as at Sheffield, within the last twelve or fifteen years, and so greatly has the manufacture increased and risen in perfection, that while the article has been constantly improving, the price has been perpetually on the decrease, so that at present the best *three-slit* pens may be purchased at 8d. the gross, commoner articles being made at a still lower price. It has been calculated that about 800,000 gross, or nearly *ten millions* of steel pens, are annually made in Birmingham *only*, employing about 600 persons, and consuming about 80 tons of fine sheet steel.

7. *Nail Making.*—The use of machinery in making screws and nails has been introduced with great success—well-formed nails being cut out of sheet-iron far more rapidly than the human hand could snip paper with scissors—and, after being thus cut, receiving, by powerful pressure, well-formed heads, while, at the same time, a novel process of annealing gives them a tenacity almost equal to that of nails forged by the hammer. The Britannia Nail Works are provided with machinery producing several thousands of nails each minute. Notwithstanding, however, the relief offered to human labour—perhaps the most slavish in the hardware branches—nails are still made very extensively by hand in and about Dudley, Walsall, and Stourbridge, employing from 30 to 40,000 persons, chiefly women and children at the nail-block, earning wages barely sufficient to maintain life.

8. *Glass Making.*—This branch of industry has long been carried on in this and adjacent towns. The largest manufactory of crown glass is that of Messrs. Chance and Hartley, near Birmingham, where there are also considerable manufactories of flint and other descriptions of glass, the quantity made in this revenue-district averaging about one quarter of the whole duty collected in England. The business is not now confined in its higher branches to cut decanters and other domestic vessels, nor to ornamental chandelier drops; but the melted metal is cast into scrolls, foliage, and various figures of small size, with a degree of boldness hitherto unknown, while from the lathe and the cutting-tool it derives a sharpness of edge and smoothness of surface, that give to it a delicacy and brilliancy not attainable by other methods.

To detail, however, or even to attempt a general description of the various manufactures that have owed their origin during the last half century to the facilities afforded by the newly created mechanical forces, and the various branches that have arisen out of the division of labour, comprising, not merely artizans, but also artists, chemists, and other men of science, would far exceed our limits. Birmingham has now nearly 150 steam engines of an aggregate power of 3,000 horses. In addition to which, the stamp, the press, the lathe, the draw-bench, and other mechanical contrivances, have multiplied the facilities of manufacture, to an almost incalculable extent. With respect to the value of the Birmingham manufactures, Mr. McCulloch states that there are no means of estimating the total value of the articles produced, owing to the confusion in the returns of goods produced here with those made at Sheffield; the value of the articles made here, however, including gold and silver plate, does not fall far short of *three millions* sterling, the value of the material bearing but a very small proportion to that of the labour expended on them; as, for instance, in watch springs the value of the raw material is not 1-200,000th part of the value of the finished article. Indeed, *it is from this extreme sub-division of employment that the superior skill of the workman and the excellence of the manufacture are mainly deducible.*

## HOUSE-PAINTING;

FORMING THE SUBSTANCE OF AN ESSAY IN THE ENCYCLOPÆDIA BRITANNICA.

In a country like Great Britain, House-painting is an art of great importance, in so far as it is conducive to the durability and comfort of our dwelling-houses, by preserving them from the effects of a changeable climate and humid atmosphere. I trust, therefore, that these few remarks on the mechanical department of the art will be found of some general interest.

It is well known that the ceilings and walls of apartments in dwelling houses and other buildings of this country are now almost uniformly finished in plaster; and the nature and properties of this composition are also well known. One of these properties is its power of absorbing moisture; consequently, when an aparment is left for any length of time without the benefit of a fire, or heated air supplied by other means, the plaster will continue to absorb a portion of the humidity with which the atmosphere is generally loaded; and this absorption will not only render the room unwholesome, but will tend to impair the durability of the plaster itself.

The first object, therefore, in decorating a house ought to be to render the interior walls impervious to this absorption, and the only way by which this can be attained is to paint them. The materials employed in plain painting are:—white lead, linseed oil, spirits of turpentine, litharge, sugar of lead, japanners' gold size, ochre, Venetian red, lamp black, Indian red, Turkey and English umber, terra de Sienna, red lead, Prussian blue, orange lead, chrome yellow, vermillion, lake, and other pigments. But white lead is the principal ingredient in all ordinary colours used in house-painting; indeed, it generally constitutes nine-tenths of the composition, and consequently forms the main body of the paint. The quality of this article is therefore of the greatest importance, as upon it depends almost entirely the durability of the work; yet it is of all the painter's materials the most difficult to get free of adulteration. The painter buys it ground in oil, to the consistency of a thick paste, which operation is now performed by machinery on the premises of the manufacturer, instead of being done by a clumsy hand-mill as formerly in the painters' shops; and of it there are three qualities, the prices of which vary, according to that of pig lead, from about 27s. to 40s. per cwt. But this difference in the price of white lead is trivial in comparison with the mode in which it is sometimes adulterated. This used to be done by the introduction of fine whiting, but now by a cheap mineral called byrates, and, as detection is very difficult, the temptation to adulterate on the part of the manufacturers is proportionally great. But how much greater must it be to the needy tradesman, who can employ whiting instead of white lead in the two first coats of his works, with scarcely a possibility of his employers knowing anything of the matter? This in some measure accounts for the great difference that exists in the prices of painter's work. The injury done to paint by the admixture of whiting or byrates is, that it not only renders it of a much less compact body, but, causing it to be more easily acted upon by the atmosphere, renders it more liable to be blanched and destroyed by repeated washings.

Linseed oil, being the principal diluent, stands next in importance. It varies but little in quality, and is seldom adulterated; the superiority of one kind over another consisting entirely in its clearness, and being of a moderate age. It is sometimes boiled, which gives it a great facility in drying, but renders it too thick and unctuous to be much used for interior work.

Spirits of turpentine, of which a great deal is now used in house-painting, is also rather uniform in quality; but varies greatly in price according to the state of the market. The only difference in its quality consists in the manner in which it is distilled; and it is easy to distinguish what has been properly done. by the absence of the resinous matter, which is generally to be found in that which has been distilled with less care.

Litharge, and sugar of lead are purchased by the painter in a dry state, and ground by him in oil into a paste of a thick consistency, and used, by being mixed with the paint, to dry and harden it. They do not individually vary much in point of quality. Japanner's gold size is a liquid of which there are various qualities, the price being from 10s. to 18s. per gallon. It is used for the same purpose.

Several of the colouring pigments vary much in quality, and the house-painter, in laying in his stock, can suit it exactly to the rates of prices at which he works; some of this class of materials varying from 9d. to 3s. per lb. according to the quality, and others, such as ochre, from 2d to 1s. per lb. These are the principal materials employed by the house-painter in the plain department of his work; and it will now be necessary to give some account of their application.

To paint plaster properly, five coats are generally requisite; but where it is not of a very absorbent nature, four are found to answer. The first is composed of white lead, diluted with linseed oil, to rather a thin consistency, in order that the plaster may be well saturated; and into this is put a small quantity of litharge to ensure its drying. In painting quick plaster, the oil in this coat is entirely absorbed, thereby hardening it to the extent of about the eighth of an inch inwards from the surface. When this is found to be the case, the second coat should also be thin, that the plaster may be thoroughly saturated; and it will be found necessary after this to give other three coats, making in all five. The second coat will be found to be but partially absorbed, and it is therefore requisite to make the third coat a good deal thicker, and to introduce into it a little spirits of turpentine, and such of the colouring pigments already enumerated, as may bring it somewhat near to the tint of which the apartment is to be finished. The fourth coat should be as thick as it can be well used, and should be diluted with equal parts of oil and spirits of turpentine. The colour of it ought to be several shades darker than that which is intended for the finishing coat, and the dry ingredient, sugar of lead instead of litharge. These coats ought all to be laid on with much care, both as to smoothness and equality, and each lightly rabbed with sand paper before the application of the other. The finishing or flatting coat, as it is termed from its drying without any gloss, is next applied. It ought, like the others, to be composed of pure white lead, ground as already described, and diluted entirely with spirits of turpentine; and it should appear, when mixed, a few shades lighter than the pattern chosen for the wall, as it darkens in the drying. The drying ingredient should be a small portion of japanner's gold size. This coat must be applied with great care and dispatch, as the spirits of turpentine evaporate very rapidly, and if touched with the brush after that takes place, which is in little more than a minute after its application, an indelible glossy mark will be left on the surface. Nothing has been said of the time that each of the coats will take to dry sufficiently to receive the next, as that depends much upon the state of the weather, the quantity of dryer employed, and the atmosphere kept up in the apartment. It may be observed, however, that under any circumstances the first coat ought to stand a few days before the application of the second; the second a little longer before the application of the third; and the third, unless in four-coat work, should have still longer time to harden. But the coat, immediately before the flatting or finishing coat, ought not to stand above two days, as much of the beauty and solidity of the work will depend on the latter dying into, and uniting with the former.

[*To be continued.*]

## SHELL AND ROCKET PRACTICE.

The following very interesting experiments took place in the Woolwich Marshes, on Monday week, before a number of officers of the Royal Artillery. The experiments commenced by firing six 32-pounder shells from two pieces of ordnance, placed at 400 yards distance from the bulk head, the object against which they were directed. The first shell entered the mound on the east side of the bulkhead, and exploded, tearing up the earth with great violence; and the second entered the mound nearly in the same place, and with a similar effect. The third shell went through the bulkhead, and entered the mound to a considerable distance before it exploded, which it then did, scattering a large quantity of earth in all directions. The fourth entered the mound and exploded nearly similar to the first and second. The fifth and sixth shells both entered the bulkhead and went into the mound at the rear before they exploded, nearly in a similar manner as in the experiment with the third shell. The inventor of the shells experimented with is a Mr. Buckingham, and they appear to be the best yet submitted to trial before the select committee, as they exploded in every instance at the time specified by the inventor, and after they had reached the distance of the object against which they were projected. The greatest fault of almost all the shells fired on former occasions when experiments were carried on in the marshes appeared to be the danger to be apprehended from their bursting in or at the mouth of the gun from which they were propelled, rendering them as liable to destroy the men of the army using them as the army of an enemy. All the shells hitherto tried in the marshes at Woolwich have been described by their inventors as having been constructed on the concussion or percussion principle; but Mr. Buckingham, without stating what his principle is, maintains that his invention is not on either of the concussion or percussion principles, and asserts that he can move about his shells with the greatest safety, and even let them fall on the ground, without the least danger of exploding; and that he can regulate their bursting with the greatest exactness, after a given number of seconds from the time of their being fired, and that in no instance will they burst in or at the mouth of the gun. On examining one of the cavities formed by the explosion of one of the shells in the mound we found about a yard of copper wire, which had evidently been a part of the contents of the shell, and it is, therefore, probable that Mr. Buckingham's invention is upon the principle of a galvanic battery. Our neighbours in France, who watched narrowly all Warner's experiments with his professed terrific power, which was to effect such a revolution in warfare, if the Government of this country or any other country had purchased his discovery, were perfectly satisfied that the experiments carried on by Mr. Warner were accomplished by galvanic agency. Mr. Buckingham will, no doubt, have further opportunities afforded to him to test the merit of his invention in every possible way it might have to be used in actual service, and a most practical and highly qualified committee to report upon its real value and capability for the service of the country. Mr. Warner would never consent to the experiments with his invention being made at Woolwich, and consequently the Government acted wisely in declining to purchase it. The remaining part of the afternoon was occupied in comparing the usual service rockets with others invented by Lieutenant Boxer, of the Royal Artillery. Six of each were fired at a range of 500 yards, and six of each at a range of 1000 yards, and those at the long range were excellent, Lieutenant Boxer's being generally uniform in their progress, and proceeding the whole distance with good effect, and the others performed their duty remarkably well. Mr. Hale, an inventor, tried four rockets on his principle, fired from an open trough instead of a tube, as was the case with Lieutenant Boxer's and the service rockets. Mr. Hale's first rocket, weighing about 30lb., discharged at a range of 900 yards, was raised to a great elevation in the air, and fell nearly, if not wholly, expended at the mound. The second fell to the westward considerably; the third burst at the trough, and the fragments fell into the canal, at about 100 yards distant, and a little to the rear of the line of its discharge. The fourth made several evolutions in the air, and fell considerably to the westward before it had gone half the range.—*The Times.*

## SHOTLEY SPA.

The village of Shotley, which has of late attracted considerable attention by its mineral springs, is situated in the county of Durham at an equal distance of 14 miles from Newcastle, Durham, and Hexham, upon the right bank of the river Derwent, opposite a bridge, whence the village has been more distinctively named Shotley Bridge; and since the notoriety of the mineral springs, Shotley Spa. or, as our Saxon progenitors called it, "Hally Well," or "Holy Well." From time immemorial, the water has been considered an infallible remedy for scurvy affections and scrofulous complaints, and this virtue is recorded in the following vernacular couplet, by a villager.

> "No scurvy in your skin can dwell,
> If you only drink the Hally Well."

The water, which was very pure, and always the same in wet or dry weather, used to stand in a natural basin formed by surrounding hillocks of moss and grass; such was the condition of the well about fifty years ago. Fifteen years later, the water having formed a sort of bog, was drained away into the Derwent; and was, for many years, lost, except to a few villagers and their children. The sides of the channel in which the water flowed from the drain into the Derwent, were then of a vermillion colour, indicating the presence of a considerable quantity of iron in the water. Thus this valuable mineral spring was comparatively unheeded; until, from the traditions concerning the well, and some memoranda left by his father, Mr. Jonathan Richardson, the proprietor of the Shotley estate, began to search for the lost spring, and by aid of some of the old inhabitants, succeeded in finding the Hally Well. Near it, below the peat earth, common soil, and gravel, is a stratum of very fine blue clay, from which the mineral waters spring: after the blue clay are freestone, and plates of siliceous and ironstone; and after several in iron strata, limestone at a considerable depth. Hence, the strata from which the Shotley waters spring, are similar to those whence issues Oddy's celebrated Chalybeate or Cheltenham spring, at Harrogate; and their medicinal agents also have a great affinity. Mr. West, of Leeds, an eminent practical chemist, analysed the first discovered spring, and found a gallon of water to contain the following solid and gaseous contents:—

| | GRAINS. |
|---|---|
| Chloride of Sodium ...................... | 177 |
| ————— Calcium...................... | 36 |
| ————— Magnesium ............ .. | $0\frac{3}{4}$ |
| Carbonate of Iron.............. .. ..... | $5\frac{3}{4}$ |
| ————— Soda...... ..... ........... | $13\frac{1}{2}$ |
| Silicia .. ..... .. ..... .... ............. | 3 |
| Bromine, less than a grain. | |
| Iodine, a trace. | |
| Potash, a trace. | CUBIC INCHES. |
| Carbonic Acid Gas .................. .. | 10 |
| Carburetted Hydrogen ...... ........ | 2 |
| Nitrogen ............ .................... | 13 |

The gas which escapes in bubbles at the spring, consists of Carburetted Hydrogen, 24 per cent.; Nitrogen, 76 per cent.

Dr. Granville, in his *Spas of England*, gives a decided testimony to the efficacy of the Shotley springs. "The water," he says, "which is limpid and perfectly colourless, issues in an horizontal stream through a spout in an upright stone, which covers the well. It falls into a round low basin, the inner surface of which betrays by its colour the presence of iron in the water. This deposition which is equally observable on the tile tanks of the bath-rooms, is cleared off by the attendants, from time to time, although they find it extremely difficult, occasionally, to remove it from the surface, so tenaciously does the oxyde adhere. The spring is protected by a simple round thatched roof, supported by rustic trunks of trees. Three circular steps lead down to the well. The temperature of the water I found to be 48 deg. Fahr. after repeated trials; that of the atmosphere in the shade at the time being 76 deg. When heated, the water assumes an ochreous appearance. It remains so, and nothing beyond it, as long as it is kept in motion—but if suffered to rest it precipitates abundantly the ochreous sediment. The phenomena presented by the water at its natural temperature contained in a glass tumbler are even more striking. At first, it is perfectly clear and transparent; but, in an hour or two, it turns slightly opalement. This appearance becomes gradually more at times, and assumes, at the same time, a brownish or slight claret tinge, which, with the opaleacure, keeps increasing, while the inner side of the glass and bottom is covered by myriads of air bubbles, exceedingly minute, and adhering tenaciously to the surface. I drank a large quantity of the water at the well. At first, it had no prominent taste, but after a short interval, the impression of common salt is awakened; and, on savouring the water, that impression becomes more marked, as well as the âpreté of the oxyde of iron. But beside this, there must be some other ingredient—so I find it noted among my memoranda set down on the spot—present in the action to impart to it a peculiar softness, which approaches almost to oiliness, when being swallowed. The subsequent analysis by West explained the reason of the latter phenomenon. When I drank a large tumbler of the water, previously warmed, I could not help being reminded of the appearance and taste of one of the sources at Ems. Drunk in doses of from three to four half-pint glasses, the water is said to be purgative, and with some to act violently and quickly. Others, however, are obliged to add some Epsom or Glauber salts to render it purgative."

Dr. Granville considers the Shotley Spa to hold a middle place between the absolute and purgative chalybeate springs of this country; and to be an *attractive chalybeate*, eminently calculated to relieve and cure diseases of weakness and obstruction in the circulation, glandular affections of the mesentry, dyspepsia, deficiency of tone in the intestines, impurity of blood, or tendency to decomposition, each calculated to produce cutaneous diseases and scurvy; and when used as a warm bath, rheumatic complaints have been singularly benefitted by it. The water, in fact, is a most valuable one, and may, properly studied, be made instrumental in the recovery of many disorders, which no other water in the country can cure; and this water differs in its composition from all the others examined by Dr. Granville in his recent tour. He regards its effect when used as a hot bath, very important; for the continuous application to the skin of a soluble salt of iron, rendered more active by 98° of heat, is never made with impunity. The Doctor has tested the Shotley bath, and describes its appearance in the tank as exactly like that of the Kochbrunner at Wisbaden: he felt clearer in the head, and altogether more comfortable after the bath; but he attributes much of this sensation to the situation and exceeding purity of the air of the place, which we suspect, have in all cases, more to do with the effect attributed to mineral waters than pleasure hunters are generally aware of. The immediate effect of the water on the skin is to render it rough to the touch in two or three minutes. When the hand is passed slightly over the body, one would think that the finest sand was laid between the two. The skin of the fingers is actually puckered in the water. This effect is to be attributed to the steel; but it vanishes on quickly after wiping the skin dry, and its surface acquires a soft satiny feel instead, accompanied by a rosy tint throughout. Dr. W. Reid Clemny, in some remarks on the properties of the Shotley water, especially adverts to its chloride of calcium, as a most valuable remedy in scrofulous diseases; its carbonate of soda, as an antacid and deobstruent, is important in acidities of the stomach, indigestion, scrofulous affections, and in calculous diseases of the kidneys, as a lithontriptic. There is, however, one precaution needful, in using this valuable mineral water, *i. e.* to keep the bowels free in action, else the large quantity of gases which it contains, may occasion a determination to the head. "In a word," says Dr. Clemny, "this mineral water is a powerful diuretic, and during its use, simple aperients, either saline or otherwise, according to the opinion of the family medical friend, ought never to be forgotten."

Dr. Ryan's modest volume, whence we have condensed this account of the Shotley spring, contains some very pleasing descriptions of the neighbouring country, its scenery, antiquities, and distinguished natives, &c. The spirited enterprize of the proprietor of the spring will, doubtless, render them a fashionable resort, when their superior health-giving properties become fully known. It may be interesting to mention that Shotley was once famous for its manufactory of swords; the water of the Derwent being allowed to rival that of the Tagus, on which is placed a Toledo, in tempering steel.

---

## THE EFFECTS OF ELECTRICITY ON ANIMALS AND PLANTS.

Some persons are so susceptible of changes in the electricity of the atmosphere, that they can tell when there is "thunder in the air" by the sensations they feel. Pains in the stomach are experienced by those who have partaken of such food or drink as the electric fluid can convert into a state of acidity, as readily as it can "turn the beer sour" in a barrel. The extremities of the body will sometimes display electric sparks during thunder storms. Hamilton, in his work on Asia, says,—"One of the most remarkable phenomena which I observed in Angora was the great degree of electricity which seemed to pervade every thing. I observed it particularly in silk handkerchiefs, linen, and woollen stuffs. At times, when I went to bed in the dark, the sparks which were emitted from the blankets gave it the appearance of a sheet of fire; when I took up a silk handkerchief, the crackling noise would resemble that of breaking a handful of dried leaves or grass; and on one or two occasions I clearly felt my hands and fingers tingle from the electric fluid. I could only attribute it to the extreme dryness of the atmosphere, and momentary friction. I did not observe that it was at all influenced by wind; the phenomena were the same whether by night or by day, in wind or calm. Not a cloud was visible during the whole of my stay." Some Englishmen on Mount Etna, in 1814, and Sir W. J. Hooker, when on Ben Nevis in July, 1825, were very perceptibly affected by electricity during snow storms without thunder. Previous to lightning, cattle and other animals that are peculiarly sensitive to electric changes, become restless, and seem uncomfortable. Franzius, an old naturalist, asserts that the hart is very frightened at thunder, that she never brings forth her young alive when there is thunder, and that at such times sheep are so alarmed that they cast their lambs from fright. Every body knows that cats are greatly affected by electric changes in the weather. Seals appear to experience agreeable sensations during thunder-storms, for then they sit upon the rocks, and contemplate the convulsion of the elements with evident pleasure. M. d'Isjonval says that frogs are affected by natural electricity. Eels are in great excitement and commotion during thunder-storms. M. Derheim, of St. Omer, ascribes the almost sudden death of leeches at the approach of or during storms to the coagulation of their blood, caused by the impression of the atmospheric electricity. Cuvier says that the perch fears thunder.

## VARIETIES.

*The Mariner's Compass.*—The writer of an article in the *Nautical Magazine*, No. 3, mentions a circumstance which materially affects the oscillations of the compass, that appears to have been overlooked both by philosophers and instrument makers. It is well known that the needle affixed to its card, though balanced on the pivot horizontally before it is magnetised, has its north pole afterwards drawn down, in what is called the magnetic *dip* of the needle. To overcome this additional attraction, it is usual to affix a sliding brass weight to the south pole, by which the card is again balanced; but it seems to have been forgotten that by so doing the centre of gravity of the needle and card is removed nearer to the south pole, and no longer rests immediately on the pivot. The effect of this arrangement, consequently is, that when the ship is in motion, the card which would remain stationary if balanced on its centre of gravity, oscillates as a pendulum, and produces errors in the compass which it is difficult to calculate. The mode adopted to restore the horizontal position of the needle without removing the centre of gravity is not very clearly explained, but it appears to consist of an alteration in the suspending cap that will prevent the dip mechanically. The subject is of considerable importance; and now that attention has been directed to this source of error in the mariner's compass, we have little doubt that means will be found to rectify it, even should those proposed not be effectual.

*Gelatine not Nutritious.*—The French Academy of Sciences have frequently directed experiments to be made to test the nutritious quality of gelatine; which substance has been by many, considered the most flourishing portion of animal food. The results of some recent experiments were reported at the sitting of the Academy, on the 11th of March, which confirm those previously made, in the conclusion that gelatine is of *no use as food.*

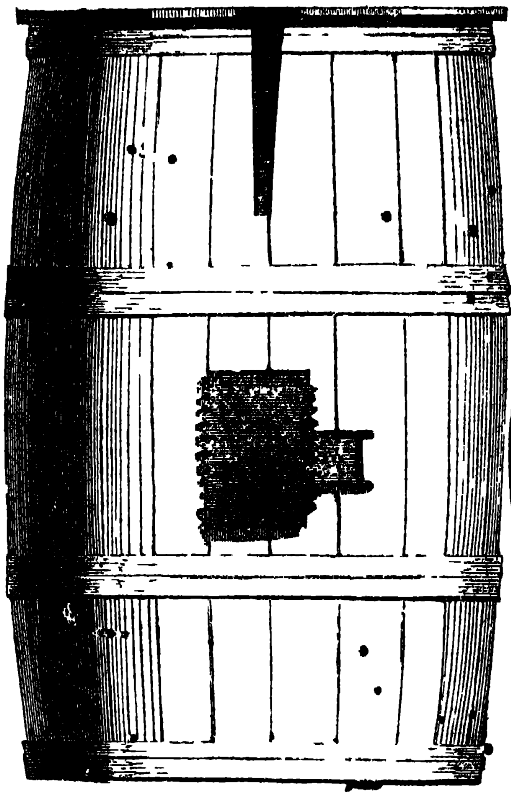
*Atmospheric Railway.*—M. Mallet, the celebrated engineer, who was sent specially by the French government to examine the atmospheric railroad at Kingston, near Dublin, states, in his report, that by the system all danger from accidents by fire is avoided, and from carriages running off the road almost, and a collision between two trains altogether prevented. None of the objections against it M. Mallet considers insurmountable; while it prevents the necessity of levelling the soil according to the present inconvenient method, and offers an economy of 140,000fr. a league, or 2000*l.* British per mile.

*Carbonic Acid in the Atmosphere.*—M. Boussingault and M. Lewy have made some experiments to ascertain the relative proportions of carbonic acid contained in the atmospheric air, in and out of Paris. M. Boussingault states that upon analyzing a quantity (450 litres) of air collected near the College de France, in Paris, and a similar quantity taken at Andilly, near Montmorency, it was found that the carbonic acid in the former exceeded by two parts in a hundred that of the latter.

*Water Power in Niagara.*—Measurements have been made of the volume of water of the Niagara river, from which it appears that "the motive power of the cataract of Niagara exceeds, by nearly forty-fold, all the mechanical force of water and steam power, rendered available in Great Britain, for the purpose of imparting motion to the machinery that suffices to perform the manufacturing labours for a large portion of the inhabitants of the world, including also the power applied for transporting these products by steam-boats and steam-cars, and and their steam ships of war to the remotest seas. Indeed, it appears probable that the law of gravity, as established by the Creator, puts forth in this waterfall more intense and effective energy, than is necessary to move all the artificial machinery of the habitable globe."

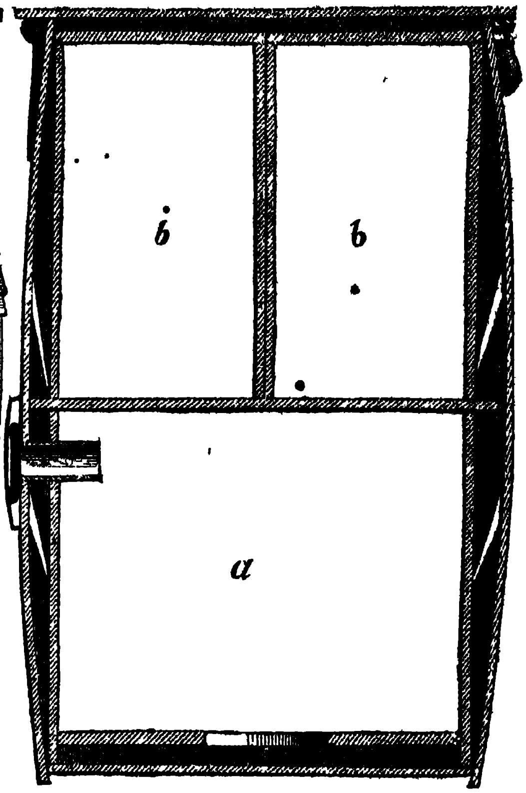
*M. Faye's Comet.*—A communication has just been read to the Academy of Sciences, at Paris, from M. Goldsmith, of Gottingen, on the results of the new calculations which he has made for the purpose of rectifying the parabolic elements of the comet of M, Faye. These calculations accord with those originally made, in attaching to our planetary system this comet, which, in the most eccentric point of its orbit, is at a distance from the sun which does not exceed six times the circuit of the terrestrial orbit.

*Fig. 1.*



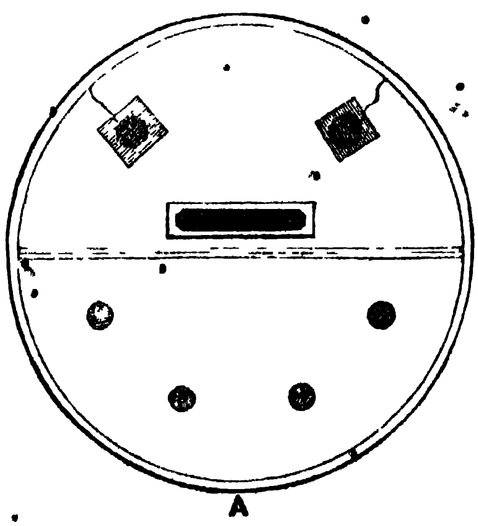
*The Hive.*

*Fig. 2.*



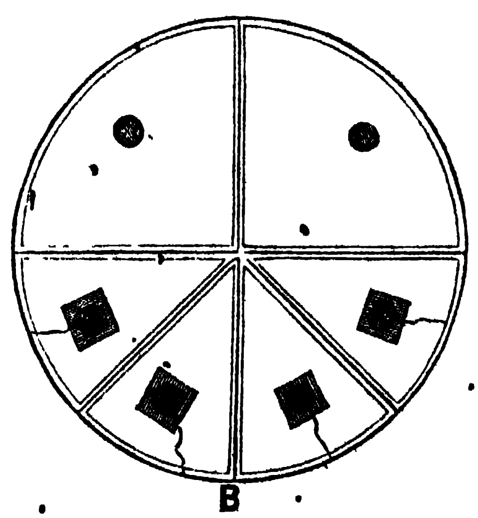

*Section of the Hive.*
(*b b*) *Surplus Honey Cases.* (*a*) *Pavilion.*

*Fig. 3.*




(*a*) *Folding partition belonging to Pavilion.*

*Fig. 4.*




(*b*) *Top of Surplus Honey Cases.*

MR. SHOLL'S PORTABLE BARREL BEE-HIVE

## MR. SHOLL'S PORTABLE BARREL BEE-HIVE.

An ingenious and humane gentleman, named Sholl, of Lamb Street, Spitalfields, has just invented a portable barrel hive, which, by its improved arrangement, is calculated materially to contribute to the healthful economy of Bees, as well as to supersede the barbarous practice of killing these wonderful creatures to obtain the produce of their industry.

Before we proceed to details, we should state that the several sections of this interesting ruro-economical invention are engraved upon the preceding page.

Mr. Sholl's cottager's hive may be thus described: The stand is of wood, consisting of five pieces, which are so arranged that they may be taken to pieces readily, if required, and put away in the hive, if necessary to send it to a distance. A common American flour-barrel forms the outworks of the hive. The pavilion is formed of wood, and may be either square or circular, and is placed at the bottom of the barrel. It is furnished with a wire-gauze door, fixed in the bottom, which answers the purpose of a ventilator: two cross bars are fixed at the top of the pavilion, to which the inhabitants attach the comb. The entrance to the pavilion is circular, and towards the top a metal tube is carried through the wall of the house or barrel, and is furnished with a sliding shield, also of metal, to keep them in when necessary. This slide is perforated so as to assist the ventilation. The pavilion, which can be removed from the house or barrel at pleasure, stands upon four legs, for the purpose of fully ventilating the space between the outer walls of the house, or barrel, and the pavilion; towards the bottom of the barrel is another aperture, furnished with wire-gauze, for the sake of ventilation. On the top of the pavilion is a folding partition by which it is covered: this partition contains six, or any greater number of apertures that may be required, to each of which is a plug of wood, with a tin cover. each plug is attached to a string, which is secured to the side of the barrel, so that when the plugs are removed from the apertures they may not be lost. The use of these apertures is to admit the bees when necessary from the pavilion into the surplus cases above. A small window is fixed in the partition, to ascertain the state of the bees at any time. These cases, six or more in number, are also constructed of wood, nearly fitting the sides of the barrel or house: each case is of a segmental form, and open at bottom to admit the bees, and further, is lighted by a small window in the top. When the bees have filled the pavilion with honey as far as possible, admission is afforded to them to one or more of the surplus cases, or additional apartments, in which they deposit new comb. The pavilion remains undisturbed so far as removing honey is concerned, the additional apartments being supplied for that purpose. When a case is ascertained to be filled with honey, it is removed to a distance from the barrel, carefully turned on one side, and the bees returning to the pavilion, the apartment may be cleared of the honey accumulated, and another case may be immediately inserted in its place. It is readily ascertained which surplus apartment is occupied by the bees, as the admission plug from the pavilion will be found placed on the top of it. The cover or roof of the bee-house or barrel is hung with common hinges, and secured either by a common lock or padlock.

## WOODEN SHOES.

BY MARTIN DOYLE.

The wages of French labourers, male and female, may be stated generally as the same in amount with those paid in Ireland; and therefore the people of each country may be said to have the same limited funds for the purchase of shoes.

Yet while the poor Irishman and his wife and children are in continual discomforts in this particular, the meanest beggar in France, from the infant to the grandsire, has the feet perfectly dry and warm. The wind is blowing keenly from the north-east; the French woman has her window open; she sits spinning away merrily, in which one of my country-women under the same circumstances would be coddling over the fire, or tramping to the bog for baskets of turf. The French children, under the same circumstances, are playing about, indifferent to the cold; the Irish children are cowering with the dog and cat over the ashes on the hearth, and shrugging up their shoulders to their ears in the attitude of misery; and why this difference? Because the French have their feet dry and warm in their wooden shoes, and the toes of the others are cold and wet, and therefore causitive of chilliness the whole day.

I have seen an old Norman woman of eighty, sitting at her fruit-stall in the street during frost and snow when the thermometer stood at 15°, and apparently very comfortable, because, with good woollen clothing, her feet were in wooden shoes, resting on a little pan containing no more charcoal than would roast a Tom-tit. I have remarked hundreds of delicate-looking females sitting in their shops, plying their needles with doors open in the severest weather, with no other covering on their heads than a muslin cap, and without a cloak, while I was muffled up in a heavy coat, and yet trembling with cold. They did not feel it, because they had their feet cosily covered up in wooden shoes, and had a dish on the counter to warm their fingers now and then, or to supply heat to the lower extremities at intervals. Wooden shoes, with the lower orders in France, are a substitute for the warmth of fuel, which is terribly dear in most parts of that country; and this consideration should, with our philanthropists, be a very influential motive for dispensing sabots through the length and breadth of Ireland. The sufferings of thousands of our poor in winter, in various localities, from the combined want of fuel and covering for the feet are horrifying.

Of these two deficiencies, one is directly remediable by the use of wooden shoes: they cost from three to ten shillings a pair, exclusively of the leather strap which is drawn across the instep, and nailed on each side near the bottom. A working-man will wear out in the year from two to three pair; and his sabots are usually made not to require any straps, though the sabots of the females are generally furnished with them: he must have two pair of strong well-knitted worsted stockings at one shilling and three pence a pair, and this cheap supply is sufficient for those farm labourers who have not occasion to walk much upon the roads. From early and constant familiarity with the sabot, the French do not find them impediments to motion, and in summer wear them without stockings from early habit, without any unpleasant sensation to their feet. But to be comfortable in winter, every one who can afford the indulgence has list slippers; which, besides imparting warmth, prevent even the tenderest feet from feeling any inconvenience from the sabot, it keeps them so firmly fixed in at the heel, which would otherwise often slip out, that a person when a little accustomed to the sabot can walk rapidly or run in them, children dance in them. These shoes are bought in France for about half a crown. I think they would cost in Ireland (or Scotland) little more than half this, on account of the much greater cheapness of our woollens. The whole average annual expense, including leather shoes for three months in the summer to the French labourer or farmer's boy, for preserving his feet, may be estimated at ten shillings; his wife and children are rendered really comfortable in the same respect the year round, and without any interruption for a far lower sum.

To women they answer all the purposes of the English patten, with the advantage of much greater warmth, in wet or sloppy weather they may be instantaneously taken off on entering the house, and are slipped on again in a moment on going out.

Women break stones for the roads very frequently in France and do much of the labour which with us is performed exclusively by men; wooden shoes to persons standing or sitting all day in wet soil are invaluable.—*Gardener's Gazette.*

## PROGRESS OF CHEMISTRY.

(*From Liebig's Lectures.*)

ONLY sixty years ago chemistry, like a grain of seed from a ripe fruit, separated from the other physical sciences. With Cavendish and Priestly its new era began. Medicine, pharmacy, and the artisan's workshop, had prepared the soil upon which this seed was to germinate and to flourish. The foundation of the science is, as is well known, an apparently very simple theory of the phenomena of combustion. We have now experienced the great benefits and blessing which have sprung and been diffused from this view. Since the discovery of *oxygen* the civilized world has undergone a revolution in manners and customs. The knowledge of the composition of the atmosphere, of the solid crust of the earth, and of water, and their influence upon the life of plants and animals, were linked with that discovery. The successful pursuit of innumerable trades and manufactures, the profitable separation of metals from their ores, also stands in the closest connexion therewith. It may well be said that the meterial wealth of empires has increased manifold since the time oxygen became known, and the fortunes of individuals have been augmented in proportion. Every discovery in chemistry has a tendency to bring forth similar fruits. Every application of its laws is capable of producing advantages to the state in some way or other, augmenting its powers, or promoting its welfare.

In many respects, chemistry is analogous to mathematics. On the one hand, the application of this latter science enables us to measure land, to erect buildings, and to raise weights, and, as in arithmetic, becomes an instrument, the skilful employment of which secures most obvious and universal advantages; on the other hand, mathematics enables us to draw correct logical conclusions according to definite rules, teaches us a peculiar language, which allows us to express a series of such conclusions in the most simple manner, by lines and symbols intelligible to every one who understands this language; it gives us the power to deduce truths by means of certain operations with these lines and symbols; it furnishes us with an insight into relations of things formerly obscure or unknown to us. The mechanician, the natural philosopher, the astronomer; employ mathematics as an indispensible instrument for the attainment of their ends. They must, indeed, be so practised in its management that its application becomes a mechanical habit, requiring only the exercise of memory. It is not, however, the mere instrument which plans and executes the work, but the human intellect. You will admit that without the power of observation, without judgment, without sagacity, all mathematical knowledge is useless. You may imagine a man who, favoured by a good memory, has rendered himself intimately acquainted with every theorem of mathematics, who has obtained an eminent degress of skilfulness in handling this instrument, but who is altogether unable to invent a problem for solution. If you propose to him a problem, and give him the conditions for the solution of a question, he will succeed in obtaining an answer by performing the current operations with which he is familiar, and express it in a formula consisting of certain symbols, the meaning of which, however, is perfectly unintelligible to him, because he is deficient in other attainments essential for judging of its truth. Such a man is a mere calculating machine. But as soon as he possesses the capacity and the talent of proposing a question to himself, and testing the truth of his calculations by experiment, he becomes qualified to investigate nature. For from whence should he derive his problems if not from nature? He is denominated a mechanician, an astronomer, or a natural philosopher, if, starting from observation, he is able to ascertain the connection of certain phenomena and the causes producing them; and then is capable, not merely of expressing the results in a formula, in the language of the mathematicians, but of making an application thereof, exhibiting his formula in the shape of a phenomenon or external fact, thereby testing its truth. The astronomer, the mechanician, the natural philosopher, therefore, in addition to mathematics, which they use only as an instrument, still require the art of observing and interpreting phenomena, the ability to present the results of abstract reasoning in a visible shape by means of a machine or some form of apparatus; in fact, to prove the correctness of his conclusions by experiment. The natural philosopher proposes to himself the solution of a problem.—he endeavours to ascertain the conditions of a given phenomenon, the causes of its variation, and, when the problem has been correctly proposed, and all its factors taken into account, he succeeds in obtaining, by the aid of mathematical processes, a simple expression for the unknown quantity or relation which has been the object of his search. This expression or formula, translated into ordinary language, explains the mutual connection of the observed phenomena, or of the experiments which he has instituted; and it is correct, when it enables him to produce a certain series of new phenomena which are its corollaries.

You may now perceive how the mathematics stands connected with the study of nature, and that, besides mathematics, a high degree of imagination, acuteness, and talent for observation, are required to make useful discoveries in astronomy and other physical sciences. It is an error to ascribe discoveries to mathematics. It happens with this, as with a thousand other things, that the effect is confounded with the cause. Thus, effects which have been ascribed to the steam-engine, belong properly to fire, to coals, or to the human mind. The true discoveries in mathematics are the successive steps towards the perfection of the instrument, by which it is rendered capable of innumerable useful applications, but mathematics alone makes no discoveries in nature. It works upon data furnished to it, upon what has been observed by the senses, and ideas created by the mind. Experimental natural philosophy stands in this sense contrasted with mathematical natural philosophy. It is the former which discovers, examines, and prepares facts for the mathematician. The task of experimental physics is to express the laws, the general truths deduced, in the form of phenomena, to illustrate the mathematical formulæ by experiments, to make them manifest to the senses.

Chemistry proceeds in the same manner, in answering her own questions, as experimental physics. She teaches the methods of discovering and determining the qualities of the various substances of which the crust of the earth is composed, and which form the constituents of animal and vegetable organisms. We study the properties of bodies and the alterations they undergo in contact with others. All our observations, taken collectively, form a language. Every property, every alteration which we perceive in bodies, is a word in that language. Certain definite relations are manifested in the deportment of bodies toward each other, a similarity in form or analogy in properties, or diversities in both respects. Such diversities are as numerous and various as the words of the most copious language, and they are no less varied in their signification and in the relations which they bear to our senses.

*(To be continued.)*

## STONE BREAKING MACHINE.

### VEGETABLE PHENOMENON.

I remember, some time ago, to have seen in the *Magazine of Science*, an enquiry by a correspondent, whether there was a machine for breaking stones for road making; and I think your answer was, that you knew of no such machine. In walking through Thoresley Park, my attention has been directed to a machine for breaking stones, worked by water-power: there are two breakers, both of which are occasionally *set to work*. The same building also contains mills for grinding bones and corn, and crushing gorse for cattle; all which are put in motion by the water-wheel before mentioned. I had almost forgotten to add that there is a grinding-stone turned also by the same motive power, whenever it is wanted. At the same place are some small "stone breakers," in which the hammers are worked by leverage.

In a plantation called *Pelham Cover*, in Thoresly Park, on the right of the road leading through the park from Thoresly to Clumber, is the following singular phenomenon. Two Scotch firs which are planted at the distance of three or four feet, have joined together five or six feet from the ground, so completely, that the part of the body of the trees above the junction appear as one, without any apparent seam or fissure, and considerably thicker (for several feet upward) than either of the stems, as it derives nearly an equal support from each. There are no boughs for a considerable height above the junction. The tree immediately above the junction may be one foot and a half in diameter.

A Civil Engineer.

## IGNITION OF METALS IN ACID SOLUTIONS.

### BY MR. MACKRELL.

In the second number of the 'Electrical Magazine,' are some remarks by Professor Grove, on various voltaic phenomena,—The last of which relate to the peculiar action occurring when, with a very powerful voltaic battery, "small wire electrodes of platinum are dipped into water acidulated with sulphuric acid,—a brilliant combustion, attended with a decrepitating noise, is observed at the cathode, provided the anode is previously immersed in the liquid; on reversing the experiment, a slight spark only is observed at the anode."

The brilliancy of the phenomenon is there described, as being due to the strong affinity between the platinum cathode and the sulphur of the sulphuric acid. Having, in the early part of 1810, made several experiments on this particular phenomenon (a notice of some of which was published in the proceedings of the Electrical Society), I cannot help thinking, that this combination of the sulphur of the acid with the metal of the cathode, is rather the effect than the cause of the phenomenon,—the latter of which still seems to require elucidation.

I have carefully repeated my former experiments with the assistance of my friend, Mr. Pollock, and made others—some of which were performed in muriatic acid, and others in nitric acid; and the results were precisely similar to those made in diluted sulphuric acid;—that is, the combustion was exceedingly brilliant at the cathode, when last immersed in the electrolyte; but at the anode, when the experiment was reversed, the combustion was comparatively feeble. Wires of iron and copper, and plates of platinum a quarter of an inch in width, were also used, instead of platinum wire, with analogous effects.

In the case of the cathode, when introduced last into the solution; if, instead of diluted sulphuric acid, muriatic acid is employed as the electrolyte, hydrogen is of course evolved; but the affinity between hydrogen and platinum we know to be very weak; yet the phenomena are as brilliant as when sulphur in the former instance is concerned;—and perhaps more so.

Then again, if nitric acid is substituted, from which hydrogen azote, or ammonia are disengaged, the affinities of these bodies for platinum are weak, yet the phenomena are most brilliant. In the case of the anode, the phenomena are less brilliant than those at the cathode, although the existing affinities of the platinum for the oxygen, and more particularly for chlorine, are stronger than those of the cathode platinum for the hydrogen, the azote, or the ammonia. These results appear to indicate that the strong affinity of the cathode platinum for the sulphur is not the cause of the brilliancy of the phenomena.

I think it proper, however, to state, in conclusion, that these experiments were made in the acids of commerce, which are not entirely pure; my occupations not having yet allowed me time to repeat them in pure acids, which it is my intention to do as I have more leisure, when I shall feel much pleasure in forwarding you the results.

## NEW LIFE BOAT.

A new and ingenious Life-Boat has just been made at Boulogne. It can be put together and taken to pieces in an incredible short space of time, and if it strike the side of a vessel, a rock, or a pile, will bound off like a foot-ball, without any injury to itself; if designedly upset, keel up, it will right itself, without any danger to the boatmen or passengers, who cannot be skaken out; and after acting as a pontoon, it can be converted into a comfortable tent for men or horses. The boat is made of cloth waterproof, and imperishable, is of the whale-boat build, and ketch-rigged. The ribs or timbers, which run from gunwale to gunwale, in a piece, are of white oak, and perfectly elastic, like bows. The ribs are served or corded in a manner sometimes used with coachsprings, on the inside of which are thin laths of whalebone. This frame-work is covered, in place of a plank, with a peculiarly strong cloth or canvass, impenetrable to water. The deck is also of cloth, tightly laced to the gunwales, and laced through the centre, fore and aft, from the stem to stern-post; but the water is effectually excluded by laps or doublings. The oarsmen sit in thwarts, which are of cloth, through scuttles in the deck, from which coats are erected the same as the coats of a mast or pump; these are nearly fitted by plaits to their bodies, and buckle below the breast. A boat of 32 feet in length can save between 40 and 50 persons. When the boat is taken to pieces the keel can form the upper ledge of the roof of a tent, the walls being made of the cloth mentioned above. The inventor, Captain Cotter, has laid his invention before the French Board of Admiralty, where its merits are at present under examination, with a view to being reported on within a short period.

## NEW SCAFFOLDINGS.

Some very interesting papers, detailing new contrivances for the construction of buildings, have lately been read to the Institution of Civil Engineers. First, —"An Account of the Scaffolding used in erecting the Nelson Column, Trafalgar Square," by Mr. T. Grissell. This scaffolding, which was first used in London for the erection of the façade of the London and Birmingham Railway Station, by Messrs. Cubitt, then by Messrs. Grissell and Peto at the Reform Club House, and also at Woolwich in forming the New Graving Dock, was composed of sills, uprights, crossheads, longitudinal timbers, braces, and struts, all of whole timber. The upright timbers were slightly tenoned into the horizontal timbers, and the junctions secured by iron dugs driven into the timbers diagonally across the joints, which were preferable to bolts or spikes, as they could be more easily withdrawn, and the timber was not injured. It was stated, that with this scaffolding, and the travelling machine at its summit, one mason could set as much work in one day as was formerly done in three days by the old system, even with the aid of six labourers, who are now dispensed with. The base of the scaffold was 96 feet square, exclusive of the raking braces; the height of each stage varied from 21 feet to 48 feet, the total quantity of timber used in its erection was 7,700 cubic feet, and its cost was 240*l*. for labour in erecting.

It was recommended that the plan adopted at Liverpool of bonding timber upon dry land instead of allowing it to float in timber ponds, should be made use of in London, as by that means there would be less decay and the timber would be better seasoned, and the Kyanizing process would not be so much required.

A paper by Mr. Pierre Journet was then read, describing the scaffolding employed by him for the construction and repair of columns, obelisks, and chimneys of great height, at Paris; and also the machine used for raising building materials at the Houses of Parliament, the mansions at Albert-gate, Hyde-park, &c.

The scaffolding consisted of a simple combination of a number of brackets, fixed at regular distances of about five feet apart, vertically upon girdles of chains and screws, braced tightly round the column under repair; upon these brackets the platforms were laid, and as the workmen proceeded upwards the lower brackets were alternately raised to the platforms above, where the workmen stood. The progress thus made in forming and in taking down a scaffold was stated to be very rapid, with corresponding economy of time and expense. No poles or cord were used, and no waste of material occurred. By these means the obelisk of Luxor, at Paris, was repaired in a very short period, and at a very small cost.

The machine for raising building materials consisted of an endless chain of square open links, the lower end revolving round a driven wheel, and the upper end around a corresponding wheel fixed upon the scaffold at the height of the building. The hods, buckets, and baskets were each furnished with a hook, by which they were suspended on the rising side of the chain, and when they arrived at the necessary height they were taken off by labourers, and carried to the spot where the materials were to be used; when empty they were hung upon the descending side of the chain, and lowered to be again filled. Messrs. Grissell and Peto, who had used these machines, expressed themselves much pleased at the economy they effected, which would induce them to employ them more extensively with engine power for the erection of the Victoria Tower at the new Houses of Parliament.

## ATMOSPHERIC SPRING FOR RAILWAY CARRIAGES.

This much approved method of giving elasticity to railway carriages is now in constant operation on the Stockton and Darlington Railway, and is universally admired for its superiority over the ordinary spring now in use. The motion given to the carriage is perfectly smooth, easy, and, from the unpleasant sensation caused by the harshness of the steel spring; and the lateral motion, which in most carriages is so very disagreeable, is entirely removed. The following is a brief description of it:—The air is by means of an air pump condensed in a small metallic cylinder, made air-tight at one end, and having a piston at the other end working perfectly air-tight; one of these cylinders is placed over the axle box of each wheel, the piston rod resting in a cup in the centre of the box, so as to form a universal joint; the top of the cylinder is placed under the frame work of the carriage, and the centre of which works in a ball and socket joint similar to that of the piston rod. In the cap of the cylinder there is a small screw, which can be taken out when required, and the air pump applied, by which means, with the assistance of the valve inside, the air is condensed in the cylinders, consequently the carriage is supported by the four columns of condensed air, and that air by its elasticity accommodates itself to the weight of the load whether it be heavy or light; the cylinders working in ball and socket joints at each end allow the carriage to work with much greater ease and freedom than when it is bound up and tied with the long steel springs, and is a great acquisition in going round the curves: this also prevents the lateral motion which might otherwise be given to the carriage. The cylinders, when once charged, retain the air for a number of years; and should the air by any possibility become partially exhausted, it is very easily remedied by taking out the small screw above described, and applying the air pump; this operation occupies a few minutes only, and can be done without removing the cylinder, or deranging any part of the carriage. By the adoption of this spring the saving in the wear of the carriages and of the rails will be found to be very considerable, and its durability and exemption from disarrangement, either from concussion or any other cause, will render it a great acquisition to railway companies. It is also admirably adapted to locomitive engines and carriages bearing heavy loads. The inventor and patentee of this valuable spring is Mr. Hesslegrave, land surveyor, of Darlington, and it is anticipated that it will soon become generally used.

## PERPETUAL MOTION.

(*To the Editor.*)

SIR,—In one of the small rooms of the Polytechnic Institution, in Regent Street, are, or were a year ago, several curious pieces of mechanism, the invention of a Frenchman, M. Moineau de Montauban, which might easily escape the observation of a casual visitor to that establishment. They appear, however, worthy of being generally known, as they exhibit specimens of what, but for the unavoidable wear and tear of the materials, might be called "perpetual motion," produced solely by mechanical contrivances, without the assistance of magnetism or electricity. They consist of three or four clocks, one of which was going when last I saw it, and apparently keeping correct time. All these clocks have the means of themselves restoring the moving power to its original position; so that when once set in motion, they will continue in action as long as the materials will last. In the clock which was going when I saw it, this was accomplished by means of a number of balls, which, falling in succession on a series of cups on the outer edge of a vertical wheel, set the machinery in motion, and were returned to their original position above the wheel by an Archimedean screw. Perhaps the subject is not of sufficient importance (especially as it has been before the public for some years) to induce you to give an engraving of any of these pieces of mechanism; but if you could find room in your excellent publication for a description of them, I cannot but think it would interest many who, like myself, have always been under the impression that it was almost an established fact in mechanics, that no machinery can *wind itself up*, or reproduce the power that set it in motion.

In the Catalogue of the Polytechnic Institution for 1842, these contrivances are numbered from 1359 to 1365 and are placed in what is called the upper west room of the establishment.

L. E. T.

## TO PURIFY THE AIR OF STABLES.

BY HENRY REECE.

MR. HENRY REECE having been invited by Mr. Evans, of Dean House, Enstone, to make some experiments on his excellently conducted farm and stables, he trusts the results of those upon the absorption of ammonia may prove of sufficient interest to entitle them to publication. As gypsum (crystallized sulphate of lime) had been highly recommended for this purpose in some recent works on agriculture, the stables were in the first instance freely strewn with this salt coarsely powdered; but though the ammonia was evolved during the removal of the wetted straw in sufficient quantity to affect even the eyes of the grooms, after two days' exposure, the slightest trace of it could not be detected in the gypsum when examined with slaked lime. This result was the more surprising, as it is known to every chemist that solutions of carbonate of ammonia and of gypsum are incompatible; the carbonic acid leaving the ammonia to form the precipitate carbonate of lime, the sulphuric acid passing to the ammonia; and it had been previously ascertained that in an atmosphere so highly charged with ammonia as to be destructive to animal or vegetable life, a very appreciable proportion was taken up by wetted gypsum. The following experiments appeared conclusive upon the point, that under less favourable circumstances not an atom was absorbed:—200 grs. wetted with distilled water were exposed in a close stable for three days, precautions having been taken to avoid any error from evaporation; it was again weighed, no increase could be perceived, nor was any ammonia evolved on the application of the usual tests; while 200 grs. wetted with diluted sulphuric acid, and exposed the same time, were found to have gained 36 grs. of ammonia. The stables were then strewn with the gypsum moistened with sulphuric acid, and examined the next morning; every portion was found to have absorbed sufficient ammonia to evolve its peculiar pungent odour when brought in contact with slaked lime; the stables had also lost their close, unhealthy smell. To use the words of the grooms, they appeared sweetened. As it was evident the gypsum acted merely mechanically, affording a convenient absorbent surface for the acid, experiments were made, substituting sawdust for gypsum with even more favourable results. That the proportion of free ammonia in stables is very large may be shown by the simple experiment of placing a moistened piece of litmus-paper reddened with weak acid in a stable. In one badly cleaned or ill ventilated, the effect is instantaneous; but even in those of Mr. Evans, where the greatest attention was paid to these points, the paper was observed in a few minutes to become blue; even the water kept in the stable the over-night, as is the habit to take off the chill, becomes sufficiently impregnated with ammonia to affect tests. As this Alkali is justly ranked among the most powerful stimulants, the continual breathing of an atmosphere vitiated by it can hardly fail to have a prejudicial effect. Grooms are observed to be short-lived; and the rapid course of inflammatory diseases in horses, and their distressing predisposition to colds and affections of the chest, are no doubt greatly aggravated by this cause. The increased salubrity and sweetness of the stable, if pointed out to the grooms, would therefore soon reconcile them to the slight additional trouble the adoption of this remedy would incur. At Dean House the acid gypsum was first strewn amidst the straw; but as this was considered likely to injure the feet and clothing of the hunters, it was afterwards spread on trays. 1 part of sawdust will be found to absorb readily 3 times its weight of acid solution, which I made with 1 part, by measure, of sulphuric acid to 15 of water. If intended to be tried as a manure, it should be mixed in with the straw when removed from the stable. During the process of rotting, the ammonia is evolved so freely, that at the end of two or three weeks, the acid powder, which should not remain more than three days in the stable without changing, will be found completely neutralized; and as the greatest benefit was derived from covering up and salting dungheaps, by which I believe an additional absorption of ammonia could only have been gained, it may be reasonably hoped that an increased value would result from a manure thus surcharged with ammoniacal salts.—*Journal of the Royal Agricultural Society of England.* vol. iv.

## GLASS-PAINTING.

Mr. C. H. Wilson, Architect, of Edinburgh, in a paper on the decorative arts in Germany and France, observes, " I now call your attention to an important art which has been restored, and is practised with much success in Munich; I mean that of glass-painting. Before entering upon a description of it, I would beg such of you as have seen them, to recall to your memories the noble specimens we possess in some of the cathedrals and ancient churches in the South; I would mention the fine windows of Cologne Cathedral, but especially those of St. Lawrence in Nuremberg, in which church the Volkamer window may be mentioned as, in all probability, the finest in the world. The art has never been lost in Nuremberg, and I am happy to show you a copy, by the best artist of that place, of a portion of the Volkamer window. You observe that we have here a figure of St. Catherine, admirably drawn, and she is placed over a Gothic pattern or ornamental design, which runs through the greater portion of the window behind the figures. You have here a specimen of the true system on which such subjects on glass should be designed. These should be treated in a conventional manner; no attempt should be made to represent nature, as we do, for instance, in a picture, as thereby the idea of a window is immediately destroyed. Many of you who have seen it must have been struck with the bad effect produced by this mode of painting a window, as seen at St. George's Chapel at Windsor, in St. John's Chapel here, and in the Parliament House. Notwithstanding the just criticism with which these have been assailed, glass-painters, both in the South and amongst ourselves, persist in copying pictures for such purposes, so little do they understand the principles of design as applicable to their art. I saw in London a copy from Rubens' Descent from the Cross, being executed for a church, and I might cite many other examples of this perversion of taste.

Now, the glass should be painted with architectural ornaments in character with the architecture of the church, and these should be correctly coloured in imitation of ancient painted examples of church architecture. Some of you are aware that both the exteriors and interiors of ancient buildings were richly painted. It was thus in Egypt, thus in Greece, and such was the practice in ancient and Gothic times. It was a practice which, I believe, was abandoned when the principles of taste were better understood, although I say this with caution, and it would be foreign to my subject to enter upon this interesting question. The architectural and ornamental design, then, in church windows, in the the particular examples which I bring before you, seems to be a representation, in brilliant colours, of the painted architecture of the period, and over these are painted the figures, whether of holy personages, saints, or heroes.

" The architectural ornaments or design fill the whole window, and the figures are drawn and painted in a severe manner, without any affectation of pictorial effect as to light and shadow.

"To give you a more distinct idea of my meaning, besides these specimens of painted glass, I exhibit a coloured engraving from one of the windows of the Au Kirche at Munich; in this specimen the true principles of design, as I view them, have been adhered to with considerable fidelity, although such is not exactly the case with all the windows in that church.

" I have made these brief observations upon this important subject, because, as far as I can judge from the examples which I have seen, neither in London nor any where in this country, is the art of designing for glass-painting yet understood. The windows which you frequently see executed of pieces of stained glass arranged in patterns, cannot be criticised as specimens of the art at all.

## CHEMISTRY OF VEGETATION.

Mr. Solly has lately delivered to the Royal Institution, a lecture on this very important branch of Chemistry, and its application to Agriculture.

This discourse commenced by a short sketch of the general nature of organic matter, describing the composition of plants, the conditions necessary to their growth, and the sources whence they derive the substances which constitute their food. Mr. Solly pointed out the cause of the exhaustion of soils, and described the various methods adopted to restore fertility, giving a sketch of the principal substances employed as manures, and the principles on which their action depends. After phosphorus, alkalis, &c., were treated of, attention was drawn to sulphur, an element existing in most plants, especially of those which formed the food of animals. Mr. Solly stated from experiments, that sulphuretted hydrogen, so far from being poisonous to plants, was, when in small quantities, conducive to their vigour and luxuriance. Very conclusive experiments were then exhibited to prove that solid substances, in such minute quantities as to evade all chemical tests, were occasionally suspended in the air. Thus the steam, arising from a strong boiling solution of carbonate of soda, was proved by the yellow colour it conferred on flame, to contain a notable quantity of the solid salt. The manner in which fixed substances derive volatility from their combination with volatile substances, was illustrated by visible white flocks of phosphoric acid, which had risen in vapour when heated with sal-ammoniac. Mr. Solly then called attention to the enormous extent to which artificial manures are adulterated. He mentioned an instance where an article contained only one thirty-third part of the salt for which it was sold. He proceeded to refer to the experiments which he had made on manures at the Horticultural Gardens, and which are published in the Horticultural Transactions. He dwelt on the probable effects of of muriate of lime, to increase the retentive power of the soil for moisture, and suggested that this salt might be effectual in hastening the growth of turnips beyond the period at which they are attacked by the fly. The last subject brought forward was one of considerable interest, and involving speculations of a very singular nature. Mr. Solly drew attention to the remarkable fact, that the fossil bones of extinct animals contain a considerable quantity of fluoride of calcium; thus the bones of the Colossochelys, or great tortoise, discovered in the Himalaya Mountains by Messrs. Falconer and Cautley, contain eleven per cent. of fluoride of calcium; whilst recent bones on the other hand are found to contain little or no fluoride of calcium. It is reasonable to suppose that the earthy matter constituting the bones of these extinct animals was originally derived from plants? and hence the interesting question—Whence comes this fluoride? It might be supposed that the fluoride had passed into the substance of the bone by some subsequent process. It might be supposed that the plants on which the animals fed contained fluoride of calcium; or lastly, it might possibly be, that some nearer relation existed between phosphorus and fluorine than we were yet acquainted with; and it was not impossible that the one might be converted into the other: this was mentioned merely as a curious speculation—possible, though perhaps not probable. In the mean time it was interesting to observe the action of fluoride of calcium in growing plants; and accordingly experiments had been instituted, the result of which, as far as they could be ascertained at this early period, seemed to favour the conclusion that the fluoride was absorbed, and therefore that it might possibly, to some extent, supply the place of phosphate of lime in plants. Mr. Solly concluded with some general remarks on the progress of Agricultural Chemistry, and the probable results of its future study; expressing a regret that many are so sanguine as to the immediate benefits to be derived from it, that they can hardly fail to be disappointed by the results, as the latter will inevitably fall short of their expectations.

---

## VARIETIES.

*Coal Tar as Manure.*—A communication was read at the Bath Agricultural Society on the subject of the value of coal tar as a manure. The writer stated that in 1840 he published his experience on the subject. He had now used it as a manure for seven years, and had never found it to fail when properly applied. By means of a water cart he distributed over his wheat stubble 180 gallons to the acre, allowing it to remain there two or three months in the autumn before being ploughed in. Its cost was a halfpenny a gallon; it was economical, and valuable for carrots, turnips, potatoes, and all roots, He had tried it on seeds, but not with equal advantage as on wheat. It was very useful on a sandy loam, resting on a marl subsoil; next to that a deep clay land was best, but its least beneficial effects had been upon soil resting on an oolite formation.

*Chloride of Lime*, moistened with water, and applied to ink-spots on silver, &c, will remove them far more effectually than "salt of lemons."

*Mining in New Zealand.*—A copper mine is now being worked on the Great Barrier Island, in the Frith of the Thames, in New Zealand, the produce of the ore of which is sometimes as high as 40 and 60 per cent., and the average about 30 per cent.

*New Water Colour.*—A lady at Palermo wishing to make a drawing of the beautiful Bourgainvillœa Spectabilis, was at a loss for a rose-colour that would match it. It struck her, however, that the juice of the Opuntia fruit would do, and upon trial she found it yield a most beautiful rose-colour, which was as readily worked as if it had been prepared in a colour-shop; and now, after, a year it is as fresh as ever. It would be worth while to get the Sicilians to make up the juice of the Opuntia into cakes.

*Immense Lens.*—M. Guinant has submitted to the Academy of Sciences, at Paris, a lens of flint glass, twenty inches in diameter, the largest that now exists. M. Arago stated that the telescope of Pulkowa, the largest in any observatory, is only fourteen inches in diameter.

*Perpetual Snow.*—M. Agassiz has made some experimental researches amongst the Alps, to determine the limits of perpetual snow, and has read a paper before the Academy of Sciences. It appears that each succeeding year leaves behind it its own region of snow, and that a vast number of years may thus be traced. The superficial bed distinctly shows the quantity that has fallen in the preceding season, but little further knowledge has yet been gained.

*Remedy in case of Poison.*—Instantly administer two tea-spoonsful of made mustard, mixed in warm water. It acts as an emetic. This is a certain remedy, if instantly administered, and may save a fellow-creature from an untimely death.

*Domestic Yeast.*—Persons who are in the habit of making their own bread can easily manufacture their own yeast by attending to the following directions:—Boil one pound of good flour, a quarter of a pound of brown sugar, and a little salt; in two gallons of water, for an hour; when milkwarm, bottle it, and cork it close, and it will be fit for use in twenty-four hours. One pound of this yeast will make eighteen pounds of bread.

*Guano.*—The *Dundee Courier* mentions the arrival at that port, of the ship *British Princess*, with a cargo of 700 tons of guano from South Africa.

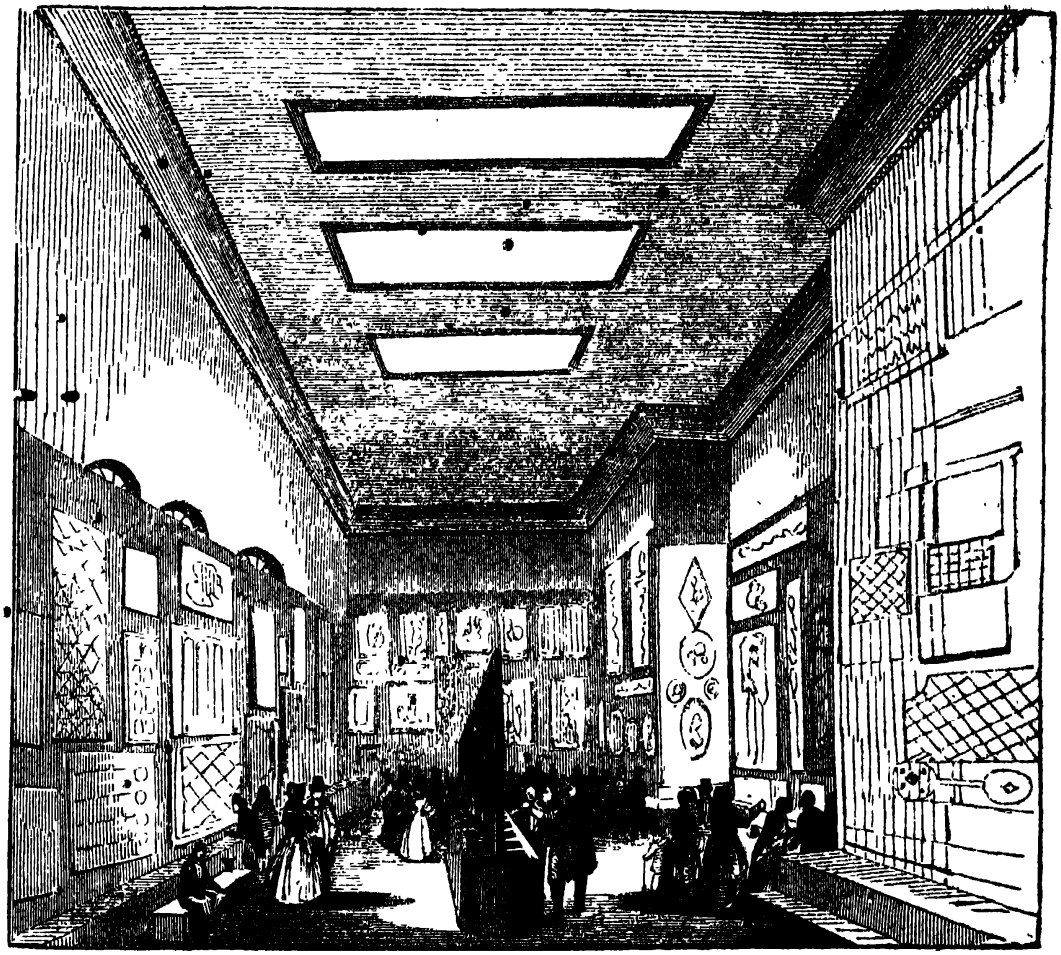
*Butter Made in Ten Minutes.*—By a newly invented churn, made of block tin, and now in use at Derry, butter, at all seasons of the year, can be made in ten minutes!—*Waterford Mail.*

*Novel Experiment.*—Mr. Aplin, foreman of the silk manufactory in East Reach, Taunton, has recently tried a novel experiment, which has turned out very successful. A short time since, he placed sixteen hen's eggs in a warm situation in the steam engine belonging to the factory, in order to raise chickens without the regular method of incubation. A large brood were hatched, and they are now in a thriving condition, and likely to live.

*Kyanizing and Burnetizing Timber.*—The difference between Kyan's process and that of Sir William Burnett is, that the former employs a solution of sublimate of mercury, and the latter a solution of chloride of zinc,

*Cast-iron Buildings* appear to have been constructed for centuries past in China; and M. Gutzlaff has just found a pagoda entirely composed of cast-iron.

*The Princeton Gun*, which burst a short time since, with such lamentable consequences, was the largest wrought-iron gun in the world. It was 14 feet long, 3 feet diameter at the breech, and weighed 30,000 lb.



EXHIBITION OF DECORATIVE WORKS, KING STREET, ST. JAMES'S.

THE Commissioners of Fine Arts, (the noblemen and gentlemen appointed to superintend the decoration of the New Houses of Parliament,) have just opened an exhibition of the specimens submitted to them in prosecution of the plan of competition announced last year. The place selected is in the St. James's Bazaar; the several objects being arranged on the walls, on a screen down the centre, and on the staircase. These decorative works consist of designs for pavements, pieces of mosaic and tesselated pavements of stone, marble, composition, &c.; designs for painted windows, pieces of painted glass; specimens of carving in oak for doors and doorways, for mullions of windows, arches, panellings, reliefs, and statues, &c.; specimens of ornamental works in iron and in leather; specimens of emblazoned coats of arms and heraldic devices; and of several other things for the decoration of halls, state apartments, cathedrals, churches, public buildings, &c.; and more particularly of such designs, devices, and ornaments as may be required for the decoration of the new Houses of Parliament now being built. Most of the things exhibited are creditable to the advancement of art, in connection with the uses to which it has been applied. The above Engraving shows the Exhibition Saloon; and, with the reader's permission, we will take a glance at the specimens.

### WOOD-CARVING.

The subject pointed out for this department is a design for a door for the House of Lords, with an accompanying carved panel of oak. Many competitors have sent in; the total number of designs are

67, forming 29 separate compositions, by artists from all parts of the country: London, Norwich, Cambridge, York, Dublin, Liverpool, Birmingham, Edinburgh, &c. Of course, we can only notice a few of the specimens in detail.

1. Design for the principal door of the House of Lords, by Thomas Legg—The centre panels contain the emblems of the three kingdoms, and two shields, on which are placed the arms of the cities of London and Westminster. At the bottom of the upper panels are ranged the crowns of the peers in the proper order of precedence; and in the heads of the end panels the archbishop and bishop's mitres. The royal arms and supporters are placed on the principal centre panel, and on either side the arms of England, Scotland, and Ireland. On the small shields at the top of the door are arranged the arms borne by successive monarchs, &c., from the time of Edward the Confessor.

We see more to commend in the execution than the design of this specimen; it being cleanly carved.

9. Design for the principal door of the House of Lords, by S. Pratt, jun., rich in design, but sadly overloaded with ornament in the French flamboyant style: this should remind the English artist to look at home for gothic detail, which is infinitely superior to any to be found on the continent.

11. Design for the principal door of the House of Lords, by S. A. Nash.—In this design, red lines shew the extent of each leaf of a pair of folding doors, similar in arrangement, the head of the arch being left fixed. In one door is represented a portrait statue of King Henry III. (from his effigy in Westminster Abbey), the monarch under whom the first traces of the present constitution of a Parliament appeared. In the corresponding situation it is proposed to place the resemblance of the reigning sovereign. The subject of the sculpture proposed for the head of the arch is the memorable event in the history of English constitutional government, which took place in Westminster Hall on the 3rd May, 1253, when the peers obtained from Henry III. a fresh and most solemn confirmation of liberty for his subjects.

This is, altogether, a composition of gr at merit and beauty, which we should much like to see executed. Another meritorious design is—

13. Design for the principal door of the House of Lords, by John Thomas.—This design is divided into four panels; the figures in these panels, under canopies, are the patron saints of the four divisions of the United Kingdom. Under these, in a band forming the centre style, is the name of each figure, and corresponding division, such as "St. George for England," &c.; the lower panels are filled in with the heraldic devices of bearings, helmets, crests, and mottoes proper to each; the whole resting on a plinth, with the motto of "O Lord, preserve the Queen." The tracery above the canopies is enriched with the roses of Lancaster and York united, having the thistle and shamrock on each side; the door is intended to open in the centre, the joint being concealed by an enriched buttress, which forms the centre ornament.

15. By John Wolstenholme, of York, is too *ecclesiastical* for its purpose though the style is good.

28. Design for the principal door of the House of Lords, by Henry Ringham.—In this design, the doors being folding, the left hand style of the specimen is larger on that account; the extreme thickness of this door would be eight inches.

This specimen is very freely carved, but the details are very exceptionable; the arches being ill-drawn and the design altogether overwrought with thistle crocket-work.

26. Design for the principal door of the House of Lords, by William Allen.—The first panels below represent a priest, a soldier, and an agriculturist, a lawyer, a sailor, and a merchant, in the costumes of the twelfth century. The centre panels represent Cranmer receiving the Bible from Henry VIII., and King John signing Magna Charta, in the costumes of the respective periods. The top panels represent David I., King of Scotland, administering justice, and St. Patrick summoned before the king and princes of Tara for lighting the paschal fire. The centre figure represents Britannia, those on the left Henry III. and Henry VII., and those on the right a bishop in the costume of the eleventh century and Robert Fitzwalter.

This design has the defect of being over storied with pictorial subjects, and some of its details are faulty.

The three next specimens are cleanly carved, and are more purely English than the majority of those around them; the details are however, occasionally faulty.

36. Design for the principal door of the House of Lords, by Samuel Nixon.

37. Design for the principal door of the House of Lords, by Samuel Nixon.—Representing—1. Alfred the Great receiving an illuminated Missal, as a reward for learning to read, from his mother Osburgha. 2. Alfred at the battle of Aston. 3. The first flotilla defeating a Danish squadron. 4. Alfred scolded by the neatherd's wife for letting her cakes burn. 5. Alfred dividing his only meal with the pilgrim. 6. Alfred comforted in his adversity by the vision of St. Cuthbert. 7. Alfred in the Danish camp. 8. The meeting of Albert with his trusty followers at Egbert's stone. 9. Baptism of Guthrum previous to his signing a treaty, Alfred standing sponsor. 10. Alfred releasing the wife and and children of Hastings, his most powerful enemy. 11. Trial by jury. 12. The assembly of the Witan, or first Parliament.

38. Specimen of carved work relating to design No. 37, by Samuel Nixon.

We see little in the remaining specimens of Wood-Carving to demand special mention. There is, however, a general error in them, which calls for reprobation: this is the mixing up of allegorical figures with those of real personages—Egbert and Victoria with Discord and Suffering—Alfred with Lycurgus, &c.—portraits of contemporary Ministers—and other absurdities. Nothing can be in worse taste than these incongruities.

We should mention that Mr. Pratt's Carvings are executed by his new machine, the advantage of which is, the rapidity with which carvings can be produced, the accuracy of the corresponding parts composing the whole; viz., crockets, quatrefoils, cinqfoils, roses, &c. and armorial devices; and the little cost of the production.

We shall return to this Exhibition next week. Meanwhile, we trust that according to the original proposition, it has been thrown open gratuitously to the public.

## PROGRESS OF CHEMISTRY.

*(From Liebig's Lectures.)*

*(Continued from page 36.)*

The verbal meaning conveyed by the properties of bodies,—to pursue the illustration,—changes according to the mode in which these elements are arranged. As in all other languages, we have in that language whereby material bodies hold converse with us, articles, substantives, and verbs, with their variations of cases, declensions, and conjugations. We have also many synonymes. The same quantities of the same elements produce a poison, a remedy, or an aliment, a volatile or a fixed body, according to their manner of arrangement.

When we would understand the meaning of the properties of bodies, that is, of the words in which nature speaks to us, we use the alphabet to decipher and to read them; as, for instance, a fountain of mineral water in Savoy, cures that remarkable enlargement of the thyroid gland denominated goitre,—I put certain questions to that water, the combination of the several letters in its answer informs me that it contains *iodine*. A man, having partaken of some food, dies soon after, with all the symptoms of poisoning. The language of the phenomena, which is familiar to the chemist, tells him that arsenic, or corrosive sublimate, or some other body, was mixed with the food.

The chemist by his questions is thus enabled to make a mineral speak, to disclose its composition; it tells him that it contains sulphur, iron, chromium, silicia, alumina, or any other element, arranged in a certain mode. This is CHEMICAL ANALYSIS. Then, again, the language of phenomena teaches the chemist to make new combinations, from which he derives innumerable useful truths that are applicable to the improvement of manufactures and arts to the preparation of remedies and metallurgy. THIS IS APPLIED CHEMISTRY.

Further, when the chemist has deciphered a compound into its constituent parts, as, for instance, ultramarine, it is required of him to combine the letters and to translate the word into a sensible and tangible shape, to exhibit the ultramarine again with all its properties. THIS IS SYNTHETIC CHEMISTRY.

Hitherto scarcely any demand has been made upon the science of chemistry, by arts, manufactures, or physiology, which has not been satisfied. Every question, clearly and definitely put, has been satisfactorily answered. It is only when an inquirer has no precise idea of what he seeks. that he has remained unanswered.

The last and most elevated object of chemistry is the investigation of the causes of natural phenomena, of their variations, and of those factors which are common to different series of phenomena. The chemist ascertains the laws which regulate natural phenomena, and by combining together all that is observable and has been observed by the senses, he at last attains to a general intellectual expression for them, in other words, to a THEORY.

But to enable us to read the book of nature, to understand its language, to perceive the truth of the theories of the philosopher, to subject to our will and examine at pleasure the phenomena upon which a theory is based, and the powers producing them, we must necessarily learn the alphabet of the language, we must become acquainted with the signs or symbols employed, and by practice acquire skill in their management and familiarity with their combinations. As in the higher branches of physics, it is indispensible that the philosopher should have attained considerable practical skill in *mathematical analysis*, so the chemist must have a perfect knowledge, much practice, and a readiness in applying *chemical analysis*, to qualify him to investigate nature successfully; he must be able to test all his notions by experiment. Every experiment is a thought rendered perceptible to the senses. In order to prove or disprove our conjectures, to establish, or to overthrow suggestions for the explanation of phenomena, we produce other phenomena at will, we seek their true interpretation by experiments.

There was a time when chemistry, in common with astronomy and all the physical sciences, was nothing more than an art, founded on empirical practice, subject only to rules discovered by experience; but since the causes of the changes in bodies which it effects, and their laws, *i. e.* the reasons of its rules, have become known, the empiric art has also lost its value and importance. The acquisition of skill in manipulation by laborious and long-continued application, the tedious methods and endless precautionary measures formerly necessary to success in chemical manufactures, have become wholly needless since a correct knowledge of causes has been obtained. The strange apparatus and utensils of the chemist of former ages, their stores and stills, are now mere matters of curiosity. The success of an experiment or a process depends far less upon mechanical skill than upon knowledge. Discoveries are made, not by manual dexterity, but by skill in the combining of means, and by the powers of thought and reflection.

In our lecture-room, we teach the letters of the alphabet; in our laboratory their use. It is in the latter that the student acquires a readiness in reading the language of phenomena, that opportunities are furnished to him of learning the rules of combinations, of applying them, and of gaining a ready dexterity in their application. As soon as these signs, letter, and words, have become formed into an intellectual language, there is no longer any danger of their being lost or obliterated from his mind. With a knowledge of this language he may explore unknown regions, gather information, and and make discoveries wherever its signs are current. This language enables him to understand the manners, customs, and wants prevailing in those regions. He may, indeed, without, this knowledge, cross the frontiers of the known, and pass into the unknown territory; but he exposes himself to innumerable misunderstandings and errors. He asks for bread and he receives a stone.

Without a profound study of chemistry, and natural philosophy: physiology, and medicine, will obtain no light to guide them in the performance of their most important offices, that is, in the investigation of the laws of life, the vital processes, and the removal of abnomal states of the organism. Without a knowledge of chemical actions, the nature and effects of the vital force cannot be fathomed; the scientific physcian can expect to derive assistance from chemistry only when he shall be able to put his question to the chemist correctly.

Commerce and the arts have already derived immeasurable advantages from the progress of chemistry; mineralogy has become a new science since regard has been had to the composition of minerals and the chemical relations of their constituents. If the composition and chemical nature of rocks and strata are not in like manner investigated (and this has hitherto been much neglected), it will be impossible to effect any considerable progress in geology. Chemistry, moreover, is the foundation of agriculture, and it is impossible to accomplish a scientific consolidation of this important art without a knowledge of the constituents of the soil, and the aliments essential to the life of plants.

Without an acquaintance with chemistry the statesman must remain a stranger to the vital interests of the state, to the means of its organic development and improvement; his attention cannot be sufficiently alive, nor his perception adequately acute, to what is really useful or injurious to his country,—to society. The highest economic or material interests of a country, the advantageous production and increase of food for man and animals, the preservation and restoration of health, are closely linked with the advancement and diffusion of the natural sciences, especially of chemistry.

## PURIFICATION OF FISH OIL.

BY MM. GIRARDIN AND PREISSER.

THE constantly increasing price of seed oils (*huiles de graines*) has drawn the attention of speculators to whale oil; and those who first thought of mingling the latter with vegetable oils for the purpose of illuminations have realized large profits. It is now difficult to find the oils of colza, &c. entirely free from fish oil.

In various scientific and technical works we find processes for the purification of fish oils, which, although simple, are useless, and rather tend to mislead those engaged in their sale or purification.

Thus, Mr. Davidson, of Edinburgh purifies oil by treating it with one per cent. of chloride of lime, diluted with water, under violent agitation, and he assures us that the odour is entirely destroyed; but we obtain only a bleached and thick matter, which is clarified by adding eighty-five grms. of sulphuric acid, diluted with sixteen or twenty times its weight of water. The mixture is stirred, gently boiled, and, after filtering warm, is suffered to cool and repose for several days. MM. Girardin and Preisser repeated this process without any satisfactory result.

The "Journal hebdomadaire des Arts et Metiers," points out the several processes for the same purpose. The first consists in mingling twenty-eight grms. pulverized chalk, and forty-two grms. slaked lime with a gallon of the oil, stirring well, and adding 0·236 litre water; after two or three hours of repose it is mixed again, and this operation repeated for two or three days; twenty-eight grms. of common salt, dissolved in 0.710 litre water, is then added, the mixture stirred at intervals for two days, suffered to settle, and the oil drawn off.

Another process in the cold, applicable to cod oil, consists in putting into four and a half litres of the oil, previously prepared by the preceding process, twenty-eight grms. of chalk; then, after twenty-four hours, twenty-eight grms. of potash dissolved in 113 grms. water; and finally, after several hours, fifty-seven grms. common salt, dissolved in 473 grms. water. After settling a few days, the oil is drawn off.

Neither of these processes is sufficient, as MM. Girardin and Preisser have satisfactorily ascertained. The same journal asserts that the oil is obtained so pure by the following process, that it can be employed in woollen manufactures.

Put into four and a half litres (one gallon) of impure oil, thirty-four grms chalk, an equal amount of slaked lime and 0·473 litre of water; after stirring, and a repose of several days, add 0·473 litre water and eighty-five grms. potash; heat the liquid, without bringing it to boiling, and draw it off when the oil has a light amber colour; it has now only a pungent, fatty odour. Finally, add 0·473 litres water, containing twenty-eight grms. salt, and after boiling the mixture for half an hour, turn off the oil into a reservoir. This process does not refine the oil.

Many English patents for the same purpose were tested by MM. Girardin and Preisser.

One treats fish oils in the cold by bone black, in small fragments, and filters through animal charcoal after repeated agitation. Such a process clarifies the oils, and removes a portion of their empyreumatic odour, but does not in the least diminish their essential odour.

Another method, recently published in France, has succeeded no better. It consists in pouring into the oil a solution of bichromate of potash, mixing thoroughly, then adding a solution of oxalic acid. The action is energetic, but after repose and drawing off, the oil still retains its characteristic odour.

There is a process among the French patents, which consists in heating the oil merely to simmering with ten parts of water for five or six hours, and towards the close of heating adding a milk of one part of water with one-twelfth of chalk and one-twelfth of lime.

After settling perfectly, it is drawn off and run in to reservoirs through carded wool or pounded charcoal. This process clarifies the oils, but decolorizes them imperfectly, and does not at all remove their odour.

At Rouen they refine whale oil by sulphuric acid, as in operating on seed oils; but this method removes neither colour nor odour. If, previous to this operation, it be stirred for some hours with chalk, and a current of steam be passed through it, a bleached liquid is obtained which, by the addition of a suitable quantity of sulphuric acid, deposits plaster on settling. The clear oil, filtered through animal black, has lost a portion of its deep colour, and has not a strong odour; but it is not perfectly purified, even after many successive filtrations.

The oxygenation of oils leads to very bad results. MM. Girardin and Preisser remark, that oils filtered and treated, whether by chlorides, lime, chalk, or animal charcoal, and then left to themselves for thirty or forty days, deposit a bleached organic substance, soluble in water and æther, analogous to margarine, and, while depositing, the oil is more and more decolorized. Fish oil may be obtained, of a quality resembling fine olive oil in appearance, by exposing it to the sun, then to the action of chloride of lime, and filtering several times through animal charcoal. The odour is lessened, but not entirely removed.

A simple exposure to the sun for several months determines an abundant deposit, while the oil is clarified and sensibly purified.

If whale oil be brought in contact with caustic ley, employed cold and in small quantities, the decolorization is hastened; the mass separates into two distinct strata; the upper one decolorized, is very fluid and limpid, but always odorous; the lower, which is very small, is a mixture of the alkaline solution, strongly coloured brown, and of all the solid portion of whale oil analogous to margarine. It is not necessary to submit the decanted oil to any other process of purification; in this state it is suitable for all manufacturing purposes, excepting on account of its odour, which is always well defined.

It appears from the experiments of MM. Girardin and Preisser on fish oils, that we at present possess no sufficiently efficacious means of removing their strong and disagreeable odour. The best method, at present, is to submit them either to the action of alkalies, or to the successive action of chalk, steam and sulphuric acid; to suffer them to repose, and filter several times through animal charcoal. We thus obtain a clear oil, less coloured, and of a less repugnant odour; but its want of odour is out of the question.

The refining and purification of fish oils is the more important, since for the last twelve years their importation has constantly increased. Thus, in 1827, there was entered only 3,000,000 kilogrms., (about 6,000,000 lbs.), the greater part of which came from the islands of St. Pierre and Miquelon; while in 1839 the importations amounted to 9,200,000 kilogrms., representing a value of 5,500,000 francs. —*Journal of the Franklin Institute.*

## PREPARATION OF THE OIL OF ROSES.

In a letter addressed from Arabia to M. Landerer at Athens, the following details respecting this preparation are given:—The roses are conveyed into the distilleries, in which there are from three to six copper alembics without any cooling apparatus. The plucked roses are thrown into the retort, and water thrown on to them, with the addition of a large quantity of salt. After two or three days of maceration the distillation is commenced, and is continued until the liquor which passes over has a yellowish colour. The water of roses, removed from time to time, is conveyed, in order that it may cool, into earthern vessels placed in water; various names are applied to it, and it has a different value according to whether it had been collected at the commencement or towards the close of the distillation.

It is the water of roses obtained at the commencement which is employed in the preparation of the oil or otto of roses, and this is the manner in which it is separated:—After having filled with this water some large porous vessels of clay and covered them with linen, they are buried in rows in the earth, where they are left for nine or ten days according to the coolness of the nights. They are covered externally with straw, which is watered in order to keep them as cold as possible. By degrees the rose-water becomes covered with a layer of oil, which solidifies; this crystalline mass is removed, and the water subjected to several similar refrigerations, until not a trace more oil is evident. The water, completely deprived of this latter, is sent to the markets to be sold, or is again employed in the preparation of an inferior kind of oil of roses which is sent to Europe under the name of Oriental Oil of Roses. This latter is found in the bazaars of Constantinople, of Smyrna, &c., and is obtained by agitating the rose-water, the odour of which is still strong, with an oil derived from Africa, and which results from the distillation of the wood of very tall and odoriferous trees (perhaps sandal-wood?).

## HOUSE PAINTING.

(*Continued from page 30.*)

The description of this process might be sufficient to convince every one, that there could be no better mode of rendering the plaster with which the walls of our apartments are lined, impervious to the effects of our changeable and humid climate. In the first place it hardens the surface, and then forms a compact and smooth incrustation, upon which the dampness of the atmosphere can only condense when any sudden change takes place in the temperature. This is often exemplified in stair-cases, where the wall gets so low in temperature during a continuance of cold weather, that when a change takes places, the condensation is so great, that the water runs in streams upon the steps. How then, it may be asked, can any one employ paper-hanging, or any other absorbent mode of finishing, in such apartments? It ought to be well-known, that in such cases the moisture, instead of being condensed and rendered easily removeable, is absorbed and gradually given out in connection with the natural effluvia of glue, rotten paste, and other noxious materials.

In many cases it has been found that this substantial style of painting is too heavy in its effect for ceilings, which require a degree of an aerial lightness, especially in drawing-rooms, boudoirs, and such like apartments. In these cases, therefore, the absorption is stopped by two coats of paint, and when these are quite dry and hard, a coat of what is called distemper colour is applied; that is, white lead ground in water, and diluted with size of the purest kind. In ordinary apartments, fine whiting may be substituted in distemper work for white lead.

The painting of the wood-work of such apartments as are not fitted up with oak or other hard woods, is a process very similar to that employed upon plaster, not only when it is to be finished plain, but also as a ground-work for imitations of the foreign woods now in use: only each of the coats should be thicker, and applied with still more attention to smoothness. The imitating of woods and marbles may be termed, in house-painting, a link between that which has been already explained, and is essentially plain, and that which is really ornamental. It has of late been brought to such perfection, that in some cases, where the real and the imitation wood are brought into juxta-position, it is scarcely possible, even after examination, to distinguish the imitation from the reality. Imitations of marble have, in some cases, been brought to equally great perfection; yet this is far from being so general. But as nature affords her imitators much latitude in the choice of particular tones of colour, great care must be taken, in the introduction of those imitations, that they are not only perfect in point of resemblance to a particular species, but that it be of the tone peculiarly adapted to make up the harmony of the arrangement.

The process of painting imitations of woods is, in the first instance, as already observed, to lay a groundwork of four of five coats of paint, taking the greatest care that no brush marks remain. This requires much more time than applying the same number of coats for plain finishing; and the last coat, instead of being flatted, is composed of equal portions of oil and spirits of turpentine. The shades and grain of the wood are given by thin glazings of, Vandyke brown, terra de Sienna, or umber, according to the kind of wood to be imitated; which colours are ground in water and mixed with smal beer, the tenacity of which is sufficient to prevent i rubbing off by the application of the varnish which immediately follows. All imitations of woods are painted in this way, except wainscot, for which thick substance is requisite, in order that it may receive the impression of an ivory horn comb, by which the peculiar grain of that wood is imitated. The varnish employed upon work of this kind is copal, which, of all the materials used by the painter, is that in which he has most latitude. The price of copal varnish is from 10s. to 42s. per gallon: so here, again, he can suit his materials to the price which he receives for his work.

The imitation of marbles has nothing very peculiar in its mode of execution, being more like actual painting than that employed in imitating wood; and on this account it depends more on natural taste than on mechanical skill.

The ornamental department is likewise making great strides towards its ancient excellence, and, owing to the improved taste of the present age, is beginning to be somewhat in demand. What is meant by the ornamental department, is the decorating of the walls of apartments either by original designs of paneling and borders, or by careful imitations of Raffaelle's arabesques, Watteau's grotesque panellings, and the Pompeian frescos; as well as decorations in imitation of basso relievo, in white and gold, polichrome, and various other styles.

The want of general instruction in the art, and the prevalence of the use of paper-hanging, have tended to retard the progress of ornamental painting; but the former cause is, by the establishment of schools for ornamental design throughout the country, in a fair way of being removed; and the latter will soon give way to the rapid improvement which is taking place in public taste: for paper-hangings being manufactured of size colours, have, in artificial light especially, a crudity and chalky effect, that generally renders them obstrusive and inharmonious.

## METHOD OF SILVERING CAST IRON.

BY MAJOR JEWREINOFF.

By the combination of iron with carbon, cast iron, from the ease with which it melts, and the consequent possibility of taking the finest impressions of form, has come into very extensive application. The art of founding, converts cast iron into enormous arches, columns, cannons, and also into the most delicate bracelets, ear-rings, &c. Unfortunately the moist atmosphere very soon alters the surface of these objects, and it is found necessary to coat them with paint, which gives the cast iron, the colour of which is itself not very attractive, the appearance of mourning. In the present state of the art of founding, cast iron might easily be substituted for bronze, were it not for its sombre appearance, which entirely excludes it. This disadvantage may however be entirely overcome, from the possibility of plating it with silver; in fact, cast iron may be readily silvered, and equally as well as copper and bronze. Some successful experiments which I have made on this subject induce me to give a short description of the method which I have employed. The liquid for silvering is prepared in the following manner:—Cyanide of potassium, prepared according to Liebig's method, is introduced into a stoppered vessel, and freshly-prepared pure chloride of silver, still in a moist state, added; the whole being covered with water and shaken violently for some time at the ordinary temperature. An excess of chloride of silver is taken, and should a small quantity of it remain undissolved, a few pieces more of the cyanide are added after some time, taking care however to avoid having an excess of the latter salt, but always a small quantity of undissolved chloride at the bottom of the vessel. This last circumstance is important, because when the liquor contains too much free cyanide of potassium it is easily decomposed, and moreover does not silver so well; before employing it, it is filtered, and is thus rendered perfectly clear, iron and a little chloride of silver remaining on the filter. I effect the plating by means of a galvanic pair of plates, consisting of zinc and a coak cylinder, which are separated from each other by means of an earthern diaphragm, The pair are placed in a glass vessel containing dilute sulphuric acid, and dilute nitric acid is conveyed into the earthern diaphragm. Experience has shown me that the best mixture for the coak cylinders should consist of five parts by weight of finely pulverized coak, eight parts pulverized coal, and two parts common rye flour. When the cylinders are dry they are placed in earthen crucibles, in the lids of which there is an aperture for the escape of the gases, and are then heated to redness

Those cast iron objects may be most easily silvered which have not been painted, as the removal of the paint from the surface of the metal is somewhat difficult. The cleansed object is immersed in the silver solution, and connected with the zinc pole by means of a conducting wire, and a platinum plate immersed in the liquid at some distance from the object to be silvered, and connected with the coak cylinder. A plate of cast iron, of four square inches surface, is generally completely plated in thirty minutes.—*Bulletin de St. Petersbourg.*

## NEW ZEALAND FLAX.

New Zealand flax is superior to the Baltic hemp. The flax houses are covered with rushes and wire grass, to prevent the rain or damp from penetrating into them, as the flax turns black when saturated. At present it takes tar very indifferently, that substance coming off on the hand when the ropes are hauled over; this is a great defect in running rigging, but experience may produce a remedy for it.

There are a variety of species, principally caused by the climate and soil. Some flax plants to the northward are scarcely six feet high, while to the southward it attains the height of sixteen feet. Portions of flax are to be seen adjoining almost every village; it is of incalculable service to the natives. In its natural state it is called korari or korali; when scraped or dressed, the common or inferior is called mooka; the superior sort hunga hunga, the latter term is but rarely used. The natives make all their valuable apparel of the leaves of this plant, they also manufacture their fishing lines and every kind of cordage, and by splitting the leaves into strips, the fishing nets and sieves are made, simply by tying these strips together; some of the latter are of an enormous size. This plant is also indigenous to Norfolk Island as well as the Chatham Islands. Flax is prepared by the New Zealand females and slaves. The separating of the silky fibre from the flax leaf is thus performed: the apex is held between the toes, a transverse section is then made through the succulent matter at this end with a common mussel shell, which is inserted between that substance and the fibre. which readily effects its separation, by drawing the shell through the whole of the leaf.

Leaves of this plant are generally scraped as early as cut, as the thick gum is enclosed at the lower part of the leaf, rising from either side in a pyramidal form, and adheres strongly when drying. The phormium has been in use many years past, made up into tacks, sheets, braces, stays, &c., and its superiority over hemp in bearing a great strain has been well attested. It is very elastic and strong.

The root of the phormium is fleshy, a tuberiform root-stock creeping beneath the surface of the soil, sending up many tufts of luxuriously growing leaves, from four to twelve feet long, and from two to three inches in diameter. They are green coloured at the base; the inner edge has a furrow, which sheaths the leaf immediately within it, and upon various parts of the surface a gummy substance flakes off in whitish spots; from the centre of these tufts arises a scape, often eighteen feet in hight, bearing several branches, containing a number of beautiful crimson flowers, which contain a saccharine juice much esteemed by the natives. It is a handsome and vigorous plant. It is singular that among the many inventions for the clearing of flax made by European machinists, none has been found to answer the purpose equal to the slow method of scraping it by mussel-shells as used by the natives.—*Illustrated Polytechnic Review.*

## MANUFACTURE OF SUGAR FROM INDIAN CORN.

EXPERIMENTS have been made in the state of Indiana, which seem fully to prove that the stalks of the maize plant may be employed in the manufacture of sugar with much greater advantage than the juice of the beet or maple, and that it almost equals the sugar-cane. It is well known that the sugar-cane, as grown in Louisiana, does not produce above one-third so much saccharine matter as when raised in Cuba and other tropical situations. In Louisiana one acre yields from 900 to 1000 lbs. of sugar; and it appears, from experiments that have been made at Indianapolis and Lafayette, that 1000 lbs. of sugar may be obtained from one acre of corn-stalks. The juice of the corn-stalk contains more than three times as much sugar as that of beet, five times that of maple, and equals, if it does not exceed, that of the ordinary sugar-cane as raised in the United States. By plucking off the ears of corn from the stalks as they begin to form, the saccharine matter of the stalk is greatly increased. Experiments on a small scale have shown that six quarts of the juice obtained from the corn stalk, sown broadcast, yielded one quart of crystallized syrup, which is equal to sixteen per cent., while the same quantity of syrup requires no less than thirty-two quarts of the sap of the maple for its production.

The corn-stalk requires a much smaller degree of pressure than the sugar-cane, and consequently there would be a greater saving in machinery. The whole of the stalk, excepting the extreme top, can be used in the manufacture, which is not the case with the sugar-cane in this country.

The cultivation of the sugar-cane requires much care and attention, and it does not arrive at maturity under eighteen months; while the Indian corn can be raised with the greatest ease, requiring only from seventy to ninety days. The leaves afford excellent fodder for cattle, and the stalks, after being pressed, may be used for the same purpose.

The plan for increasing the quantity of sugar in the stalk by removing the ears, was proposed some time since, but has never been carried into operation. If the manufacture from the maize plant should succeed, it is highly probable that in a few years the United States will import no sugar whatever. In 1840 the import of sugars amounted to 120,000,000 lbs. In 1841, 30,000,000 lbs. of sugar were made from the maple and beet-root in the northern, middle and westward states.—H. CROFT, *Upper Canada.*

## GERMAN METHOD OF DRYING PLANTS.

THE plants are laid between sheets of blotting paper, and slightly pressed for one night. The sheets, containing the plants, are then placed on the bottom of a chip sieve, previously covered with a simple layer of paper; not, however, precisely one above another, but rather beside each other, and in separate layers—these may amount to twelve or fifteen. Then the whole being again covered with a single sheet of paper, a quantity of moist sand, to the depth of two or three inches, is spread over the latter, and the sieve thus prepared placed in a baker's oven, or a drying room, until the plants are perfectly dry; which, according to the state of temperature, and to the greater or lesser watery contents of the plants, will be attained in one or two days. Plants containing a great deal of juice must not be pressed at all; but, after being placed in the paper, at once brought into the sieve, and covered with sand in the manner previously described. All plants dried carefully according to this method, preserve their natural colour, and require only to be left for a short time in a somewhat moist place, and to be pressed afterwards a little more, in order to appear perfectly prepared for the herbarium.

## VARIETIES.

*Elevation and Subsidence of the Earth's Strata.*—In the course of Mr. Lyell's interesting lectures on geology, delivered a short time since, at the Marylebone Institution, he adverted to the principle of elevation and subsidence of the strata of the earth, illustrating that principle by a lucid and scientific history of the manner in which coral reefs were raised in the Pacific Ocean, of the nature of the zoophyte, or animal plant, which deposited the coral matter, and of the general striking features of the geological phenomena to which they gave rise. One amongst the interesting facts mentioned by the learned lecturer was, that those coral reefs increased in proportion to the violence of the breakers of the sea upon them, a violence which neither flint, quartz, nor granite could withstand. Those reefs were reared up by their myriads of little living inhabitants, which were constantly employed in the work of reconstructing and improving their dwellings. In describing the atolls, or ring-shaped reefs, with their lagoons (whose vivid and emerald waters presented a beautiful contrast with the deep blue of the surrounding ocean), the lecturer mentioned that in the varied coloured fishes of these lagoons was found digested coral, which, when dried, was ascertained to approach very nearly in its chemical qualities to the chalk of the Bermuda Islands and other parts of the world.

*Musk.*—It is a well-known fact, that musk becomes finer by exposure to the air without becoming weaker; while that taken from the fresh pods, or preserved for any length of time in a moist state, has an offensive and ammoniacal odour.

*Zinc Milk Vessels Poisonous.*—The following extract will show the danger and the folly of the practice of keeping milk in zinc bowls—a custom which has lately become very prevalent: these articles being sold with the recommendation of a larger quantity of cream being produced, owing to the galvanic action. "I would scarcely have believed says L. Elanes, of Berlin, that zinc vessels would again have come into use for alimentary purposes, as Vauquelin, forty years ago, proved that such were certain, after a short time, to hold a certain quantity of zinc in solution. I have found by experiment, that a solution of sugar which had stood only a few hours in the summer in a zinc vessel, contained a considerable amount of zinc salts. It has often been stated that the cream will separate more easily from milk, if the latter be kept for a short time in a zinc vessel. As, however, it is known that milk will turn acid much sooner than a solution of sugar, it is the more to be apprehended that some zinc will be be dissolved, and such zinc will be the more noxious, as it is well known that even a small amount of zinc will cause spasmodic vomiting."—*Pharmaceutical Journal.*

*Yellow Colour of the Barberry.*—The principal use of the root of the common Barberry (*Berberis vulgaris*) is in dying or staining leather yellow. It is a drug which is beginning to be much sought after, and Mr. Solly was consequently led to inquire whether the substance could not be advantageously obtained from India. The colouring matter is found in the whole of the root, but in the stem it is only deposited round the pith and near the bark; the great bulk of the woody fibre contains no colour; the finest colour is found in the largest stems. The species of *Berberis* are distributed through every part of the globe, and are very abundant in the north of India. Mr. Solly made some experiments on a portion of root from India, and found it to contain about the same quantity of berberine, or colouring matter, as the root of the European species, which possessed an equally good, if not better tint than that obtained from Cologne and Hamburg. As the weight of the colouring matter bears but a small proportion to the ligneous fibre (in the root of 17 per cent.,) it would be advisable to have the wood extracted in India, and the extracts sent over. This could be well effected, the natives being well skilled in preparing extracts, for they are in the habit of using a preparation of barberry medicinally.

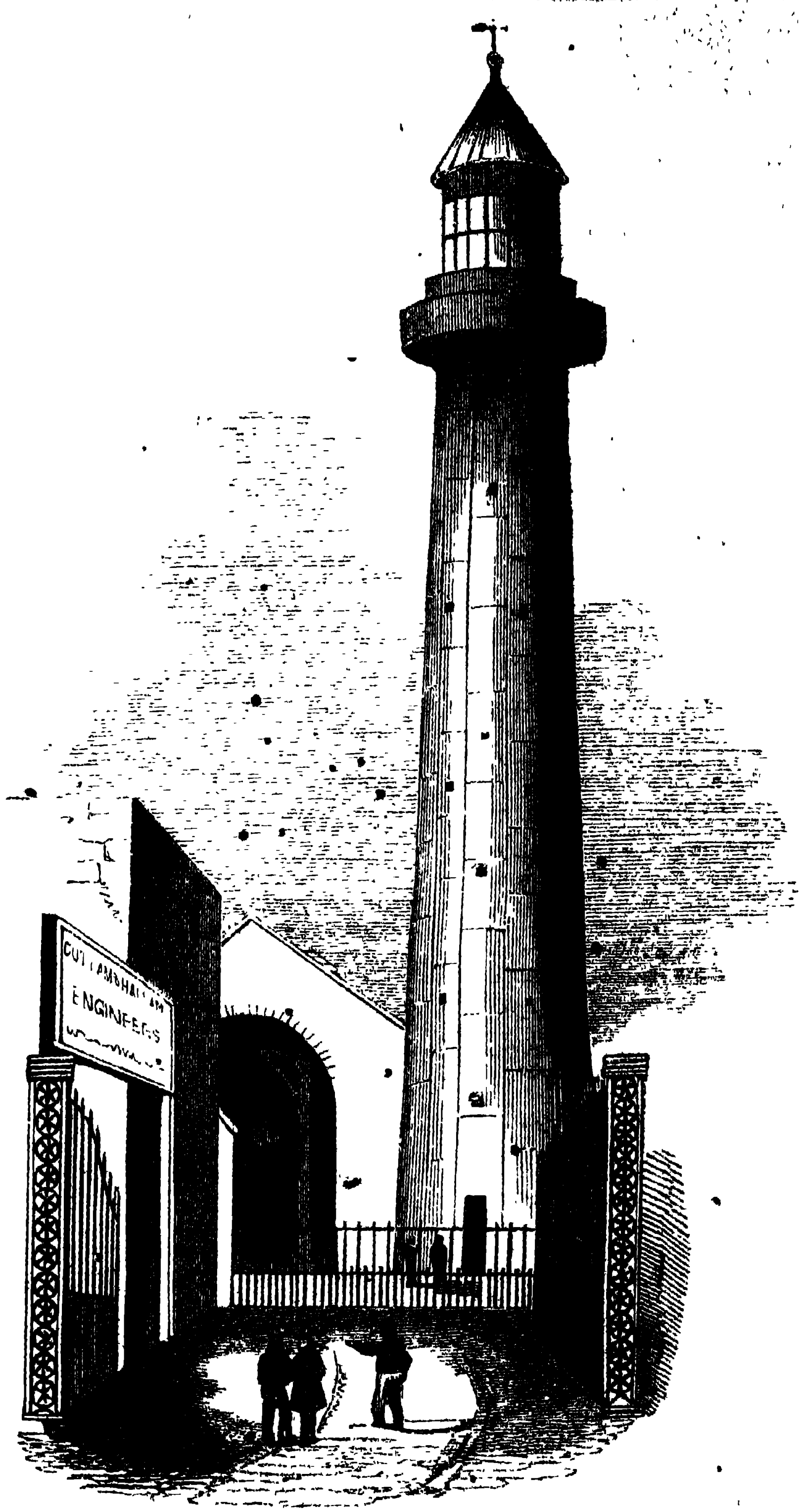
*Curious Statistics.*—M. Hommaire de Hel, has ascertained, by precise calculations, the difference between the level of the Black and the Caspian Seas, by which it appears that the level of the latter is 18 yards 30-00 lower than the level of the former. In ascending the river Wolga, "this intrepid engineer, after surmounting a thousand difficulties solely by his courage and perseverance, made several discoveries. Amongst other facts, he ascertained that the quantity of water flowing out of the Wolga has diminished to a remarkable extent, which diminution has caused a complete revolution in the commercial position of several towns situate on its banks."

*Hops.*—Hops are absolutely necessary for the preservation of beer, but not at all essential for yeast. The flavour is independent of an aromatic essential oil, which is dissipated by boiling, though the bitter extractive is obtained in solution. An infusion, however, will extract the aroma without much bitter principle. Now, a decoction of Hops will not keep long, any more than a decoction of Malt, but they cannot contain very opposite constituents. Hops contain tannin, extractive bitter principle, wax, resin, and lignin; whereas Malt contains resin, gum, sugar, gluten, starch, and hordein. The antiseptic properties of the Hop, therefore, are evident, and, no doubt, after vinous fermentations of the two decoctions, a combination of constituents (notwithstanding the sugar, &c. of the Malt being converted into spirit) takes place and the result is a liquid which will keep for almost any length of time, if preserved from the action of the atmosphere. It is evident, from the common practice of brewers adding the Hops previous to fermenting the wert, that they do not prevent, nor retard vinous, but undoubtedly they retard acetous fermentation; therefore yeast may be made with or without Hops.

*Beautiful Green Colour, without Arsenic.*—Forty-eight lbs. of sulphate of copper and two lbs. of bichromate of potash are dissolved in the requisite quantity of water, and two lbs. of carbonate of potash (pearlash) and one lb. of chalk added to the clear solution. The precipitate is pressed, dried and rubbed to a powder. This colour is not so beautiful as the Schweinfurth green, but is peculiarly well adapted for painting dwelling-rooms and workshops, there being no fear of any poisoning from arsenic.—By varying the proportions a number of different tints of this colour may be obtained.—*From the German.*

*Carnelians.*—The Carnelian is a beautiful illustration of change. This elegant gem embraces every colour, from the pale fine yellow of sulphur to the deepest crimson; its opacity varies from the dull and coarse texture common to other stones, to the exquisite fineness of garnet. But what is it in its state of nature, before it is dragged to the light of day? A dull, worthless, flinty substance, similar to the agate, varying in its colour, and sometimes in its material. The ignorant native of India, who is no geologist—who knows not what philosophy means—but, simply excited by his cupidity alone, abstracts the worthless stone from the earth, and placing it on some elevated spot, suffers it to remain on the surface of the earth for three years, at the expiration of which period, he boils the stone for several hours, in order to expedite the result, and to check its further changes. In the cutting, we acknowledge Carnelian, one of the most becoming and beautiful ornaments of the female sex, although, from its abundance, but held in light esteem. Again, to anticipate the slow operation of natural causes, these uncultivated people inclose the unripe stones in a vessel of earth, and, in this state, expose it to artificial heat; thus, in a few days, the like result is obtained.—*Correspondent of the Mining Journal.*

*Silvering Glass for Mirrors.*—A new discovery has just been patented, which must very greatly affect our commerce with Spain. Glass is not silvered without aid from mercury, at present, as our readers are aware. Silver leaf is rubbed with mercury, a bright amalgam is formed, and the glass is pressed on it; the superfluous mercury drains off, and the mirror is complete. The glass is, in the patent process, washed with a solution of ammonia, nitrate of silver, mixed with oil of cassia and spirit of wine; a few drops of oil of cloves and spirit of wine are then dropped on it, in a few minutes a coloured film spreads over the glass, this is gently wiped away, and a mirror is formed, far superior in polish and beauty to the old process.



CAST IRON LIGHT HOUSE FOR THE WEST INDIES.

## CAST-IRON LIGHT-HOUSE FOR THE WEST INDIES.

By courtesy of the Proprietors of the *Illustrated London News*, we are enabled to present our Readers with the annexed engraving, and quote the accompanying details, of a Light-House of novel material and construction, by Messrs. Cottam and Hallam, the engineers and iron founders. It may be inspected at their factory in the Cornwall Road; and seen from Waterloo Bridge, it has excited considerable interest from the rapidity with which the structure has risen.

The tower is constructed of cast-iron concentric plates, and it is intended, when permanently fixed, for a light-house on the sea shore of the island of Bermuda, in the West Indies.

The extreme height of the whole, from the base to the ball on the top of the lantern will be, when completed, as seen in the engraving, about 130 feet. The outside diameter at the base is 24 feet, tapering upwards to 14 feet, and then springing out to a diameter of 20 feet; so as to form the platform, round the edge of which is fastened a palisade railing. On this platform will be placed the lamp-room, a polygon of 16 sides and about 15 feet diameter.

The tower is divided into seven floors, exclusive of the platform or gallery. The communication between the base and the first floor, about 20 feet from the ground, is by a spiral staircase, winding round the column in the centre. The space between the staircase and outer plates forming the tower, will be a solid mass of brickwork and concrete.

At this floor the interior brick casing is reduced to a thickness of 18 inches, and is carried up in a perpendicular line, leaving a circular room of 18 feet in diameter. The spiral staircase is then carried round the interior circumference of this floor to the second floor, which has likewise a casing of brick. The spiral staircases then pass from floor to floor in the same manner, until they reach the interior of the lamp-room.

The whole structure is to be lighted by 36 port-holes, each fitted with a pane of strong plate glass in the centre, and attached to the shell of the tower by hinges.

The tower is formed of 135 plates; the base plates have a surface of about 56 square feet; the plates decrease in proportion to the cone; each plate has a flanch or edge projecting inwards, and is joined together in the manner seen in Fig 1.—a horizontal section of a pair of plates, showing the joint. Fig. 2.—a Sectional Elevation: the screws and nuts hold the plates together, and the hollow space between the flanches is filled with iron cement, and forms a perfectly air and water-tight joint.

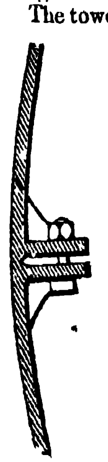


Fig. 1.

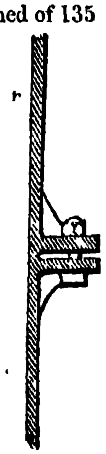


Fig. 2.

The three upper floors following those cased with brick, have an interior casing of wrought iron, with an air space between the plates forming the tower, and the casing with mouldings and pilasters of oak.

In considering the many useful purposes to which iron is now applied, there is not one that can be more beneficial than its application to the construction of light-houses. How many of the colonies of Great Britain are surrounded by dangerous reefs and rocks, causing the destruction of numerous vessels yearly. Now these dangerous situations might be made comparatively safe by a light-house; and it is not generally known that a commodious and permanent structure of this kind can be made in England, and easily transported, at a comparatively trifling cost; whilst it will require little more foundation than levelling the spot on which it may be placed by a small number of men, and thus be constructed and set up within a few months.

---

## POTTERY AND MOSAIC WORK.

Mr. Boothe, of Burslem, Stafford, has patented the following improvements in Pottery and Mosaic work.

This invention consists in improvements in forming designs on pottery, and producing the combinations known by the name of mosaic work.

In order to produce colored designs on grounds of different colors (such as a black design upon a white ground, or (*vice versa*), the designs are first made from a mould, in the same manner as the ordinary "figuring" process; they are then laid in the moulds used for forming the piece of ware, and the ground colour, being poured on, will cover the back, and fill up the spaces between the different parts of the design; on leaving the moulds, the design will appear quite clear and distinct on the surface of the piece of ware. This process is applicable to the manufacture of tiles, bricks, quarries, panels and slabs of various shapes, &c.

Another method consists in cutting the design in paper, parchment, or any similar pliable substance, and laying it in the moulds, the halves of which are then fastened together, and the ground color is poured in; after which, the paper or other material is removed, and another color is poured in, to form the device, and the inner lining of the ware. When it has attained the desired thickness, the remaining liquid is withdrawn, and, after standing for a short time, the piece of ware will leave the mould with all the colours perfectly distinct upon its surface.

To produce a raised pattern, of a different colour to the ground of the piece of ware, the design is carved, or otherwise produced, on the inside of the plaster of Paris moulds used for hollow ware, and filled in with the composition of which the raised figures are intended to consist; the halves of the mould being then fastened together, the slop that is to form the ground is poured in, and allowed to stand until the composition adhering to the mould, is of the thickness required for the body of the ware; the remaining fluid stuff is then withdrawn in the usual way. If the ground is of an expensive color, the slop only should be allowed to remain a sufficient time to give a very thin coating to the mould; it is then drawn off, and some other slop, of an inferior quality, is poured in, to form the inner lining of the piece of ware.

When designs of a mosaic or like character are required, the pattern if formed of compositions of various colors, and fixed upon the inside of the mould; the halves of the mould are then fastened together, and slop, of a suitable color for the ground-work (such as black or blue), is poured in; as soon as a sufficient thickness of clay has adhered to the mould, the remaining fluid stuff is withdrawn.

## ILLUSTRATIONS OF MECHANICAL DRAWING.

(*From the Glasgow Practical Mechanic.*)

It is unnecessary to enter upon any particular description of instruments for mechanical drawing. Suffice it to say, that the most essential appurtenances to the drawing board and T square, are a pair of plain dividers, or compasses, for marking distances, a pair of compasses with a moveable leg, which may be replaced by an ink-pen or pencil leg, as wanted, for the purpose of describing circles of a larger radius,—ink and pencil-bows, for the description of smaller circles: and a distinct drawing-pen for straight lines. As for pencils, the H B (hard and black) quality is usually recommended; but it is too soft to retain long the fine point usually required for the correct execution of mechanical drawings; and besides, the softer pencils are the more unctuous, and therefore the less ready in taking on ink lines than the harder. F-pencils work pretty well upon smooth paper; but for drawing paper, of a thick and rougher quality, especially after having been damped and stretched, H H and even HHH-pencils, (of two or three degrees of hardness) are better suited to retain their sharpness. They are further recommended by the lightness and delicacy of the lines that may be thrown off by them; for where a pencil-drawing is made, with the view of being done over with ink-lines, the excellence of these lines, as well as the readiness with which they are produced, depends much upon the quality of the pencilling.

In constructing preparatory pencil-drawings, then, it is advisable, as a rule of general application, to make no more lines upon the paper than are necessary to the completion of the drawing in ink,—and also to make these lines just so dark as is consistent with the distinctness of the work. In regard to the first idea, it is of frequent application, in the case, for example, of the teeth of spur-wheels, when, in many instances, all that is necessary to the drawing of their end-view in ink are three circles, one of them for the pitch-line, and the other two for the tops and bottoms of the teeth; and again, to draw the face-view of the teeth, that is, the edge view of the wheel, we have only to mark off by dividers, the positions of the lines which compose the teeth, and draw four pencil-lines for the two sides, and the top and bottom. Many other abbreviations will suggest themselves to the practised draughtsman in the course of his work. And here we cannot help remarking the inconvenience of that arbitrary rule, by which it is sometimes insisted that the pupil shall lay down every line in pencil that is to be done, before drawing it in ink. It is often beneficial to ink in one part of a drawing, before touching the other parts at all: it prevents confusion, makes the first part of easy reference, and allows of its being better done, as the surface of the paper inevitably contracts dust, and becomes otherwise soiled in course of time, and therefore the sooner it is done the better.

We remarked also that the pencil lines ought to be just so dark as to render them distinct, for the more lightly they are executed, the fitter they are to receive the ink. A little practice, and a steady hand, will secure the end proposed. The pencil needs not be held tightly; a slight hold, without slackness, is all that is wanted, inclined a little to the sides towards which the line is drawn. Besides a drawing pencil for straight lines, it is well to have one for sketching in small circles, not requiring the regular application of the bows, as the rounding and filling up of corners, ends of bolts, &c. The straight-line pencil, to be properly cut for use, should in the first place be cut down to the flat side of the lead, in a plane nearly parallel to its axis; then cut away, on the opposite side, to a bevel considerably inclined,—and cut likewise, transversely, at equal angles. The lead being thus laid bare, should be cut down gradually on the three inclined sides, till brought to a fine edge, viewed laterally, and a flat round point in the other aspect. The less inclined side, when applied to the square, admits of the point being brought close to the edge, by which the line is more certainly drawn,—and the roundness of the point evidently enables the pencil to stand longer, before requiring mending. The sharpening of a sketching pencil, is simply conical, and brought to a fine point. To produce a good working pencil, a sharp knife is indispensable; if the knife be blunt, the point will invariably break away before it is properly brought up.

India rubber, or caoutchouc, is the ordinary medium for cleaning a drawing, and for correcting errors in the pencil. That substance, however, tends to destroy the surface of the paper; and by repeated application, it so ruffles the surface, as to spoil it for good drawing, especially if ink-shading or colouring is to be afterwards applied. It is much better to leave trivial errors alone, if corrections of the pencil may be made alongside without material confusion:—time enough to clear away all superfluous lines when the inking is finished.

To draw lines in ink with the least amount of trouble to himself, the mechanical draughtsman ought to take the greater amount of trouble with his tools. If they be well made, and of good stuff originally, he ought carefully to preserve their working parts from injury, keep them well set, and above all to keep them scrupulously clean. The setting of his instrument is a matter of some nicety, for which purpose a small oil stone is convenient. To dress up the tips of the blades of the pen, or of the bows, as they are usually worn unequally by continued usage, they may be screwed up into contact, in the first place, and passed along the stone, turning upon the point in a directly perpendicular plane, till they acquire one identical profile. Being next unscrewed, and examined to ascertain the parts of unequal thickness round the nib, the blades are laid separately upon their backs on the stone, and rubbed down at the points, till they be brought up to an edge of equal fineness. Being screwed together again, it is well to pass them once or twice more, perpendicularly, to bring up any fault; and to retouch them also on the outer and inner side of the blade, to remove barbs that might arise; for which last purpose, too, they should be drawn across the palm of the hand.

To keep the blades of his *inkers* clean, while using them, is the first duty of a draughtsman who is to make a good piece of work. To facilitate this, the Indian or Chinese ink, which is commonly used for line-drawing, ought to be rubbed down in water to a certain degree—a mean between depth of blackness and consistency;—avoiding, on the one hand, conveying a sloppy aspect to the drawing by lightness of shade; and, on the other hand, making the ink just so thick as to run freely from the pen. This medium degree is sometimes ascertained by drawing up the fluid ink on the side of the pallet, and judging of it by the appearance; but a better method is, to take up a little of it in a hair pencil, after mixing it, and try it on white paper. The shade may thus be correctly ascertained; and experience will lead each for himself to the most proper proportion of ink and water. By rubbing down a stick of ink in water on the pallet, it is apt to crack and break away in splinters at the point. This may be done away, by varying from time to time the position of the stick while being rubbed, so as to round it away. Nor is it advisable, for the same reason, to bear very hard, as the enamel of the pallet, besides, is subject to wear. When the ink, on being rubbed down, is likely to be for some time required, a considerable quantity of it should be prepared, as the water continually vaporises: thereby it will remain for a longer time in a condition fit for application. It is convenient, also, to use two hair pencils, fixed on the ends of a slip of wood—one of them a water brush, and the other for lifting the ink into the pen; which is a much better process than the awkward manner of wetting the pen in the mouth, and then levelling it in the ink: and besides, in using a brush, the ink may be re-mixed on each occasion, as it is liable to deposit a sediment.

[*To be continued.*]

## PROGRESS OF AMERICAN MANUFACTURES.

In Simmonds's *Colonial Magazine*, for the last month, will be found proofs of the untiring enterprise and industry of the Americans, which go far to prove the energy and perseverance they are bestowing upon the improvement and progress of new manufactures, as may be seen in these paragraphs culled from the journals of the United States.

*Clocks.*—A correspondent of the *Hartford Journal*, from Bristol, writes "The amount of capital employed in this branch alone is some three or four hundred thousand dollars, and the business gives employment to nearly four hundred mechanics. The manufacture of clocks has greatly increased within the last five years, although, for fifteen years prior probably one million were made and profitably disposed of. We have every facility for manufacturing, and the vast improvements recently effected in machinery have done wonders for the business. The division of labour is well understood, and carried out to a nicety, otherwise it would be impossible to manufacture and afford brass mahogany cased clocks for the low price of three, four, or five dollars each, which is now done. More than ten thousand have been sent to England alone within the last eighteen months.

According to the *Newark Advertiser*, the number of wooden clocks manufactured in Connecticut last year was five hundred thousand. The number will be greatly increased this year, in consequence of a foreign demand. Within an hour's ride of Hartford, a thousand clocks are finished daily.

*Needles.*—A correspondent of the *Rochester Democrat*, thus describes a factory to make needles, established at Haverstraw, Rockland County, New York. "I saw needles in various stages of the process by which they are made from the wire, prepared on the same premises. The wire is at first cut into lengths which will make two needles each. The depressions where the eyes are to be made, and where the grooves are to be found on the finished articles, are stamped in both needles by a single stroke of the machine, with which a single hand can turn off thirty thousand in a day. It is then turned over to another boy, who with a machine punches the eyes, and another separates the two needles, and smoothes away any irregularities. The eye of the needle is then bored by another process, which renders it so smooth that it will not cut the thread. After this, a man grinds a handful at a time on a common grindstone, holding them in his left hand, and giving them perpetual rotary motion with the right, so that they are made round and sharp. They are now to be 'case hardened' and finally burnished, all of which is done by simple processes, in which immense numbers can be subjected to the operation at the same time."

*Pins.*—The new tariff imposed for the first time a decidedly protective duty on pins, equal to fifty per cent. There were but two pin-making establishments in the country when the law was passed, each of which had been carried on for years without making a single dividend; one certainly had made none. Since then this concern has paid its first dividend of two and a half per cent.—the sole return on a nine years' investment—and is now driving a good business, and likely to do well. It is selling pins fifteen per cent. cheaper than it did before the tariff was passed, and making a vastly superior article.

"We are informed," says the *New York Evening Post*, "that but a small quantity of English pins are imported, and only about fifteen cases were passed through the Custom house this season. In consequence of this, the demand for American pins has greatly increased.

*American Bunting* is now made at Framingham, Mass., 500 yards daily, quite equal to the foreign article. Heretofore all the bunting under which the American navy has fought, and which has been displayed by their merchant vessels, has been the manufacture of foreign countries.

*Match Making.*—This business is said to be now worth 1,000,000 dollars in the United States. A few years since they were all imported from Europe. Now the Americans export several hundred thousand dollar's worth to the West Indies and South America.

## MANUFACTURE OF PAPER.

Mr. Brooman has taken out a patent, the specification of which is to be found in the *Mechanics' Magazine*, for the manufacture of paper, cordage, matting, and other textile fabrics, from vegetable substances not before made use of for that purpose, as also for the application of the materials to the stuffing of cushions and mattresses.

The invention consists in manufacturing paper, cordage, matting, and other textile fabrics, from the convolnuli of the cissus genus or family of plants which abound in the West India Islands, in English French and Dutch Guiana, the Brazils, on the coast of Africa, and other parts, instead of from linen or cotton rags. All the plants of this order may be used, but those known at Guadaloupe, vulgarly as *oua oua*, or *baba*, which is the *mimosa scandens* of Linnæus; the *guidandina bandue* which is well known at Guadaloupe by the name of *yeux a bourrique*, or *yeux a bœuf*, and the *ledum*, or marshbindweed, are most suitable.

The following is the manner in which these vegetable matters are converted into paper. The stems are first stripped of the bark or rind, and then beaten or bruised till the fibres are separated from one another. The fibres are next dried, in order to extract the sap, and afterwards boiled for three or four hours with a suitable quantity of American potash. They are next washed, and after that bleached by immersing them in hydrate of chlorine for three or four hours, or by any other approved means of bleaching. If a still greater degree of whiteness is desired than has been obtained by the preceding operation, the fibres are boiled with soda, then washed, and, lastly, steeped in water saturated with slack lime. The fibres, after being thus bleached or whitened to any desired degree, are carded by a metal comb, and then reduced to a pulp by pounding or beating. The pulp thus produced is to be afterwards manufactured into paper in the usual way, and it will be found at least equal to that obtained from linen or cotton rags, and it may be used, either by itself for the manufacture of paper, or in combination with rag pulp, or any other material suitable for the purpose.

The bark which has been stripped from the stems, as aforesaid, and which is of considerable thickness, may also be manufactured into paper pulp of a good quality by the same processes as before described, provided care is taken to detach from it in the first instance the epidermis or outer covering.

Another class of vegetable matters not heretofore made use of for the manufacture of paper, &c., but from which a good paper may be nevertheless made by the before-described processes, consists of the plants known in the West India Islands by the name of *herbes coupantes*, and also the bark of the West Indian pear tree, *poirier*, only these substances need not be subjected to the carding process by the metal comb before reducing them to pulp, but may be thrown into the boilers as they come to hand, together with a small quantity of soda or potash.

To make cordage, matting, and other textile fabrics, the plants, after being reduced to filaments as before described, must be first soaked and submitted to the same processes that hemp and flax undergo when used for similar purposes.

Secondly. The invention consists in applying the fibres of the plants aforesaid to the stuffing of cushions and mattresses. All that is necessary for this purpose is to card the fibres after they have been treated in the same way as for the making of paper. No bleaching or decolouring process is requisite.

The claims are, firstly, to the manufacturing in manner before described of paper, cordage, matting, and other textile fabrics from the several vegetable matters before specified. And, secondly, the application of the said vegetable matters in the manner before described, to the stuffing of cushions and mattresses.

## WROUGHT IRON LATTICE BRIDGE.

G. W. HEMANS has lately constructed a peculiar wrought-iron Lattice Bridge, on the line of the Dublin and Drogheda Railway, and described the same to the Institution of Civil Engineers.

This kind of bridge is stated to have been first used in America, where, timber being so abundant, the lattice sides are formed of that material, and consist simply of planks three inches thick, crossed so as to form deep beams, secured with oak trenails at all the intersections.

The bridge is situated about three miles from Dublin, over an excavation of 36 feet in depth; its span is 84 feet in the clear, and the two lattice beams are set on edge parallel to each other, resting at either end on plain stone abutments built in the slope. These beams are 10 feet in depth, and are formed by a series of flat bars of wrought-iron, 2½ inches wide, and ⅜ inch thick, crossing each other at an angle of 45°. At a height of 5 feet 6 inches above the bottom edge, transverse bearers are placed, formed of ¼ inch angle-iron, 6 inches deep, and set 2 feet apart, similar to the cross ties now used for the decks of iron steam vessels, and upon these the planking for the roadway is fastened.

The author states, that some deflection or sagging of the lattices was expected, and was provided for by constructing each of them with a camber or gradual curve from the ends, amounting to 12 inches in the centre, but that far from such being the case, they did not sink even when heavy weights passed over them.

The total cost of the bridge, including the masonry of the abutments was £510.

Major-General Pasley has seen and approved of the bridge; it appeared to be on a good principle, and was well constructed. He understood that it had been Mr. Macneil's intention to have a model made of a viaduct of 230 feet in length, with a central span of 140 feet, which he had designed for carrying the Dublin and Drogheda Railway across the Royal Canal in an oblique direction, but he now considered that the bridge which had been described was better than a model; and as it had borne, with only a slight deflection, a loaded waggon weighing 22 tons, and all other tests to which it had been submitted, he had decided upon building the larger bridge upon the same principle.

Captain Moorsom thought that the bridge was too expensive, and that if the lattice sides had been 8 feet 6 inches in depth, they would have been quite strong enough. In the timber bridges of the same construction in America, any tendency to either flexibility or buckling was obviated by placing several ranges of lattices side by side, and the custom of roofing the timber bridges of that country, also gave additional strength laterally. The timber bridges on this principle which he had constructed on the Birmingham and Gloucester Railway (one of which was 100 feet span, and others between 90 and 120 feet span), varied in cost from £4 to nearly £6 per running foot, according to the span, the larger spans being proportionally less expensive than the smaller. Materials and labour were dear at the time of constructing the bridges alluded to.

## THE AUTOMATON CALCULATOR.

MR. WERTHEIMBER has exhited to the Institution of Civil Engineers, several modifications of the "Automaton Calculator," invented by Dr. Roth; and has exemplified their practical use, by performing, with great rapidity, calculations in all the simple arithmetical rules.

The machine for performing addition, multiplication, and subtraction, consists of a narrow oblong box, with a metal plate on the top, which is divided into nine indexes, and semicircular notches; the first six, from left to right, serve for the numbers, from hundred thousands to units; the three last are appropriated to shillings, pence, and farthings. Round each index are engraved figures, from 0 to 9, and the semicircular notches contain teeth, which correspond with the figures. Under each notch is a circular hole, and in these, the result of the calculation appears, at the end of the operation.

The mode of using the instrument is very simple; it is performed by inserting a metal point in the teeth of such figures in the indexes, as are required to be brought into action, and drawing each one down to 9; the result is then read off from the circular opening in which it appears recorded.

The machine for division, and for performing more complicated calculations, is circular and much more bulky.

Mr. Wertheimber showed the interior of the machine, and explained, that its action was produced by a simple combination of toothed wheels and springs, so contrived as to render an error in the result impossible.

He then gave a short historical sketch of the various attempts at constructing calculating machines, noticing:—

First, the Abacus of the Romans, and the calculating boxes of the Chinese and the Russians.

Secondly, The calculating rods, two of which, being each divided into equal parts, from 0 to 100, were used for addition of two numbers, by placing the first number on one scale opposite 0 on the other, and opposite the second number would be the result of the calculation. The operation of subtraction was directly the reverse of that for addition. Several modifications of these scales were introduced by Perrault, in 1720; Poetius. in 1728; Perègre, in 1750: Prahl, in 1789; Grüson, in 1790; and Güble, in 1799

Thirdly, The inventions of Napier, the "Virgulæ Napernianæ," the "Multiplicationis promptuarium," and the "Abacus Arcalis," in 1617; then the plans of Caspar Scott, in 1620; Demeam, in 1731; Lordan, in 1798; Leopold, Petit, and others.

Fourthly, The improvements in Gunter's Scale, by Wingate, in 1627, which were modified by Milburne into the present sliding rule, in 1650, and still further improved by Seth Partridge, in 1657.

These contrivances gave rise to the formation of the more important machines of Blaise Pascal, in 1640; Sir Samuel Moreland, in 1666; Lepin, in 1725; Hillorin, in 1730, and Gersten, in 1735; this latter was presented, like that of Leibnitz, to the Royal Society of London.

Several other attempts at calculating machines, most of which were failures, were then noticed, until 1821 when Mr. Babbage undertook his large machine, which he completed as far as forming a progression up to five figures.

Upon these examples, Dr. Roth is stated to have worked. and the result is shewn in the simple instrument which he has produced, and which has been extensively used in public offices and banks, where it is found to be very useful.

It has also been adopted as a counter, or register of the number of strokes, or of rotations of machines, and answers very well for that purpose.

## IRON STEAM VESSEL, GRANTON.

THIS fine example of the adaptation of iron to naval architecture, was launched upon the Forth, from the building yard of Messrs. J. B. Maxton and Co., on the 7th of March last. She is intended to ply upon the ferry between Granton and Bruntisland, and is one of two vessels built by the same firm for that station. We have had the pleasure of inspecting both vessels, and must observe, that in point of strength, they are not surpassed by any iron vessels as yet afloat. The keels are of the form patented by Mr. Gladstone, and the first, we believe, used in Scotland. The ribs are of strong angle iron, eighteen inches apart, to which the plates are firmly rivetted. The bottom is stiffened by cross plates from rib to rib, and four strong keels running fore and aft on top of these, an arrangement which seems to us highly judicious, in vessels which may be expected occasionally to touch the ground. The decks are supported by strong T-shaped iron beams, three-feet apart; and the plates from stem to stem are joined edge to edge, and flush rivetted so as to present quite a smooth appearance. The stems are of the clipper form, with full length figure heads; the length of keel is 110 feet, and breadth of beam 20 feet. To these dimensions the proportions are very excellently adapted to vessels in which stiffness and great strength are required. The engines are also made by Messrs. Maxton and Co., are highly creditable specimens of engineering. Each vessel is fitted with a pair of 40 H. P., the design, we believe, of Mr. J. Maxton. The owners are the Duke of Buccleuch, and Mr. Gladstone.

## SUBSTITUTES FOR WHALEBONE.

MR. DAVIDGE, of Greville-street, Hatton-garden, has patented the following improvements in manufacturing certain materials as substitutes for Whalebone.

These improvements consist in the application of strips of metal, either rolled, drawn, or twisted into tubular forms, for various purposes to which whalebone is now applied; and also in suitable machinery for forming the same into tubes.

The advantages to be derived from the application of twisted strips of metal or metal tubes over the use of whalebone, are elasticity, durability, lightness, and economy; and the principal objects to which they may be applied, are riding and other elastic whips; whip-stems, as intermediate pieces between the thong and the handle; umbrellas and parasols, as the framing over which the cotton, silk, or other fabric is distended; stems for feathers, walking-sticks, fishing-rods, and ramrods; the flexible stems of brushes or apparatus for sweeping flues or chimneys; as substitutes for the pieces of whalebone or cane employed for stiffening the caps worn by boys and men, and a variety of other useful purposes.

Various modes of forming the tubes, either by twisting, rolling, or drawing the strips of metal, and a variety of mechanical contrivances for effecting these objects, may be suggested; but the method preferred by the patentee, is forming the tubes of strips of metal, by twisting the said strips helically or conically round a mandril in the following manner: Sheet-metal for forming the tube is cut into strips of the desired breadth, according to the stiffness intended to be given to the tube, and these strips are then twisted round a mandril. They are afterwards drawn several times through "draw-plates," in order to bring them to the required diameter: they may be passed through one, two, or more pairs of grooved rollers, and by altering the shape of the grooves therein, the tubes can be made to assume a circular, oval, square, or any other desired form. When this operation of drawing or rolling has been effected, the heliacal twists are in a compressed state, and only shew a space between them, when the tube is bent out of a straight line. The tube is then hardened and tempered, great care being taken to keep it straight, and if required, it may be turned and polished in a lathe, or ornamented in any other manner. It should be remarked, that the length of the strip of metal must be according to the length of the tube required, as no joining of the strip of metal can be effected, either during the operation of making the coil or afterwards; and the circumference of the mandril must not be less than the breadth of the strip of metal intended to be used.

## THE CANABIC COMPOSITION.

Mr. B. Albano has exhibited to the Institution of Civil Engineers, a collection of specimens of a new material for architectural decoration, which is called the 'Canabic' Composition; its basis, he explained, was hemp, which, after being amalgamated with resinous substances, and undergoing careful preparation, was worked up into sheets of considerable dimensions. The ornaments were produced in very high relief, and with great sharpness in the details, by subjecting these sheets to compression between metal dies under powerful presses; they were thin, were less than half the weight of papier-maché ornaments, and possessed an amount of elasticity, which was advantageous in adapting them to the walls of houses; yet they were so hard as to bear the blow of a hammer, and resisted the action of heat and cold and of the weather, without change of form. The composition had even been used on the continent for covering roofs, and in those situations had remained uninjured.

The invention was of Italian origin, and had only recently been so extensively brought into use, as to justify its being introduced to the notice of the Institution.

Mr. Albano promised on a future occasion, to give a full account of the machinery used in the process, as soon as it should have been brought into active operation in this country; at present, the ornaments were imported from France, but even with that disadvantage, their price was from ten to twenty per cent. under that of any other material used for a similar purpose.

## IMPROVEMENTS IN GLASS.

Mr. Apsley Pellatt, of the Falcon Glassworks, Blackfriars, whose many improvements in the manufacture of glass are already favourably known to the public, has recently taken advantage of a principle ingeniously defined by Professor Cowper, of King's College, and by which the latter gentleman, by successive layers of transparent pasteboard, produces complimentary colours, the same results being obtained by Mr. Pellatt by the pressure of a block of solid coloured glass in an ornamental mould; where the glass is thinnest and the mould is pressed the deepest there is a light tint, and each tint varying according to the thickness of the glass, until, in its thickest parts, the complimentary colour is obtained. Thus, in a puce or purple, while in its thinnest parts the pattern is a beautiful light violet, the colour and tone varies until in the less transparent parts it approaches to a deep rich green—the complimentary colour of purple. This discovery is at present carried no further than in the formation of panes of ornamented glass for the illumination in colours of large windows; and as the process does not involve expense or require complicated machinery to carry it out, this new style of window decoration will be brought within the reach of most classes. There are some specimens of what has yet been done in this way at the exhibition of the decorative works at the St. Jame's Bazaar, although not mentioned in the catalogue. In these, however, the complimentary colours—the most remarkable feature in the adaptation of a philosophic discovery to a useful purpose—are scarcely perceptible, from the angle or sufficiency of light not having been studied in placing the frames containing the specimens.

## POWER REQUIRED TO WORK MILL-STONES.

A steam-engine of 23½ horses' power, works two pairs of flour-stones of 4 feet 8 inches diameter, two pairs of stones grinding oatmeal, of the same diameter as the above, one dressing-machine, one pair of fanners, one dust-scree, and one sifting-machine, which takes very little power to work it. One of the flour-stones makes eighty-five, the other ninety revolutions per minute. 120 turns per minute is the speed of one of the stones for grinding oatmeal, and 140 revolutions per minute is the speed of the other. At the time the diagram was taken, the steam-engine was about burdened: the whole of the machinery was working, and the stones, &c., were in good order.

A steam-engine of 26·5 horses' power works two pairs of flour-stones, one dressing-machine, two pairs of stones grinding oatmeal, and one pair of shelling-stones. The flour-stones, 1 pair of the oatmeal-stones, and the shelling-stones, are 4 feet 8 inches diameter. The diameter of the other pair of oat-meal stones is 3 feet 8 inches; 7 feet 6 inches is the length of the cylinder of the dressing-machine, and 20 inches is its diameter. The flour-stones make 87 revolutions per minute, and 111 revolutions per minute is the speed of the oatmeal-stone of 4 feet 8 inches diameter. The shelling-stone, and the small oatmeal-stone, revolve at a speed quicker than 111 revolutions per minute. At the time the diagram was taken, each pair of flour-stones was grinding at the rate of about 5 bushels an hour; each pair of oat-meal stones, about 24 bushels in the same time; and the shelling-stones were shelling at the rate of about 54 bushels an hour. In addition to the machinery above-named, the fanners and scree were of course working.

8·65 horses' power works one pair of oatmeal-stones of 4 feet 6 inches diameter, and one pair of flour-stones 4 feet 8 inches diameter. 100 revolutions per minute is the speed of the oatmeal-stone, and the flour-stone makes 89 revolutions per minute. The oatmeal-stones were grinding about 36 bushels an hour, and the flour-stones about 5 bushels in the same time.

The same steam-engine, when working to a power equal to that of 12·028 horses, works one pair of flour-stones 4 feet 8 inches diameter, and one pair of stones 4 feet 8 inches diameter, grinding beans for cattle. The flour-stone makes 89 revolutions per minute, and the other stone makes 105 revolutions in the same time. The flour-stones were grinding 6 bushels an hour, and the other pair of stones were grinding about 6 bushels an hour.

When this steam-engine was working to 18·186 horses' power, it was about burdened, and it then worked one pair of flour-stones of four feet eight inches diameter, one pair of stones of four feet, eight diameter grinding beans for cattle, and one dressing-machine having a cylinder of 19 inches diameter. The flour-stone made 85, and the other stone made 100 revolutions per minute. The speed being slower, the quantity ground by each pair of stones per hour was consequently a little less than stated in the last paragraph. The dressing-machine was doing about 24 bushels an hour. There were no fanners or screes in motion when this experiment was made.

Taking another diagram, when the steam-engine was working two pairs of flour-stones of 4 feet 8 inches diameter, the speed of both stones was 89 revolutions per minute. The steam-engine in this case worked to a power equal to that of 9·69 horses. —*Whitlaw's Description of his new Water-Mill.*

## LINDLEY'S PATENT COFFIN.

THE time must arrive when "each in his narrow cell for ever laid" must be, and the respect which we owe to the remains of those whom we have loved demands that they should remain unmolested by sacrilegious hands, and as uninjured as the destroying hand of time will allow. Amongst the ingenious inventions of the day is a coffin, that has been patented by Mr. Lindley, which offers a security from those chances, and almost those changes to which all that exists on earth is subject, and in which may repose when once inurned the bodies of the deceased: so carefully has the patentee arranged its different compartments, that even the ghost of the royal Hamlet could scarcely here "burst its cerements" and revisit the glimpses of the moon. Beyond this case, the receptacle is valuable from its construction, preventing the concentration of those gaseous exhalations which are not only offensive but deleterious, which are destructive to the living, and are often the unsuspected cause of numerous diseases. Mr. Lindley has exhibited considerable ingenuity in his invention, and deserves to have attention bestowed upon the result of his industry.

The "Patent Coffin" is of the usual form, made of the best quality of elm wood, with an inner lid and plate glass let in so as to show the whole or part of the body; this lid is temporarily put on loose over the corpse, immediately after it is placed in the coffin, the object being to prevent the atmospheric air affecting the body, thus preventing the disagreeable effluvia that is invariably found to arise from those in common use. Another improvement is the introduction of two stop-cocks, air-tight, to which are attached, by the means of a screw to screw on and off, two India-rubber tubes (if necessary to be used) to draw off the mephitic gas that is generated after death. There are also three straps fixed inside with buckles to prevent the body shaking about or being disfigured in removal from the country or abroad; the whole is made complete with an external solid lid.

These advantages the patent has over the common style every care being taken to render the joints air-tight, which, by trials and constant study has been accomplished; and by the use of composition inside, the wood itself is made impervious to the air, which never has yet been accomplished, thereby totally doing away with the risk of contagion from fevers.—*Illustrated Polytechnic Review.*

## VARIETIES.

*Electro-Plating and Gilding.*—Mr. E. Tuck has taken out a patent for plating. He employs either the sesqui-carbonate or the bi-carbonate of ammonia as one of the ingredients in the solution. He varies the salt of silver according to the nature of the metal or alloy to be plated; for the German silver he uses the sulphate of silver; for the superior kind and for copper, he uses the cyanide of silver. He prepares a solution of seventy parts by weight of bi-carbonate of ammonia; and to this he adds one hundred and fifty-six parts by weight of sulphate of silver, or else one hundred and thirty-four parts of cyanide of silver, these being equivalents; and he boils the liquor till the salt of silver is entirely dissolved. He varies the strength of the solution according to circumstances; the strongest he has used contained half an ounce of bi-carbonate of ammonia with one hundred and seven grains of sulphate of silver to a pint of water.

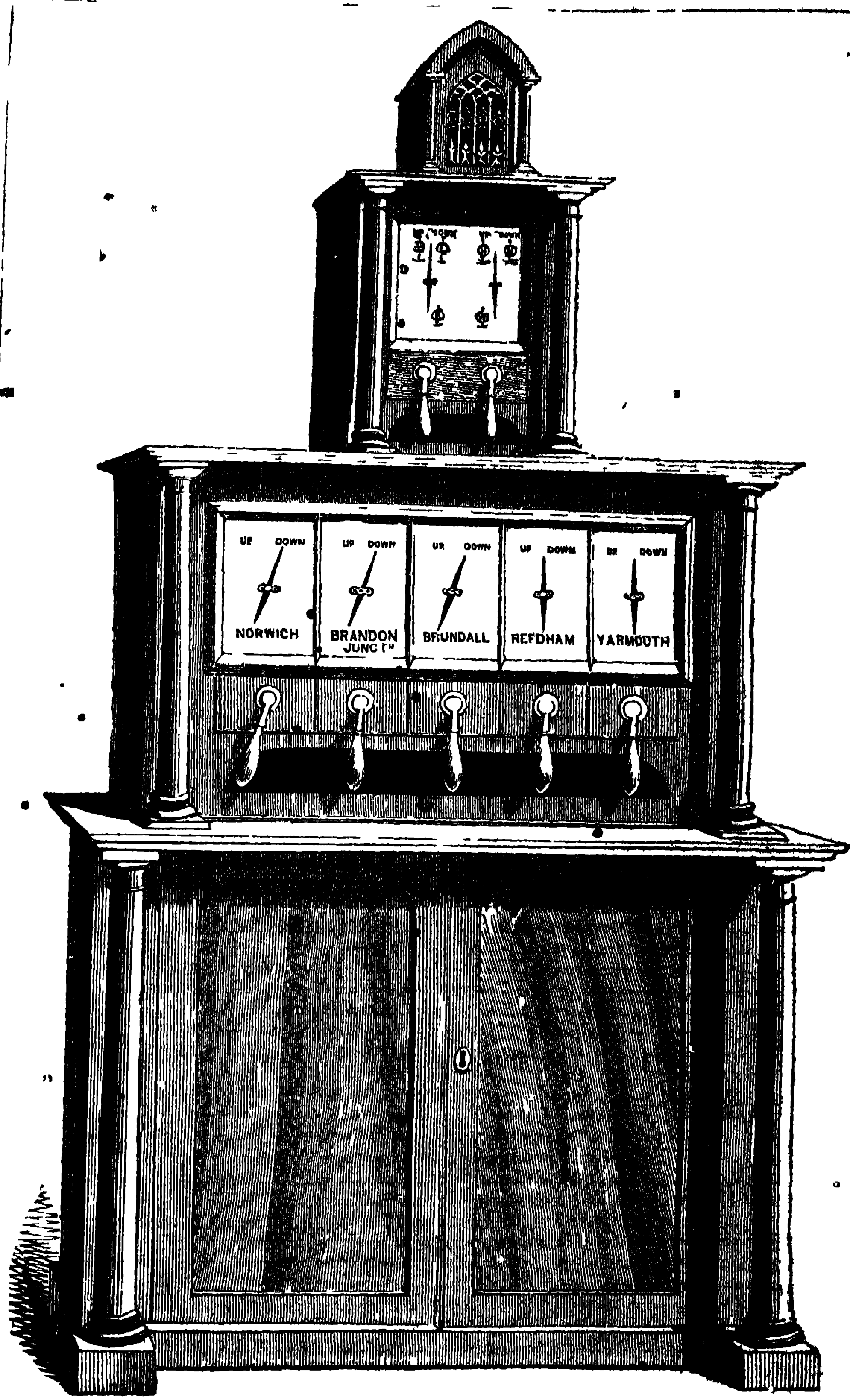
*Plating.*—Mr. Woolrich has patented the following preparations:—He boils twenty-eight pounds of pearl-ash in thirty pounds of water; to which, when cool and filtered, he adds fourteen pounds of distilled water, and then saturates the solution with sulphurous acid gas, producing this sulphate of potash, which he terms the solvent. He now dissolves twelve ounces of crystallized nitrate of silver in three pounds of distilled water; and adds the solvent as long as a whitish precipitate falls. the precipitate is then washed, and re-dissolved in a sufficient quantity of the sulphate, to which is added one-sixth part more, so that the solvent may be in excess: this he calls the silvering liquor. For gilding, he dissolves four ounces of fine gold in eleven fluid ounces of nitric, thirteen of muriatic acid, and twelve of distilled water; the solution is evaporated, and the crystals are re-dissolved in one pound of distilled water. The gold is then precipitated by pure magnesia; the precipitate is first washed with distilled water, acidulated with nitric acid, and then with water alone. To the washed precipitate is added enough solvent to dissolve it, and one-fifth more. A coppering liquor is prepared by dissolving seven pounds of sulphate of copper in thirty pounds of distilled water, and adding solution of carbonate of potassa till precipitation ceases. The washed precipitate is dissolved in the solvent, with one-third more than enough.—*Illustrated Polytechnic Review.*

*Blasting by Electricity.*—Mr. R. W. Thomson, a Scotch Engineer, is engaged in experiments for exploding gunpowder by Leyden discharges. He avoids hygrometric effects by enclosing his machine and battery within an air-tight box, containing chloride of calcium, so that he is not dependent on the varying conditions of the atmosphere.

*To render Linen Cloth Waterproof.*—Boiled oil, 25 parts; Bee's wax, 2 parts; Litharge, 2 parts Lamp Black 2 parts; mix, and use it at discretion.

*Horse Shoes for Wood Pavement.*—Several ingenious contrivances have been brought before our notice for the prevention of accidents which are likely to arise from the slipperiness of the wood pavement. To all that we have yet seen there is the objection, that as the whole of the streets in London are not yet laid under this material, when the horses are for any length of time upon the granite, or even upon the macadamized road, the shoes lose the very quality which is necessary for them upon wood.

*A Scientific Bird.*—It is a remarkable fact, that the talegalla (an Australian bird somewhat resembling our domestic fowl) does not hatch its eggs by incubation. In order to effect this object, it assimilates in some degree to the practice of the ostrich, yet upon a totally different principle. The telegalla collects together an immense heap of decaying vegetable matter, as a depository for the eggs, and trusts to the heat engendered by the process of decomposition for the hatching them. Mr. Gould says, that the heap employed for this purpose is collected by the birds during several weeks previously to the period of laying; that it varies in size from two to four cart loads, and is of a perfectly pyramidal form. The construction of the mound is not the work of one pair of birds, but is effected by the united labours of several; the same site appears, from the great size and the entire decomposition of the lower part, to be resorted to for several years in succession; the birds adding a fresh supply of materials on each occasion, previously to laying their eggs.—*Jesse's Country Life.*




THE ELECTRIC TELEGRAPH ON THE YARMOUTH AND NORWICH RAILWAY.

## THE ELECTRIC TELEGRAPH ON THE YARMOUTH & NORWICH RAILWAY.

The accompanying Engraving represents one of a system of Telegraphic Apparatus, adapted to the working of the Yarmouth and Norwich Railway, as a Single Line.

This Railway has two intermediate Stations at Reedham and Brundall, where sidings are arranged to facilitate the passing of Trains going in opposite directions.

Between Reedham and Brundall there are also two minor stations, Cantley and Buckenham.

The Stations are situated in the following order :—

| | miles | | miles | | miles | | miles | | miles | | miles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yarmouth | 8 | Reedham Siding | 2 | Cantley | 3 | Buckenham | 1½ | Brundall Siding | 5 | Brandon Junction | ½ | Norwich. |

All these points are included in one general Telegraphic Communication, by means of Conducting Wires, extending along the Line from Yarmouth to Norwich. These Wires are suspended in the air from wooden standards, in the following manner :—Strong posts of timber are fixed firmly in the ground every quarter of a mile, from which the wires are strained, and between every two of the "Straining Posts," seven standards are placed fifty-five yards apart to act as supports.

Attached to the head of every second "Draw-Post" are a number of winding apparatus, corresponding with the number of conducting wires, but at the intermediate posts, the wires are merely attached to pieces of earthen-ware, fixed to a frame of iron. Perfect insulation at the point of contact with the posts is an object of indispensable importance, as the dampness of the wood during rainy weather would otherwise allow the electric fluid to pass freely into the earth, or into an adjoining wire, and thus to complete the circuit without reaching the distant terminus at which the telegraphic effect is to be produced. To attain this object, at the draw-posts, wooden boxes are employed to enclose that portion of the post to which the winders and insulators are attached, and small openings are left for the free passage of the wires, without risk of contact with the outer box. The standards are furnished with covers or boxes, to the outside of which the wires are equi-distantly attached by insulators of earthenware. The general height of the posts and standards is nine feet above the ground, the wires six, (and between Reedham and Brundall seven,) in number, are suspended one below the other, six inches apart, the lowest wire being kept five or six feet above the ground. In passing over an accommodation road, or in crossing the railway, loftier standards are employed, which abruptly lift the wires to the height of fifteen or sixteen feet from the ground, in order to clear objects passing below.

The holes for the standards are made by a boring tool ; a level taken from the rails gives the depth to which the standards are to be sunk, which is chalked on the boring tool, and thus the hole is opened and the standard fixed, and rammed closely round the sides without the soil being further disturbed.

The perfect insulation of the wires from the earth, obtained by the means above described, allows of the earth itself being employed as half of each conducting circuit, without risk of the electric current finding a shorter course through some imperfectly insulated point. The plan of employing the earth as half the conducting circuit, has been in successful operation for some years on the London and Blackwall Railway, and is also employed for eighteen miles on the Great Western Railway, between Paddington and Slough.

By reference to the drawing, it will be observed that the apparatus as arranged for the Yarmouth and Norwich Railway, consists of three portions, resting upon a stand which contains the batteries.

The small upper portion of the apparatus is appropriated to the alarum. The second portion, with two pointers, is the "Speaking Telegraph," which gives all the letters of the alphabet, the numerals, and a variety of conventional signals.* The third portion contains five station Telegraphs, devoted exclusively to the working of the trains.

The principle on which this form of Electric Telegraph is constructed, is founded on Oersted's celebrated discovery that a magnetic or compass needle may, through the agency of a Voltaic current, be invested with an artificial polarity. Thus, as a natural stream of electricity, passing round the circumference of the earth, causes magnetic needles in general to be deflected at right angles to its course, or towards the north and south poles, so an artificial stream of electricity, of adequate strength, will cause magnetic needles, placed within its influence, to be similarly deflected at right angles to its course, whatever that may be. If, then, a magnetic needle were placed parallel, and near, to any part of a conducting wire (which we will suppose to be laid down between Yarmouth and Norwich), the transmission of an electric current from a voltaic battery would cause the needle to change its position, so as to stand, during the continuance of the current, at right angles to the wire ; being turned in one direction or the other according to the course of the current. If this deflexion of the needle were limited by two fixed stops, placed respectively at the two sides of one of its poles, the motion of that pole to one stop might evidently constitute one signal, and its motion to the other stop, another signal.

The annexed engraving represents the Norwich instrument, which is constructed upon the principles above explained. The signals are given by magnetic pointers, each suspended vertically on an axis, moving freely through the face of a dial. Behind the dial another magnet is fixed on the same axis as the pointer, so that both move together. A portion of the conducting wire is coiled many times longitudinally round a frame, in which the magnet moves, so as to subject the magnet to the multiplied deflecting force of the voltaic current. The motion of the magnet is limited at both sides by fixed stops. Now, suppose four of these very simple instruments (included in the same conducting wire) to be placed, one at Yarmouth, a second at Reedham, a third at Brundall, and a fourth at Norwich : the general effect of this arrangement would be, that the transmission of electricity along the conducting wire, and therefore through the convolutions of wire surrounding the respective magnets, would deflect the whole of those magnets with a sudden and decided motion to one of the stops, and cause the exterior pointers to indicate corresponding and simultaneous signals upon the dials of the instruments at each of the four stations. Each instrument is provided with a battery, and a handle, by which a Clerk or Porter is

* This form of Telegraph may be seen in constant use on the Great Western Railway (where it is open to the Public) for eighteen miles between Paddington and Slough. By this apparatus signals are passed at the rate of thirty or forty a minute, with the greatest accuracy.

enabled at pleasure to connect the conducting wire with his battery. By moving the handle to the right or left, either of the signals can be instantaneously transmitted from any one of the instruments to all the others; which, by means of their own handles, have the power of sending back signals in reply correctness being ensured by the simultaneous appearance of the signal in the instrument of the operator, and that of all the recipients. The transmission of intelligence is prefaced by sounding a bell till attention is obtained; an operation also effected through the agency of the electric current.

To simplify the working arrangements of a Single Line, of great length, (or of adjoining Railways,) it would be desirable to divide the Line into distances of from 20 to 30 miles each; these grand divisions being subdivided by the ordinary Stations, which as on the Yarmouth Line, might be from two to four, or even eight miles apart.

By making the particular traffic of each division dependent only upon its own terminal or division-stations, and by imposing upon those stations the whole responsibility of attending to the external relations of the division, the ordinary traffic of the longest Line would be divested, in a great measure, of the confusion caused by irregularities in the passage of the long trains; indeed these grand divisions, though in strict correspondence with each other, might be regarded as distinct Railways.

On the Yarmouth and Norwich Railway, as above stated, there are four principal stations; and the annexed drawing represents the Telegraph at the Norwich station. A similar apparatus belongs to each of the other three. Each pointer represents the state of the line under the control of the particular Station whose name it bears; and the distinct telegraphic system belonging to that station has its representative at all the other stations. The four stations have, therefore, four distinct systems of telegraphs, each with a distinct conducting-wire and with their four representative dials at each station in the convenient form of compartments in one frame. The fifth compartment in the drawing communicates only with the point at which the Brandon Line will form a junction with the Yarmouth, at about one mile from Norwich, and will be used to give notice of the approach of trains from the Brandon Railway.

It must be apparent that no difficulty, or danger, can occur with such ample means of information, *while two trains are never allowed to be on the same stage at the same time*, and every movement of a train depends upon positive assurance, in reply to an enquirer, and not to inferential conclusions, that the Line is prepared for their reception. If, from any cause, an answer could not be obtained from a particular station, a signal would be sent through that station to the next; and with the assurance from the further station that no other train could be on the intervening portion of the Line, a train might be permitted to proceed with caution to the silent station. Having there ascertained the cause of the silence, it would telegraph its arrival and departure as usual.

On a single Line, a train would never be allowed to approach a station, *without a particular affirmative order; the quiescent condition of the station signal, being always a state of danger*, not a state of safety, so that a train would only proceed under a special guarantee that all was clear to the next station. With such an arrangement, no bad consequence could arise from want of presence of mind on the part of the signal-man, at a moment of sudden danger. On Lines of great traffic the signals might be a counterpart of the Telegraph dials, so that the conductor and the engine-man on passing a station might read the state of the line for several stations in advance upon a semaphore by day, and a set of lamps by night.

Should a train be delayed in its passage from one station to another, its non-appearance when due, would lead to immediate enquiry, but on this line (at least during winter and at night), each train would be furnished with a portable Telegraph, capable of communicating its wants, and signalizing to the nearest stations from any part of the Line; and, if necessary, an engine, or a train with carriages or workmen, would be dispatched from the nearest depôt, to the place of the accident.

---

## REDUCTION OF TURKISH ORES.

MR. W. FAIRBAIRN has just read to the Institution of Civil Engineers, an important communication on the reduction of the magnetic ores of Samakoff (Turkey). It commenced with reviewing the few attempts which had been made towards improving the method of treating the richer iron ores both of England and of foreign countries, the great English iron-makers having restricted themselves to using the lean carbonates of iron, on account of the facilities they offered for working; the great advantages which might have resulted, both in the quantity and quality of the metal produced from rich ores, have thus been neglected.

It is stated that Mr. Dhannes Dadian, an active and enterprising Armenian in the service of the Sublime Porte, brought to this country specimens of the magnetic iron ore and of bituminous coal found in the district of Samakoff, in Turkey. He had them analyzed at Paris and in England, and found that the ore was nearly a pure oxide of iron, containing about 63 per cent. of metal; that it was free from sulphur, arsenic, or other deleterious matters; and that there was mixed with it about 12 per cent. of silicious earth.

The ore was described as being found in the form of a fine sand covering extensive plains, where it had been deposited to the depth of several feet, probably by the action of water upon the mountains around, where a similar ore existed in considerable masses. In consequence of the favourable report of the assayists, and acting on the advice of Mr. Fairbairn, Mr. Dhannes Dadian determined to persevere in his projects, and his attention being directed to the process invented by Mr. Clay for producing malleable iron direct from the ore, as described in a paper read at the Institution of Civil Engineers, February 14, 1843, he secured that gentleman's services to conduct some experiments, and subsequently engaged him to proceed to Turkey to prosecute the working of the iron ore on an extensive scale.

Mr. Clay's report, and that of Mr. League, were fully given; they contained details of the various ingenious modes employed to work the ore, which, being in the state of a fine sand, either fell unmelted through the fire into the bottom of the furnace, or was blown out of the furnace top by the force of the blast; at length Mr. Clay, thinking that if the ore could be deoxadized by a previous operation, it would be in a fitter state for fusion in the blast furnace, submitted it to a partial process, as far as causing it to form into lumps; in that form it was easily fused, and produced cast-iron of a peculiarly ductile, fluid, and yet strong character, of which specimens were exhibited. The success of this plan was considered so complete, that preparations were *immediately commenced for erecting works in Turkey on a large scale.*

Incidental to the subject of the glassy scoriæ of the iron furnaces, Mr. Clay mentioned that he had studied carefully the composition of crown-glass; he believes that he was the first to point out the true atomic character of glass, that its quality depends on the ingredients being compounded in certain definite atomic proportions, and that the crown-glass is quinquisilicate of lime and soda. He arrived at these conclusions in the year 1835; and, at the works of Messrs. Chance at Birmingham, it was found, that on following the rules he laid down, the production of a constant quality of glass was inevitable. He then treated of the production of optical lenses and the make of bottle-glass. The paper then returned to the forms of the furnaces proposed for working the Turkish iron ore; the various modes of treating it, and the nature of the flukes, &c., concluding the first part of the paper, with the details of the experiments made upon it at Manchester and at the Backbarrow works.

The second part of Mr. Fairbairn's paper noticed the remarkable richness and purity of the iron ores of the East, and the superior quality of the Damascus steel produced from iron made apparently in the rudest and most primitive manner; it was remarkable that up to the present time there had been but little change in the manner of manufacturing charcoal-iron even in England. This might be accounted for by the small quantity of wood charcoal used for smelting iron, but it appeared that, with the exception of that which was sent into Staffordshire and South Wales, for mingling with the lean ores of the coal measures, but little of the hœmatite or rich ores of Lancashire, Cumberland, Cornwall, or Devonshire was used, although in richness and in quality of metal they equalled those of foreign countries.

The paper then entered at length upon the experiments on the transverse strength of the Turkish iron, and also of the iron from other rich ores, presenting the results in a tabular form, mingled with those which had been reported on previous occasions; in the Transactions of the Philosophical Society of Manchester, and in the reports of the British Association. These tables were arranged so as to afford the means of comparison of the strength and other qualities of various irons, and also for practical purposes, to furnish a guide for selecting such irons as, y proper mixture of the different kinds, would enable unerring results to be arrived at by the founder, when engaged in producing castings for the engineer, the architect, or for various purposes in the arts or in constructions. Simple rules were also given for finding the breaking weight of beams cast from the fifty-two kinds of iron which had been experimen ed upon. The importance of the subject of the paper, the novelty of the application of Mr. Clay's system, and the unwearied attention of Mr. Fairbairn, together with Mr. Hodgkinson, in the numerous experiments they had made, were fully appreciated by the meeting, and it was announced that the valuable tables would speedily be published entire, in the minutes of proceedings of the Institution.

A specimen of steel made from the Turkish ore, and a knife manufactured from it by Mr. Durham, of Regent-street, were exhibited and were much admired.

## EXHIBITION OF DECORATIVE WORKS OF ART.

*(Continued from page 42.)*

We resume our notices of this important Exposition *with a glance at the specimens of*

### STAINED GLASS.

No. 58, by John Summers. A design for a Window, stained glass. The upper lights are occupied by figures under canopies, taken from Henry VII's chapel in Westminster Abbey; in the centre lights are placed Edward III, and his wife, Philippa; on the right of the queen is John of Eltham, and on the left of the king is the Earl of Warwick. The lower lights are occupied by Edward the Black Prince and the princess. On the left of the princess is Sir Guy de Bryan, and on the right of the prince Sir Oliver de Ingham. This is altogether, an ill-storied design.

No. 59, by Ward and Nixon, is of much greater merit than its predecessor. It is a design for a stained glass window, representing Henry III. and his queen, and Edward I. and his queen, in the costume of their several reigns, with their heraldic insignia and badges

No. 60, is worthy of the name of Gwilt, (C. E.) It is a design for a stained glass window, admirably coloured. The figures are those of the first eight kings after the Norman conquest, and the general design and ornaments are intended to be of coeval date and style with the new palace. The figures are left uncoloured; the pedestals and canopy are drawn in elevation, and are wholly free from anomalous perspective.

No. 61, is a rich heraldic design for a stained glass window, representing the arms of British Sovereigns, and of contemporaneous illustrious individuals, from the Saxon heptarchy to the present time; by Spence and Co.

No. 62, another window design, by Charles Clutterbuck, is one of a series to represent the wars of the Houses of York and Lancaster, and is very artistically and historically treated.

No. 63, is one story of a picture for a stained glass window. The figures represented are, Princess Mary, Henry VIII, Prince Edward, and Princess Elizabeth, forming the family group of Henry VIII. The uppper part of the window commences with a Gothic screen enriched with the royal arms, with strings of shields relating to Henry VIII, and finishes with the roses of York and Lancaster.

No. 64, is by Robert Morrow, unfinished. It is a design for a stained glass window, representing Henry VII and Elizabeth of York after marriage.

No. 65, is a window design of great merit, by Robert Hedgeland. It supposes the window to contain, in the lower compartments, whole-length figures representing the sovereigns of England, in regular succession, from the reign of King Alfred; the upper compartments and the tracery openings being appropriated to the reception of devices, armorial bearings, mottos, &c., appertaining respectively to the monarchs represented immediately beneath.

No. 66, a window design, by Ballantine and Allan, is chiefly meritorious for its good architectural drawing.

No. 67, a window design for the House of Peers, by Cobbett and Son, is a work of high merit. The four upper openings contain the arms and badges of the Tudor family. The four lower openings contain portraits of Henry VII, Henry VIII, Edward

VI, and Queen Elizabeth, surrounded by similar arms and badges. Every part of the design has reference to the same subject.

No. 68, by William Warrington, is another good window design. It contains the armorial bearings, consisting of escutcheons, supporters, badges, collars of SS., and suns and roses of the following monarchs,—Henry IV, Henry V, Henry VI, Edward IV, Edward V, Richard III, Henry II (impaled with those of Elizabeth of York), and Henry VIII.

No. 69, a window design by James Warrington, is likewise very successful. In the four principal openings are the arms of Henry V, Henry VI, Henry VII, and Henry VIII, enclosed by the garter, and surrounded by helmet, crest, and lamberquin. In the lower openings are the supporters of each monarch holding banners emblazoned with his livery colours, and charged with his different badges.

No. 70, is a rough, unfinished sketch for a window design, by H. Pether; representing the badges of the four order of British knighthood, with the arms of the founders, &c.

No. 71, by Edward Corbould, is a clever window design, representing Edward I, entering Westminster, after vanquishing the Welch in 1282.

No. 72, a window design by Edward Baillie, is of striking merit. The upper large openings contain portraits of four kings of England, Henry V, VI, VII and VIII. Over each are his arms and supporters, and under each is a medallion, on which is either a subject or a figure, illustrative of the period. The four lower openings contain portraits of four queens regnant of England. On the left, Queen Mary, with her arms and supporters. The medallion underneath represents the same queen and her royal consort, Philip of Spain. Next is Queen Elizabeth, with arms and supporters. The medallion contains her initials, with the date of her coronation and demise, and titles in a label as in the others. The third is Queen Anne, with arms and supporters, initials and titles. The fourth is Queen Victoria, with the arms of the United Kingdom. The subject on the medallion is intended to represent the signing of the treaty between the British and Chinese officers.

No. 73 is a window design by Cobbett and Son. The four large upper compartments contain portraits of her Majesty and Prince Albert, on pedestals, with canopies above; Her Majesty in her coronation robes; the Prince in the robes of the order of the garter. The four lower compartments are filled with the subject of King John ratifying the great charter of England.

No. 74 is a very gaudy storied window design by J. A. Gibbs, in which the four small openings at the top of the drawing represent the badges of the houses of York and Lancester. The large left-hand opening represents the red dragon (being the cognizance of the Earl of Richmond) overcoming that of Richard III. The right-hand large opening illustrates that curious verse :—

"The cat, the rat, and Lovell the dog,
Rule all England under a hog"

No 75 is a window design for the House of Lords, by Chance, Brothers, and Co. It exhibits four members of the house, a bishop, a warrior, a judge, and a statesman. The allegorical figures above (Piety, Valour, Justice, and Prudence) refer to the characters beneath, each standing on his coat of arms proper. In the upper part of the window are placed the arms of her Majesty Queen Victoria, and those of his Royal Highness Prince Albert, together with those of London and Wesminster, and emblems of the three kingdoms. This is a good storied design of figures and pedestals in elevation, with minute back-grounds; but the architectural details are impure.

No. 76, a complete window design by Thomas Wilurshurst, though somewhat tame in colour, it has good points. It represents Edward III., and his queen Philippa. Beneath them, Edward the Black Prince and William of Wykeham. The four side compartments contain the various arms, badges, mottoes, &c.

With our recollection of Mr. Wilurshurst's success in 1830, in his stupendous window of the Tournament of the Field of the Cloth of Gold, we expected a better composition than the above.

No. 77, a window design by I. C. Crace, is ill adapted for the building. It represents Henry VIII. delivering the first English translation of the Bible to Cranmer, for the use of the people. In the upper compartments are the arms of Henry VIII. and Queen Anne Boleyn, and on either side are the arms of the principal ecclesiastical and lay peers who supported the Reformation. The various badges, &c., of the king are likewise introduced.

We are compelled to pass over several specimens of stained glass, some of them portions of the preceeding designs. Several additional designs and specimens have been sent, but of inferior merit to those we have noticed.

---

## ILLUSTRATIONS OF MECHANICAL DRAWING.

*(From the Glasgow Practical Mechanic.)*

*(Continued from page 52.)*

Pieces of unsized paper, and some such stuff as cotton velvet, ought always to be at hand while a drawing is being inked. The former article, when a small piece is folded twice, so as to present a corner, is necessary for passing between the blades of the pen now and then, as the ink is apt to deposit at the point and obstruct the passage, for which purpose the pen must be unscrewed to admit the paper. But the necessity for this may be delayed by drawing the point of the pen over a cushion of velvet, or even over the surface of the blotting-paper; either method clears away the point for a time. As soon as any obstruction takes place, the pen should be immediately cleaned, as the trouble thereby taken will always expedite and improve the work. If the pen should be laid down for any short time with the ink in it, it should be unscrewed to keep the points separate and so prevent deposit; and when done with altogether for the occasion, it ought to be thoroughly cleaned at the nibs with blotting-paper. This will preserve its edges and prevent it from rusting.

In using the square, it is more convenient to draw the lines off the left edge, with the right hand, holding the stock steadily, but not very tightly, against the edge of the board, with the left hand; the convenience of the left edge for drawing from, is obvious from our being able to use the arm more freely, and because we see exactly what we are doing.

The edges of the square blade ought to be very slightly rounded, as the pen will thereby work the more freely. It is a mistake to chamfer the edges, that is, to plane them away to a very thin edge, with the view of ensuring the correct position of the lines, for the pen is liable to catch the edge and to leave ink upon it. To prevent the latter inconvenience at any time, *the outsides of the blades of the pen should be cleaned after each application of the ink.*

Very useful appendages to the square are a pair of small right-angled isosceles triangles, a triangle of 60 and 30 degrees, and a short straight edge. The angles at both ends of the hypotenuse of the first, are 45°, which renders the slant side very serviceable for laying off square figures and other uses; the vertical side, too, saves a deal of shifting of the square, as when the horizontal edge is applied to that of the square, short perpendicular lines may be at once described. The most convenient size for general use is from 3½ to 4 inches of a side. By applying either edge of the triangle of 60 and 30 degrees to the square, the slant side gives at once the boundaries of all triangular and hexagonal figures, as nuts and bolt-heads, and also the centre lines of wheels, &c., of six arms.

One-half of the stock of the square is sometimes made loose, so as to turn upon a brass swivel to any angle with the blade, and be fixed down by a screwed nut and washer. This modification is often useful for drawing parallel lines obliquely to the edges of the boards, such as the theads of screws, oblique columns and connecting-rods of steam-engines.

Parallel rulers also are frequently used for drawing oblique lines. We have no great opinion of them, except for sketching jobs, as they are at best inconvenient for working and liable to derangement in the joints if they be not cautiously used. A much more convenient and accurate method of drawing oblique parallel lines is had by using the isosceles triangles.

For the drawing of curves of large radii, which are beyond the range of the compasses, thin slips of wood, termed sweeps, are employed, of which one edge is cut to the required circle. In some cases "universal sweeps" are made, having a centre of variable curvature, which may be applied to the description of curves within a considerable range.

For cleaning up a drawing, a piece of bread two days old is preferable to rubber, as it cleans the surface well, while it does not injure it. When ink lines, to any extent, have to be erased, a small piece of damped soft sponge may be rubbed over them till they disappear. As, however, this process is apt to discolour the paper, the sponge must be passed through clean water, and applied again to take up the straggling ink.

The drawing paper may be fixed down on the board, either by damping and glueing its edges, or by simply fixing it at the corners with pins. The latter method is sufficient where no shading or colouring is to be applied, and if the sheet is not too long upon the board. It has the advantage, besides, of preserving to the paper its natural quality of surface. It is convenient otherwise, however, to lay the sheets with glue, for drawings of any elaboracy, and especially for coloured drawings. It is done in the following way:—Provide a board a little larger both ways than the paper; lay the sheet on the board, with that side undermost which is intended to be drawn upon; come easily, but rapidly, over the upper side with a wet sponge, damping the entire surface, and allow the sheet to lie for five minutes, till it be damped through. The damping ought to be done as lightly as possible, as the sponge will always deprive the paper of more or less of its size. The sheet is then turned and set fair with the edges of the board; the square is applied and set a little within one edge of the paper, which is then turned up over the square, *and touched all along with the melted glue. It is then folded back and pressed down by the square,* after which the edge of a paper-folder, or other smooth article, is rubbed along the "lap," to press out the superfluous glue. The same operation being applied to the other edges, the sheet is allowed to dry, in the course of which it becomes quite flat and tense. Sometimes, in lieu, of melted glue, a cake of the same is dipped in water and rubbed upon the board.

Mechanical drawing is a particular application of the general method of drawing by projection. The special object of mechanical drawing is to represent mechanical forms upon plane surfaces. Every machine, like other collections of matter, has three dimensions, length, breadth, and thickness, which are susceptible of exact definition. Now in viewing a machine from a great distance, we may conceive the rays of light proceeding from it to move parallel to one another; and conceiving them intercepted upon a plain surface at right angles to the rays, the representation thus formed is said to be a projection of the machine upon that plane; and it is evident that the picture or drawing so formed will convey, so far as it goes, correct ideas of the structure and shape of the machine. But as the form of machines must be referred, in virtue of their bulk, to three series of dimensions, each of them at right angles to the plane of the other, it follows, that any three contiguous planes of a cubical space will answer as planes of projection corresponding to the three dimensions. And there is a felicitous circumstance relative to this, that the dimensions of the component parts of machines in general are disposed in right angles; from which it follows, that if the planes of the projections of a machine be made to coincide with those of its dimensions, then, in general, these dimensions will be exactly indicated. There will, in plainer language, be little of that fore-shortening of form which so frequently occurs in representations of natural objects, clearly owing to their wavy and ungeometrical outline.

## RESEARCHES ON LIGHT.*

A VERY interesting and important volume of scientific results has just been published by Mr. Hunt, Secretary to the Royal Cornwall Polytechnic Society. It is fairly described in the title page as "An examination of all the phenomena connected with the chemical and molecular changes produced by the influence of the solar rays; embracing all the known photographic processes, and new discoveries in the art." It is, in truth, the first History of Photography which has been published, and a most valuable accumulation of facts collected and arranged with great skill. At the outset, Mr. Hunt explains that he has laboured under the difficulty of being obliged to speak of photographic phenomena as resulting from the agency of light; being, at the same time satisfied that they were to be referred to a principle which possessed none of the characters of light or heat, but which was intimately mixed with these elements in solar rays. This new principle, Mr. Hunt proposes to call Energia, and we quote his definition.

"Light, Heat, and Energia, for it is necessary to

* Researches on Light, &c., by Robert Hunt, 8vo., Longman and Co.

recapitulate, are the three principles (or the modifications of an elementary first principle) detected in the solar rays. The first, acting upon the organs of vision, and enabling us to distinguish external objects, and giving colour to all. The second is that principle which regulates the solid, liquid, or gaseous states of matter, and which maintains this planet in the condition which is essential to the well-being of its inhabitants. And the third, Energia, that power which effects all the changes, whether chemical or molecular, which are constantly in progress; it is that agent which is for ever quickening all the elements of growth, and maintaining the conditions of a healthful vitality; and it is no less energetically employed in the processes of corruption, which, indeed are no other than the necessary changes of matter in its progress from one state of organization to another."

The arrangement of Mr. Hunt's volume is as lucid as his materials are valuable: having introduced the subject, he classes it in two parts. 1. The Influence of the Solar Rays on Compound Bodies, with especial reference so their photographic application. 2. The Influence of the Solar Rays upon Vital organization and upon simple inorganic Bodies. Consideration of the preceding Phenomena. These parts, are subdivided into sections on metallic compounds—the action of the solar rays on vegetable substances—on the vegetable kingdom—the action of Light on inorganic bodies. The labour of collecting and arranging the work must have been very considerable; and the usefulness of the work for reference is enhanced by a good index. At the close of the introductory chapter, Mr. Hunt thus refers to the great object of the work.

"It will be shown in the following pages, that the rays which are active in producing chemical change, are not, as was formerly imagined, confined to the most refrangible end of the prismatic spectrum, but that they are, under certain circumstances, equally active at the least refrangible end; therefore, although it will, when speaking of the different classes of rays, be convenient to retain the common expressions of chemical, calorific, and luminous rays, it must be understood, that no attempt will be made to define the limits of the calorific or chemical influence. I see reasons for believing that Light, or that agent which affects the origin of sight, is broadly distinguished from those rays which bring heat from its solar source, and both of these classes, from those, which produce those singular changes in the constitution of bodies, which are more particularly the objects of our study.

"Sir John Herschel first called attention to a class of rays in the prismatic spectrum, situated below the ordinary red rays, and which are only seen when the eye is defended from the glare of the other rays, by a deep cobalt blue glass: these rays will be invariably termed the *extreme red rays*. These rays are situated so decidedly at the extremity of the visible spectrum, that if a dot be made in the centre of the well defined and round solar image to which it corresponds, and the glass be then laid aside, that dot is judged by the eye to be exactly at the end, or, if any thing, rather beyond than within the end of the visible spectrum. (*Herschel.*) It always appears to me as being some lines below the visible red; but I find by experiment, that my undefended eye is not sensible to the red ray so low in the spectrum as many friends have marked its limits. Sir John Herzchel has also very satistactorily shown, that there exists a class of *luminous* rays beyond the violet, which affect the eye with a sensation of lavender grey: these are called by him, in distinction, *lavender rays*, which name is also adopted in the present volume."

We shall quote a few of the processes; and first, of *The Calotype.*

"Mr. Channing of Boston appears to have been the first to publish any method by which the calotype process could be simplified. This gentleman directs that the paper be washed over with sixty grains of crystalized nitrate of silver in one ounce of water. and when dry, with a solution of ten grains of the iodide of potassium in one ounce of water. It is then to be washed with water, and dried between blotting paper: it is now fit for use. A paper of more sensitive kind is stated by the same authority, to be prepared by using a mixed solution of 5 grains of the iodide of potassium and 5 grains of chloride of sodium in an ounce of water. My own experience enables me to say that but little, if any, improvement can be made upon these proportions. A much weaker solution of the nitrate may be used, and this on the score of economy, is important. The most satisfactory preparations which I have yet employed are the bromide of silver, formed by washing paper first with a solution of silver, as above, and then with a solution of twenty grains of the bromide of potassium in one ounce of water; and, as I have before stated, the formobenzoate of ammonia and silver, formed by washing the paper first with the formobenzoate, in the proportion of fifteen grains of the salt to one ounce of water, and then with the nitrate of silver, as above. In good sunshine an edifice may be beautifully copied by either of the two last processes in a minute, and by the others in about two minutes. To preserve these pictures of a clear white, it is advisable that they should be soaked in water for a minute, previously to the application of the gallic acid.

*(To be continued.)*

## "FOOTSTEPS BEFORE THE FLOOD."

"The historian," says Dr. Buckland, "may have pursued the line of march of triumphant conquerors, whose armies trampled down the most mighty kingdoms of the world. The winds and storms have utterly obliterated the ephemeral impressions of their course. Not a track remains of a single foot, or a single hoof, of all the countless millions of men and beasts whose progress spread desolation over the earth. But the reptiles that crawled upon the half-finished surface of our infant planet, have left memorials of their passage, enduring and indelible." As a moral lesson, the remark is beautiful and appropriate. But in the succeeding period of the world's history, the sea-beach may yet disclose the desolating path of the bloody potentate, the hoofs of his war-steeds, the tracks of his chariots, and the skeletons of his victims; but if the moral actions of men shall be transmitted to that future age, the geologist will desire to trace at least one royal progress—the consecrated foot-prints of Canute, when he assembled a barbarian court on the shore to do homage to the only sovereign whom the seas and the waves obey. The discovery of "footsteps before the flood," as they have been truly called, or of the impressions of the feet of animals (supposed to be tortoises) imprinted on the solid rocks, were made by Dr. Henry Duncan, now minister of the Free Church of Scotland at Ruthwell. He observed them on the surface of the lamina of the new red-sandstone at Corncockle Muir, in Dumfriesshire. There was regular track of twenty-four continuous impressions with six repetitions of each footmark, along with traces of claws, the fore-foot being different from the hind-foot. All these tracks are either up or down, but never across the surfaces of the strata, which are inclined 38° to the horizon. Mr. Poulett Scrope has observed numerous footmarks of small animals on the Forest marble-beds north of Bath; and Dr. Buckland on the calcareous grit and Stonesfield slate, near Oxford. Footsteps of a larger size, from eight to twelve inches long, with five toes, have been found in Saxony, and are supposed to have belonged to an animal like the opossum, or kangaroo. Still more remarkable, however, are those discovered in the valley of Connecticut by Professor Hitchcock. The feet must have been *fifteen* or *sixteen* inches long, and must have belonged to two gigantic birds, about twice the size of an ostrich!

The preservation of the ripple marks on the sand, after the beds of sandstone have been indurated, may lead us to expect several other phenomena of an analogous nature. Mr. Lyell has observed the little dimples, formed by falling rain, preserved on sandstones;* and we have observed on the fine rippled surface, just left by the receding tide, a series of faint parallel markings, occasioned by the gentle touch of masses of foam driven from the waves. In places, too, where a small rill of fresh water passes over the beach, a very peculiar ramified surface is left on the sand; and when this rill has been frozen during the night, and gradually thawed by the sun, the surface of the sand, upon which the thin films of ice rested, exhibit a very remarkable structure, which we think we have seen reproduced, or rather preserved on the indurated slabs of sandstone. This last phenomenon, if confirmed by future observers, may give us important information respecting changes of climate in different parts of the earth.—*From a splendid paper on Cuvier's Discoveries; in the North British Review.* No. 1.

---

## HEAD MEASURER.

Mr. Soldi, of Southwark, has patented the following improvements in an apparatus for measuring person's heads, and for fitting and retaining hats, caps, and bonnets, according to such measure.

The peculiarity of this apparatus consists in the use of sliding radiating pieces moving in a suitable frame, so that the inner ends of the pieces may come in contact with the varying curvature of the head, and then be set fast in the frame. The apparatus is composed of two parts, an outer and an inner. The outer apparatus consists of two discs or plates, placed one over the other, leaving a space between them of the size of the thickness of the sliding pieces, which have each a longitudinal slot or groove, by which they slide upon a fixed corresponding tongue formed on the lower plate opposite each groove. When this apparatus is applied to the head, the ends of the sliding pieces are brought in contact with the head by an elastic spring, which acts upon all of them at the same time; and when in this position they are fixed by screws. The inner ends of the sliding pieces give the exact form of the contour of the head, but it is farther necessary to obtain this contour upon an external surface. For this purpose the inner or smaller apparatus is arranged so as to reproduce the exact form obtained by the outer one. It is constructed and works in a similar manner to the outer one; and by withdrawing it from the latter, it presents the exact inner contour of the outer apparatus, or, in other words, of the head.

* At the meeting of the American Association of Geologists in April 1843, Mr. Redfield and Dr. Emmons exhibited fine specimens of fossil rain-marks in the new red-sandstones of New Jersey, and in the Potsdam sandstones, lower down in the rocks than heretofore observed.

## VARIETIES.

*Glass Milk Pans.*—Captain Stanley Carr, of Tüsehenbeck, near Lubeck, has transmitted to the Royal Agricultural Society of England, a glass milk pan, employed successfully in his German dairy. From the memoir which accompanies the glass pan, it appears to be everything that can be desired in a dairy, more easily cleaned than wood, and in Germany cheaper than copper tinned, or cast iron enamelled; but the excise on glass renders their use in this country quite out of the question. The specimen sent by Captain Carr, is sixteen inches broad at the top, and twelve inches at the bottom, the glass dark bottle green, perfectly smooth, and about one-eighth of an inch thick, and provided with a rounded rim, which make it easy to retain a safe hold of them when full. It contains eight quarts, but it is not usual to pour in more than six. These pans cost in Germany eightpence each. It has been ascertained from Mr. Apsley Pellatt, of the Falcon Glass Works, that glass milk pans, of the size and shape of the specimen, but of white flint glass, (why white?) could not be made for less than 7s 6d. Another instance this of the baneful result of the duties of restrictions on glass, which have the direct effect of repressing improvements and encouraging fraud. It is a well-known fact, that there is scarcely a manufactory in England, under the controul of the Excise, which could be successfully carried on without a greater or less evasion of the laws.

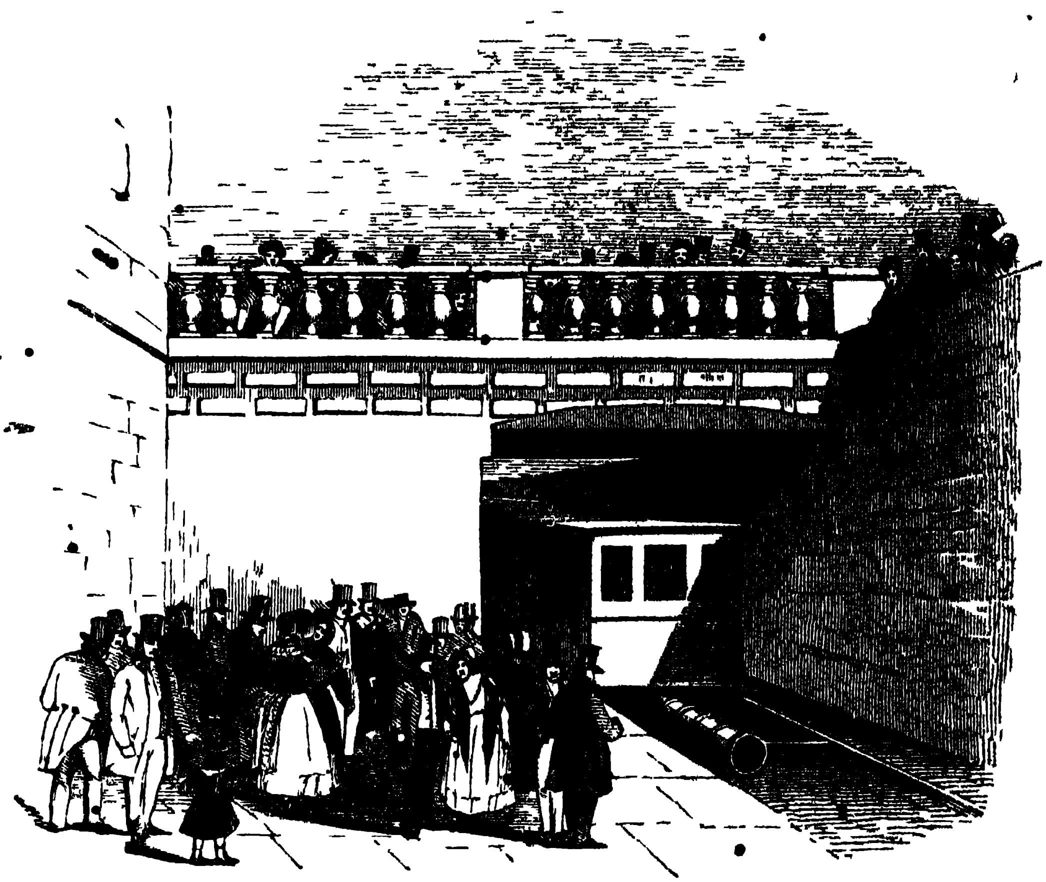
*Effectual method of preserving Iron from Rust.*—Heat the iron to redness, just perceptible in the dark, then cool it in tallow.

*The Great Britain Steam Ship.*—This goliah of the sea rests in the basin of the Bristol float, whence its exit is denied in the eleventh hour by its bulk, being far beyond the embouncher, as will be seen by the following dimensions, which may for accuracy be relied upon.

| | ft. | ins. |
|---|---|---|
| Draft of water | 11 | 9 |
| Breadth at the line of floatation | 43 | 5 |
| Breadth of the lock on the water-line | 44 | 3½ |
| Breadth of ship five feet above water line | 48 | 9 |
| Breadth of lock at coping seven feet above water-line | 44 | 10½ |

The computed weight of the ship is 1,000 tons, and the height required to be lifted from 4½ to 5 feet; even then the coping-stones must be removed. The widening of the lock would cost about £10,000, the expense of which the Bristol Dock Company will not incur. By the above statement, the ship is 3 ft. 0½ inches wider than the lock.

*Government Trigonometrical Survey.—Worksop*—On Prospect Hill, about one mile from Worksop, on the Doncaster Road, an observatory from forty-five to fifty feet high, constructed of larch poles, has recently been erected by the officers and surveyors engaged on the Trigonometrical Survey of the Northern Counties of England. The object is to obtain sight of Sutton-in-Ashfield, near Mansfield, where an erection of the same description has recently been constructed, also to complete a number of lines running into Lincolnshire and other places.



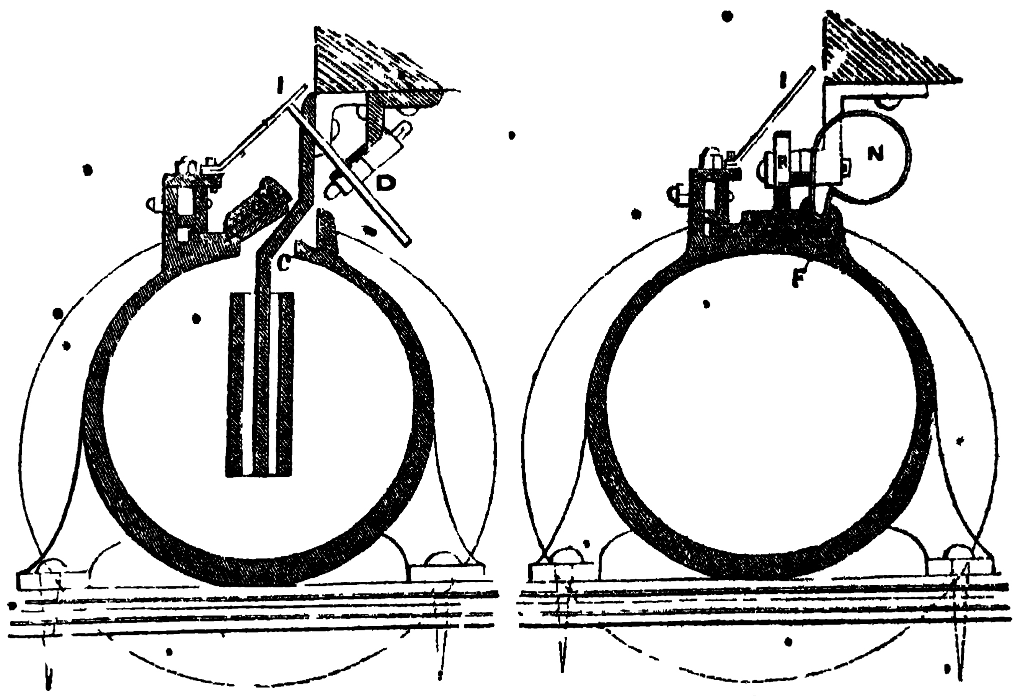



Fig 1 Fig. 2

THE ATMOSPHERIC RAILWAY.

## THE ATMOSPHERIC RAILWAY.

ATMOSPHERIC propulsion on Railways has, at length, been brought into active operation; and the advantages of the system over all others hitherto in practice, may be considered to be established.

The general principle of the system is that of the moving power being communicated by means of a continuous pipe or main, laid between the rails, and divided by valves into suitable lengths, for exhaustion; a partial vacuum being formed in the pipe, by air pumps, worked by machinery, at intervals, along the line. Along the upper side of the main is a continuous aperture, which is covered by a leather valve, guarded below and above with iron plates, hinged on one side to the pipe, and falling into a groove, containing a mixture of wax and tallow on the opposite side, so as to close the aperture. A piston is attached at some distance in front of and beneath the leading carriage of the train, and by means of a packing of leather, fits within the main pipe, so as to be nearly air-tight. When a vacuum is formed in the main in front of the piston, and in the direction in which the train is to travel, the air impinging on the other side of the piston, carries it forward with a velocity due to its pressure upon the area of the piston, which, being attached to the leading carriage, carries the train forward with it.

In the engravings on the annexed page, Fig. 1. represents a vertical section of the pipe by the continuous valve, extending the whole length of the pipe. It is formed of leather riveted between two iron plates. The upper plate is wider than the slit, and prevents the leather from being forced in by the pressure of the atmosphere, and the lower plate just fits the slit, and is curved to the shape of the pipe. One edge of the leather is fastened to a longitudinal rib, cast along the opening, and forms a hinge, as on a common pump valve. The other edge of the valve, when it covers the opening, forms, with the ridge cast on the pipe, a channel or trough on its whole extent, a section of which is shown at F. Fig 2. The trough is fitted with the composition, (bees-wax and tallow,) which, when melted and cooled, adheres to the sides of the valve, and keeps it air-tight. As the travelling piston is forced along the pipe, one side of the valve is raised by four small wheels, fixed behind the piston, so as to admit the connecting rod C *to pass*, as shown in Fig. 1. The opening thus made admits the air to cut against the piston; and the rupture made in the composition is cemented again, before the train passes, in the following manner: A steel wheel R, (Fig 2.) regulated by a spring, is attached to the carriage, and presses down the valve immediately after the connecting arm has forced it open; while a copper heater N, about five feet long, filled with burning charcoal, passes over the composition, and melts it, thus leaving the valve air-tight, as before, and ready for the next train. A protecting cover, I, formed of thin plates of iron, about five feet long, and hinged with leather, is placed over the valve, to protect it from rain or dust.

It is proposed, generally, to have each pipe about three miles long, with a stationary engine for each length of piping, to exhaust the air; and an arrangement is made, by means of which the piston, as it approaches the end of the pipe, opens a valve which admits it into the next length of piping, so that the train may proceed from one length to the other, without stopping.

The first engraving, from a sketch in the *Illustrated London News*, shows the starting of an "atmospheric" train on the Kingstown and Dalkey line, near Dublin. The pipe here shown is fifteen inches in diameter, and its length, so far as it has been tried, is $1\frac{3}{4}$ mile. The average incline is 1 in 115; the expansion has been extended to $22\frac{1}{2}$ inches of mercury, and three carriages, loaded with passengers, have been propelled up the incline, at a speed exceeding forty miles an hour.

Upwards of thirty years ago, attempts were made at using the pressure of the atmosphere for conveying goods and passengers, at the proposals of Medhurst, in 1810, of Vallance (of Brighton), and others; it appears that the first intentions were to have exhausted cylinders of considerable area, within which the carriages should travel, but as it naturally was objected that the passengers might not approve of this mode of conveyance, through a continuous tunnel, means were devised for connecting the piston within the tube, with the carriage travelling upon the rails outside it; and, after numerous attempts, Messrs. Clegg and Samuda succeeded in the system described, in which, after being tried for some time imperfectly at Wormwood Scrubs, has been carried out practically, on the line from Kingstown to Dalkey, up a series of inclines as already described

Most of the previous attempts have failed, chiefly because the continuous valve was defective; Mr. Clegg, first suggested the use of wax and tallow, which has proved so successful as a means of hermetically sealing up the opening caused by the passage of each train.

The friction of the various working parts is stated to be very small, and that on the Kingstown and Dalkey line is scarcely appreciable. The leakage of the valve, &c., being examined, and it is argued that the power lost by leakage is inversely to the speed of the train, for the farther the piston passed along, the less time the pipe will be under exhaustion, and consequently the less time will the leakage exist. Experiments upon the 15-inch main on the Dalkey line show that five horses' power will be required to overcome the leakage of three miles of railway. The system is stated to be peculiarly applicable to such steep inclines as, with locomotive engines, would be called bad gradients; for so long as the steepness of the inclines is not too great for the trains to descend, without the use of the break, no power will be lost, and the cost of working is no greater than on a dead level, for the whole of the additional power required to overcome gravity, while ascending the incline, is restored in descending, particularly when the planes are of great length, and at a convenient inclination, in which latter case there will be a slight saving in working an undulating line. The safety from collision between the trains is much argued upon, and it is stated to be impossible for the trains to approach nearer than three miles to each other, unless at the stations especially appointed for the purpose: single lines of railway can therefore be worked with safety.

The cost of working has been fully examined; and taking for data the results of the expenses on the Dalkey line, and supposing the system to be adapted to a line of 112 miles long, similar to the London and Birmingham, the expense will be greatly in favour of the Atmospheric Railway, with the additional advantage of travelling at a mean speed of 50 miles per hour, instead of between twenty and twenty-five miles with the locomotive system.

## PRINTING FABRICS.

Mr. Overand, of Liverpool, has patented the following improvements in printing fabrics with metallic matters, and finishing silks and other fabrics.

*First*, a mode of preparing materials for printing on fabrics to be afterwards covered with metallic powder; and *second*, a mode of finishing silks and other fabrics.

1. The materials used, and the method of combining them for printing on cotton fabrics are as follows:—One part of white lead, $\frac{1}{8}$th part of magnesia, $\frac{1}{64}$th of litharge, and $\frac{1}{16}$th of sugar of lead, are mixed with a gallon of clarified linseed oil, and reduced into a pasty state; to this mixture is added one gallon of gold size; the whole is then boiled, adding to it $\frac{1}{16}$th of yellow wax, and $\frac{1}{48}$th of dissolved gum. When the mixture is taken from the fire it is passed through a sieve. The colour thus produced is fit for use, and is employed in the ordinary manner of block and other printing. When the fabric is printed, and as it is drawn off from the block, the powder is sifted on to the colour from a sieve. The fabric is then removed to a room heated by steam to dry; when dry it is well brushed, placed on a hot cylinder, and subjected to a pressure, to give the metal a bright appearance.

2. The fabric is next submitted to the vapour of sulphur. The fabric is rolled on a roller, damped, and passed through a chamber in which sulphur is being burnt, then passed over cylinders (the printed side being downwards), so that the vapour of the sulphur acts on the metallic particles used. The fabric is then dried by passing over rollers heated by steam, and is ready to be calendered.

## MR. WALKER'S IMPROVED PUMP.

Mr. Walker has invented and patented a pump which is well worthy of his reputation as an hydraulic engineer: its simplicity serves to disguise the merit of the invention, although it adds to its practical value.

One of the greatest inconveniences to which pumps have hitherto been liable, is that of their valves being deranged by small substances drawn in with the water. A chip, a shaving, or a bit of tow, has spoilt the action of many a pump, just when its services were most needed. In a storm, and in distress, a ship could sometimes spare any thing rather than its pumps; and just then, in the midst of confusion and danger, all on board are appalled by the fact, that the pumps are choked. So also the pump of a steam-engine may have one of its valves held up, and consequently its action spoilt, by a trifling substance whose passage into it could not be detected or prevented. Sometimes, the consequences are of the most serious kind, as in the late case of the *Prometheus*, whose boilers were burnt out for want of water, arising from a bit of oakum having found its way into the boiler pump. All this is well known to happen, notwithstanding that the water is admitted into the pipe through a perforated guard at the bottom; in the well itself nothing can be done with the necessary minuteness and delicacy to strain out the minute substances which do the mischief. In Mr. Walker's pump, the water is made to pass through a filtering chamber before it reaches the pump barrel, this chamber forming part of the air-tight course by which the water rises from the well to the barrel. The pipe from the well passes through its bottom and nearly reaches its top, delivering the water into it: the pipe, by which the water proceeds to the barrel is carried out of it in any convenient direction, and its opening is in a part of the chamber separated from the rest by perforated zinc, or wire gauze: By this means, the water is riddled before it comes to the valves of the pump, and whatever it has carried up with it is left in the filtering chamber. It is almost superfluous to say, that the chamber is made large enough to contain a considerable quantity of refuse, and the screen, or cylinder of perforated zinc, is of such extent, that when a large part of it is blocked up, the remainder shall admit as much water as the barrel can lift. Provision is made for clearing out the filtering chamber conveniently when requisite.

Another disadvantage in pumps, as commonly constructed, is obviated in Mr. Walker's new one. In the common pump, the piston has a valve in it, through which the water passes when the piston makes its downward stroke. This valve is necessarily much smaller in diameter than is the piston itself, and consequently, the water-way through it is very limited, in proportion to the horizontal area of the barrel. Much ingenuity has been employed in devising valves which should reduce this objection to a minimum: but, after all, considerable power is wasted in forcing the water through the narrow and insufficient passages, which even the best valves afford when placed in the piston; nor does the enlargement of the piston and barrel at all remove the difficulty. Mr. Walker avoids it in the following manner: Immediately above the lower, or fixed valve, the barrel becomes considerably larger than in common pumps; and concentrically within it is placed the cylinder, in which the piston works, which cylinder does not reach to the lower valve, the two portions of the space in the barrel freely communicating round its lower edge; the piston is a solid plunger. The annular space between the two cylinders is closed at top by the delivery valve. The delivery-valve is thus made very large, so that it needs but a small lift to give free way to the water, and this effect is further increased by the exit being, by the inner, as well as by the outer edge of the ring. Not only is power thus saved, but there is little loss of water during the descent of the valve as compared with that which takes place in pumps on the old plan. By this contrivance, power is greatly economised, and the parts are made simple and of easy repair: the piston being solid is easily kept in working condition, the delivery valve is always in sight, and may be taken out in an instant, while the whole of the pump above the foot valve may be readily removed, in order to examine that important member of the machine. The advantage gained by enlarging the valves is made very obvious by limiting the rise of the delivery valve to that which gives an area equal to what can be obtained on the common plan; when a very perceptible increase of power is realized.

These pumps are found to answer exceedingly well in practice; they have attracted the attention of the authorities of the Navy, and there is reason to expect their general introduction into all our ships-of-

## CONVERSION OF TALLOW INTO STEARINE OR SPERMACETI.

The conversion of tallow or any fat into spermaceti, more properly called stearine, is effected at so trifling an expense, that it might become a valuable export, not only to England but to the southern states of Europe. All that is required is, to saponify compressed fat by *well-calcined* and recent quick-lime, the alkali being afterwards abstracted by sulphuric acid. Fat of firm consistence submitted to the action of an hydraulic press, yields about one-fourth of its weight of oil called oleine. The stearine or spermaceti, constituting three-fourths of its weight, remaining in the bag, is the substance to be saponified.

The term "spermaceti" properly signifies the stearine contained within the cranium of a whale, but the same substance exists in all vegetable and animal oils or fats. It may be extracted from oil by agitation with a concentrated solution of caustic soda. A soap of stearine is thus formed, which may be separated from the *oleine*, or remaining constituent of the oil, by gentle heat and decantation. The oleine, whether produced from oil or fat, is more valuable for the manufacture of the finer soaps than tallow itself.

As the stearine constitutes the hardening matter of fat, it will be found in most abundance in those of the firmest consistence. Ox and sheep tallow, for instance, contain about 76 per cent. of stearine and 24 of oleine, Hog's lard has 38 stearine by 62 oleine, and butter in summer, 40 stearine and 60 oleine.

In olive oil at the temperature of 44° F., Braconnot found 22 stearine and 78 oline. In oil of sweet almonds, 24 stearine and 76 oleine. In rape oil, 46 stearine and 54 oleine.

Stearine in its native state may be separated by pressure alone; but in order to give it the properties of spermaceti as a substance for generating light, it must in the first place, be rapidly boiled in water, with about 16 per cent. of the *best* quick-lime, slacked only at the moment of using. If care be not taken in the selection of the lime, the operator may find it to have been converted into chalk by exposure to the air, in which case, it would be utterly useless; or the oyster-shell lime might contain a quantity of unburnt shell, by which its strength would be proportionately diminished.

The quick-lime and the compressed fat are to be boiled for three or four hours, until converted into soap, or stearite of lime; when this substance is cooled into a mass, it is transferred into a tub of water, with steam pipes distributed over its bottom, and containing, according to some accounts, highly concentrated sulphuric acid, nearly double in weight to the lime employed. Other accounts, however, state that only four parts of sulphuric acid are required to three of lime. The whole is to be boiled by means of steam poured into it through perforations in the pipes, and the mass is to be well stirred up with a wooden rod. The sulphuric acid forms with the lime an insoluble sulphate which falls to the bottom, leaving the fat converted into stearic acid floating at the top, from which the remaining oleine, or oleic acid, is separated by an hydraulic press.

The operator should bear in mind, that as sulphuric acid corrodes copper and other metal boilers, this second boiling should be performed in a wooden tub, by means of steam conveyed through pipes of lead or some substance not acted upon by sulphuric acid. The same sort of tub with steam pipes is indeed preferred to copper boilers for the first boiling.

After the separation of the oleine from the stearine by the press, the stearine, cut into shavings, is again cleansed by the action of the steam and water, and the supernatant mass is laded into moulds. When the cakes are cold, they are ground into powder, and again subjected to pressure. This last process eliminates all the oil. The texture of the mass in this state being too crystalline for candles, contrivances have been resorted to for giving it the smoothess of wax. Some recommend the fusion of one part of arsenic with one thousand parts of the stearine; others, the addition of two or three per cent. of wax.

In Paris, where, about two years since, tallow was sold at 6¼d. per lb., of 18 oz., and the produce cost the manufacterer, eight-pence, the sperm candle of the finest quality, was sold, retail, at fifteen-pence per pound (18 oz). In Sydney, Colonial sperm is charged two shillings per lb., 16 oz.; yet the labour of making, in Sydney, ought to be less than in Paris, where beef and mutton sell for 9d. a pound.

COST OF MAKING SPERM CANDLES IN PARIS.

25 kilogrammes (each 2¼ lbs. English) of tallow cost 31 francs—£1 5s. 10d.

| Produce. | francs. | cent. |
|---|---|---|
| 15 kilog. Stearine .............. | 15 | 1 |
| 8 kilog. Oleine .............. | 6 | 72 |
| 2 kil. waste—(exaggerated)...... | | |
| EXPENSE OF MAKING 15 KILOGS. OF STEARINE. | | |
| 4¼ kil. Quick-lime ........ .... | 0 | 25 |
| 8½ kil. Sulphuric Acid, of the density of 66° French scale .... | 1 | 70 |
| Labour .................. | 0 | 90 |
| Coals 7½ kil.................. | 0 | 40 |
| Wear and tear of implements.... | 0 | 75 |
| Accidental expenses........... | 0 | 50 |
| | 4 | 50 |

This calculation is made on the supposition that the whole of the fat is saponified; but if the fat be previouly divested of its oil, only three-fourths of the above expense will be incurred excepting that of the labour of the first pressing.

The above added to the value of the tallow, less the value of the oleine, will make the cost of the 15 kilograms of stearine 28 francs 78 cents., which is eight-pence per English pound, supposing the tallow to be 6¼d. The expense of making the candle on a large scale, in France is 1d. per pound. The wick is made of cotton yarn, coiled tightly round straight rods or wires, in the same manner as wires are coiled round the base strings of musical instruments. These wires are inserted into the moulds like ordinary wicks, and when the candle is perfectly cold the rod is withdrawn, leaving a hollow cylindrical aperture through the middle.

Stearine, in the English and French markets, would be worth at least four times the value of tallow, while the freight of its conveyance and other charges would not be increased The cost of transmission to London, and sale of tallow in net value £161 7s. 7d., amounts to £33 1s. 11d., of which sum about £24 is a constant charge dependent on quantity irrespective of value. If the Colonist, by the above process, could convert his tallow into stearine, supposing it to be worth a shilling a-pound in England, he would transmit to the value of about £640, at the same cost of freight and dock charges as would be paid for the smaller value, by which he would save £72 in the cost of transit, which saving would defeat all competition on the part of the home manufacturer.

The value of the oleine in the above French estimate is much underrated. There seems, in fact, no reason why it should not fetch even a higher price than the tallow, inasmuch as the finer soaps are made with it.

## FOSSIL INFUSORIÆ.

Among the fossil remains of a pre-existing world, the least in size, though not the least in interest, are the organic remains of infusorial animalcules, of the genus *Bacillaria*, discovered by M. Ehrenberg of Berlin. Numerous genera of fossil insects had been found in the Jurassic limestone at Solenhofen, and in the tertiary gypsum at Aix; but the fossil animalcules of Ehrenberg are not individual species, detected by a sharp eye or a powerful microscope—they actually form extensive strata of tripoli or polishing slate at Frazenbad, in Bohemia. These animalcules inhabit siliceous shells of singular beauty, and hence the white chalk-like powder, which a mass of them forms, is used by the inhabitants for polishing household articles of iron and brass. A single grain of this powder contains 180 millions of these animal exuviæ. M. Ehrenberg has discovered the same animalcules in chalk flints, semi-opal, and even in noble opal. We have now before us a specimen of a sort of green mud or powder from Virginia, which is constituted of analogous animalcular exuviæ, far surpassing in variety and beauty the finest specimens of the Bohemian infusoriæ. How such masses of these living beings should have accumulated to such an extraordinary extent, and been overwhelmed by one sudden catastrophe, is a problem of which it would be in vain to attempt the solution.

## THE PARALLEL ROADS OF GLENROY.

There are few of our readers who have not heard of the *parallel roads* of Glenroy, in the county of Inverness. These roads, or shelves, or terraces, are *three* in number, running in horizontal and parallel lines along each side of the valley or glen, turning round the head of the valley, and apparently terminating at its mouth. They are such as would have been produced by the margin of a lake, that had stood for long period at *three* different heights, and produced at each height a shelf, by washing down the detritus on its banks. Hence it has been a general opinion, that these parallel roads were thus produced, and that the lake had been emptied of its waters at three different times by some volcanic agency, which broke the lower barrier where the lake adjoined the valley of the Spean. Difficult as it was to admit three successive actions of volcanic power, which should leave no traces of their disturbance at the broken barrier, the theory received strong confirmation from the alleged fact, that the parallel roads had a water level, and consequently a curvature equal to that of the surface of standing water. Agassiz has lately applied the glacial theory to explain the formation of these shelves; and granting the existence of the agent, there can be no doubt of the legitimacy of its application. The fall of the Glacier of Getroz into the Val de Bagnes, in 1818, produced a lake half a league in length, 700 feet wide, and 200 feet deep; and the triple recurrence of such an event, after long intervals, would necessarily produce three parallel terraces, corresponding to its different heights. This theory however, plausible though it be, has not met with general acceptation, and has been supplanted by the ingenious speculation of Mr. C. Darwin, that the parallel roads are ancient lines of sea-beaches, produced by the action of the waves, and are indications of the successive rise of the land. Mr. Darwin and other observers have traced such raised beaches in several parts of Scotland. Similar indications have been studied, of the elevation of the coasts of Norway and Sweden. Mr. Lyell has shown, that since the existence of the present marine fauna, the province of Scania has been depressed beneath the Baltic, while other parts of the kingdom have been elevated. Professor Keilhau has measured the heights of different marine accumulations at altitudes of 600 feet, in the interior of Norway; and M. Bravais, by a series of accurate observations, has determined the exact levels of the lower and upper sea-beaches, which stretch from *ten* to *eighteen* leagues along the sea-loch of Altenfiord. But though these two beaches seem parallel to the eye, the lower one, which was forty-six feet high at its lower end, rose to ninety feet at its upper end, and the higher one from ninety-two to 122 feet. Hence it is considered probable, that this want of parallelism and horizontality, and the varying rise of the beaches towards the Norwegian chain, indicate a system of great ascending and descending movements of the earth originating in different centres of force, and indicating different intensities of action.*

## PHENOMENA OF SOUND.

Many remarkable sounds in nature are produced by repeated reflection from surfaces. In some situations the sound of a cascade is concentrated by the surface of a neighbouring cave, so that a person accidentally entering is startled at the uproar. In the gardens of Les Rochas, once the well-known residence of Madame de Sevigné, is a remarkable echo, which illustratrates finely the conducting and reverberating power of a flat surface. The Chateau des Rochas is situated not far from the interesting and ancient town of Vitre. A broad gravel walk on a dead flat conducts through the garden to the house. In the centre of this, on a particular spot, the listener is placed at the distacne of about ten or twelve yards from another person, who, similarly placed, addresses him in a low, and, in the common acceptation of the term, *inaudible* whisper, when "Lo, what myriads rise!" for immediately, from thousands and tens of thousands of invisible tongues starting from the earth beneath, or as if every pebble were gifted with powers of speech, the sentence is repeated with a slight hissing sound, not unlike the whirling of small shot passing through the air. On removing from this spot, however trifling the distance, the intensity of the repetition is sensibly diminished, and within a few feet ceases to be heard. Under the idea that the ground was hollow beneath, the soil has been dug up to a considerable depth, but without discovering any clue to the solution of the mystery. On looking round for any external cause, the observer who has supplied this description, says, "I felt inclined to attribute the phenomenon to the reflecting powers of a semi-circular low garden wall, a few yards in the rear of the listener, and in front of the speaker, although there was no apparent connection between the transmission of sound from the gravel walk and this wall. The gardener, however, to whom I suggested this, assured me that I was wrong, since within his memory the wall had been taken down and rebuilt, and that in the interim there was no perceptible alteration in the unaccountable evolution of these singular sounds."—*The Builder*.

* Mr. Murchison, who has given a full account of these interesting researches, calls upon geologists to ascertain if the shelves in Glenroy are really parallel.—*Address to Geol. Soc.*, 1843, p. 48, 49.

## NEW CULINARY PLANT.

**Oxalis** Deppei was first introduced into this country from Mexico in 1827; and was named by Messrs. Loddiges in their *Botanical Cabinet*, No. 1500. Subsequently, M. Lejeune gave it the name of Oxalis zonata, "in order to express the black bands of the leaf;" and M. Henon published some information concerning it in the year 1838.

The uses of this Oxalis in Belgium are enumerated by Professor Morren. He states "that if cut longitudinally the root is found to have a firm transparent rind, the tissue of which resembles that of salep; like it, it become white in drying, is transparent, and consists of cells enclosing a very nutritious substance. The young leaves are dressed like sorrel, in soup or as a vegetable; they have a fresh and agreeable acid, especially in spring. The flowers are excellent in salad, alone or mixed with corn salad, endive of both kinds, red cabbage, beet-root, and even with the petals of the dahlia, which are delicious when thus employed. When served at table, the flowers with their pink corolla, green calyx, yellow stripes, and little stamens produce a very pretty effect. The roots, after having been washed and slightly peeled, are gently boiled with salt and water. They are then eaten like asparagus in the Flemish fashion, with melted butter and the yolk of eggs. They are also served up like scorzonera and endive, with white sauce. They form, in whatever way they are dressed, a tender, succulent dish, easy to digest, and agreeing with the most delicate stomach. The analogy of the root with salep indicates that its effects should be excellent upon all constitutions.

The plant consists of a tapering, white, semi-transparent tap-root of tender substance; furnished, chiefly at and near the lower extremity, with hair-like fibres, a few of which also proceed from the sides. The centre is generally more or less hollow, with the medullary substance adhering in variously fissured portions. The roots in this case are not however in other respects unsound. Sometimes, from rapid absorption, clefts are formed externally; but this will probably be of rare occurrence under favourable circumstances of soil and climate.

On the top of the crown a mass of scaly bulbs appears; their scales are lined and fringed with orange-brown silky hairs. By means of these buds the plants can be easily and abundantly multiplied. The leaf-stalks are from nine inches to a foot or more in length, supporting four inversely heart-shaped leaflets; each having a dark coloured band across its centre; these bands are somewhat curved, so that when the four leaflets are arranged in a flat equidistant manner, a tolerably perfect dark circle is formed. The flowers are of a bright rose colour, and are supported on erect scapes above the leaves.

Professor Morren states that Oxalis Deppei "will not thrive in loam, still less in calcareous earth; that it always suffers in heavy land, and often will not produce its tap-roots; but in a sandy soil, light, and mixed with decayed vegetable matter, the plant acquires a large size. The aspect in which it is grown is immaterial, although a southern exposure is to be preferred when not dry." He plants the bulbs on the 15th of April, when he no longer fears frost, an inch deep and five inches apart, in rows which are seven inches asunder. Three or four are put into the same hole, taking care to arrange them in quincunx. The beds are kept clean and in the month of May are watered with liquid cow-dung. As has been already observed, the above mode was adopted in the society's garden; but it has been found that the plants do better when the bulbs are planted singly, six inches apart, in rows a foot asunder.

The soil in the Horticultural Society's garden is not naturally well adapted for the growth of some tap-rooted vegetables: the carrot in particular may be instanced as never producing very fine roots in the usual way of cultivation. This being the case, holes are sometimes made and filled with prepared soil for this crop, in order to encourage the tap roots to extend downwards without subdivison. A similar plan was tried with the Oxalis, and found to answer better than where the whole bed was composed of prepared soil; and the expense was of course comparatively little.

The bulbs were planted about the middle of April, so shallow as to admit of their being just covered; for thus they occupy a position with regard to the surface similar to that in which they are produced, and this seems indispensable if fine sorts are to be obtained. They have been observed, indeed, to spring up from a considerable depth; but in this case tap-roots were not formed.

During summer the soil must be kept moist in dry weather; otherwise, when rain falls abundantly, the sudden accession of water to the roots occasions their splitting. The plants should be allowed to grow as long as there is no danger from frost; but previously to this occurring, they should either be taken up or protected. If protected from frost, by frames, or otherwise, the roots will continue to increase in size till November. When taken up, the roots should be divested of the numerous bulbs formed on their crowns, and then stored up for use in a cool dry place, but secure from frost. A similar situation will be proper for the bulbs; or they may be kept in dry sand till the season of planting.

Mr. Cockburn, gardener to the Earl of Mansfield, at Caen Wood, Hampstead, grows this plant in perfection with no particular preparation of soil; merely plunging the bulbs in shallow drills, a foot apart, in borders dug and manured as for other kitchen-garden crops. He also plants it by the sides of walks in the woods, as an ornamental plant.

We have in our gardens another Oxalis, apparently the O Jacquiniana, which also produces tap-roots like those of O Deppei; but they are much smaller, and inferior in quality. That species is readily known by its flowers being very small and of a pale lilac colour.—*Horticultural Transactions.*

---

## RESEARCHES ON LIGHT.*

*(Continued from page 61.)*

**Dr. Ryan** has shown the necessity of some care in the use of the iodide of potassium, into a solution of which, Mr. Talbot reccommends the nitrated paper to be placed for a few minutes. If the paper is left too long in such a solution, the iodide of silver will be dissolved, that salt being soluble in an excess of iodide of potassium. Simply passing the paper through the solution appears to answer every purpose effectually. Mr. Collen has modified Mr. Talbot's process, by brushing over the paper with a weak solution of the ammonio-nitrate of silver, and in using the same solution in combination with the gallic acid, instead of the nitrate of silver. It does not, however, appear to me that any advantage is gained by this mode of proceeding. A careful adjustment of the best proportions of the ingredients recommended by Mr. Fox Talbot, will be found to afford better results in a shorter time.

"This calotype paper is capable of being used for the production of positive photographs by one process. Mr. Talbot, in his specification, thus describes his method :—'A sheet of sensitive calotype paper is exposed to the daylight for a few seconds, or until a visible discoloration or browning of its surface takes place; then it is to be dipped into a solution of iodide of potassium, consisting of 500 grains to one pint of water. The visible discoloration is apparently removed by this immersion; such, however, is not really the case, for if the paper were dipped into a solution of gallo-nitrate of silver, it would speedily blacken all over. When the paper is removed from the iodide of potassium, it is washed in water, and dried with blotting paper. It is then placed in the camera obscura, and, after five or ten minutes, it is removed therefrom, and washed with gallo-nitrate of silver, and warmed, as before directed. Engravings may be copied in the same way, and positive copies of them produced, but reversed from right to left. For this purpose a sheet of calotype paper is exposed to the daylight to darken it, as before mentioned; but it should be darkened rather more than when intended to be acted upon in the camera. The engraving and the calotype paper must be pressed into contact by screws or otherwise, and placed in the sunshine, and the copy will be produced in a few minutes. If the copy is not sufficiently distinct, it must be strengthened by means of gallo-nitrate of silver.'*

"No other paper, which has yet been discovered, is sufficiently sensitive to luminous agency to admit of its being used for taking portraits from the life. Portraits of exceeding beauty and fidelity, may be procured without difficulty, by paying strict attention to Mr. Talbot's directions for preparing calotype paper. The inventor prefers for this purpose, a camera the focal length of whose lens, is not more than three or four times the size of the aperture; and the head of the person whose portrait is to be taken, must be kept as steady as possible; and, upon pointing the camera at it, an image is received on the sensitive calotype paper. No very good result can be expected, unless the paper is sufficiently sensitive to give a good image in twenty or thirty seconds. Mr. Talbot thinks he gains considerable advantage by carrying on the process in the open air, under a serene sky, without sunshine; or if sunshine is employed, a screen of blue glass should be used to defend the eyes from too much glare, and thus prevent that distortion of feature which would otherwise arise."

Next, of

*The Chromatype.*

"M. E. Becquerel has investigated, with considerable care, the action of chromic acid on organic bodies under the influence of light; and he has shown that the darkening is dependent upon the nature of the size used on the paper. Perceiving this, it occurred to him that the application of starch as a size to the paper, pleasing effects might be produced, by the agency of iodine, and the result was satisfactory.

"According to Becquerel's method, a sizing of starch is applied very evenly over the paper; it is then steeped in a concentrated solution of the bichromate of potash, and dried. Pictures are taken in the usual way, and the paper is washed and dried. When dry, it is immersed in a weak alcoholic solution of iodine, and afterwards, when it has remained in it some time, it is rinsed in water, and carefully dried between folds of blotting paper. If the drawing is not considered to be sufficiently distinct, the immersion may be repeated, until it becomes so. The effect is not improved by using a more concentrated solution of iodine. When the paper is wet, the shades of the picture are of a very fine blue, but when it is dry, they become of a deep violet. If while the photograph is still wet, it be covered with a layer of gum-arabic, the colour of the drawing is greatly preserved, and it is more beautiful when dry.

"The metallic chromates have been thought to be compounds of too permanent a character to change under solar influence. Many of them, however, it will be found deepen in colour by exposure; and the chromate of mercury has been found to undergo a very remarkable change. Paper was prepared with the bichloride of mercury (corrosive sublimate) and the chromate of potash, and exposed with an engraving upon it for some hours. There were evidently some change of colour, but it was very slight, over the exposed parts. This was placed aside, and remained in a dark drawer for two or three months without being noticed. It was then found to have become through its substance semi-metallic, and both on the front and back of the paper, a tolerably good impression of the engraving was visible.

"Whilst these pages have been going through the press, the author has discovered a very beautiful variation of the chromatype. A neutral solution of the chloride of gold is mixed with an equal quantity of the bichromate of potash. Paper is washed with this solution, and dried near the fire. On exposing this paper to light, it speedily changes, first to a deep brown, and ultimately to bluish black. If an engraving is superposed, we have a negative copy, blue or brown, upon a yellow ground. If this photograph is placed in clean water, and allowed to remain in it for some hours, very singular changes take place. The yellow salt is all dissolved out, and those parts of the paper left beautifully white. All the dark portions of the paper become more decided in their character, and accordingly as the solarization has been prolonged, or otherwise, or the light has been more or less intense, we have either *crimson, blue brown, or deep black negative photographs* of a most beautiful character."

The section on the colour of flowers, acknowledged to be derived from Sir John Herschel's Researches, is very attractive, as a result, Mr. Hunt, observes:

"From an examination of these admirable researches by Sir John Herschel on the colouring matters of plants, it will be seen that the action of the sun's rays is to destroy the colour, effecting 'a sort of chromatic analysis, in which two distinct elements of colour are separated, by destroying the one and leaving the other outstanding.' The action is confined within the visible spectrum, and thus a broad distinction is exhibited between the action of the sun's rays on vegetable juices and on argentine compounds, the latter being most sensibly affected by the 'invisible rays' beyond the violet.

"It may also be observed, that the rays effective in destroying a given tint are in a great many cases, those whose union produces a colour complimentary to the tint destroyed, or, at least, one belonging to that class of colours to which such complimentary

* Repertory of Patent Inventions.

tint may be referred. For example, yellows tending towards orange are destroyed with more energy by the blue rays; blues by the red, orange, and yellow rays; purples and pinks by yellow and green rays."

(*To be continued.*)

## PRESERVATION OF WOOD.

MR. ALEXANDER PARKES, of Birmingham, has patented the following improvements in preparing solutions of vegetable and animal matters, for preserving wood and other substances.

The substance employed is *eupion*, or the bisulphuret or other sulphuret of carbon. The vegetable matters referred to are India-rubber, gum mastic, and other gums and resins; and the animal matter is phosphorus.

To form a solution of India-rubber, the patentee adds to each half pound of that substance two pounds of either of the above solvents, (preferring the bisulphuret of carbon, on account of its rapid volatilization), which he says will dissolve it, without heat, quicker than any other solvent hitherto employed; and the solution, thus produced, is passed through a linen or other strainer, to remove any impurities that may exist in the India-rubber. This solution is now ready for use, either in combination with other substances, such as sulphur, for the purpose of impregnating wood; or alone, as a waterproof coating; it should be kept either in closed vessels, or under water, to preserve its moisture. For some purposes, the solution is made by adding a quarter of a pound of bisulphuret of carbon, and three pounds of turpentine or naphtha, to each pound of India-rubber.

When a solid mass or block is required, seven pounds of the bisulphuret of carbon are added to every ten pounds of the India-rubber; and this mixture, after remaining in a close vessel for about two hours, will be soft enough to be kneaded by hand or machinery, and formed into blocks. These blocks may be dried in the open air; but it is preferred to place the moulds containing them, in a stove, heated to from 70° to 105° Fahr., with a refrigerator attached, to collect the bisulphuret of carbon, as it passes off. After this drying is effected, the blocks may be cut into threads or strands, if desired, which will, according to the patentee's statement, possess the original elasticity of undissolved India-rubber.

The bisulphuret of carbon, or the other solvent, is also used, as above mentioned, for dissolving gum copal, mastic, amber, lac, or other gums and resins, to be employed for preserving wood, manufacturing varnishes, and other uses; and, for some purposes, a portion of India-rubber, in solution, may be likewise mixed with the gums or resins. Six pounds of the solvent may be used to each pound of gum or resin; but these proportions will vary according to circumstances. The addition of one ounce of camphor, or four ounces of sulphuric ether, will facilitate the action of the solvent above named.

The solution of phosphorous is prepared by adding to each pound of that substance fifteen pounds of the bisulphuret or other sulphuret of carbon, and then thoroughly agitating the mixture. This solution is applicable to various uses; and amongst others, the patentee employs it for obtaining deposits of metal upon non-metallic substances, either by combining it with the substance on which it is to be deposited, as in the case of wax, or by coating the surface thereof. Any of the known preparations of wax may be treated in this way; but the one preferred by the patentee is composed of from six ounces to eight ounces of the solution, five pounds of wax, and five pounds of deer's suet, melted together at a low heat, on account of the inflammable nature of the phosphorous. The article formed of this composition is acted upon by a solution of silver or gold, in the manner hereafter described, with respect to articles which have been coated with the solution.

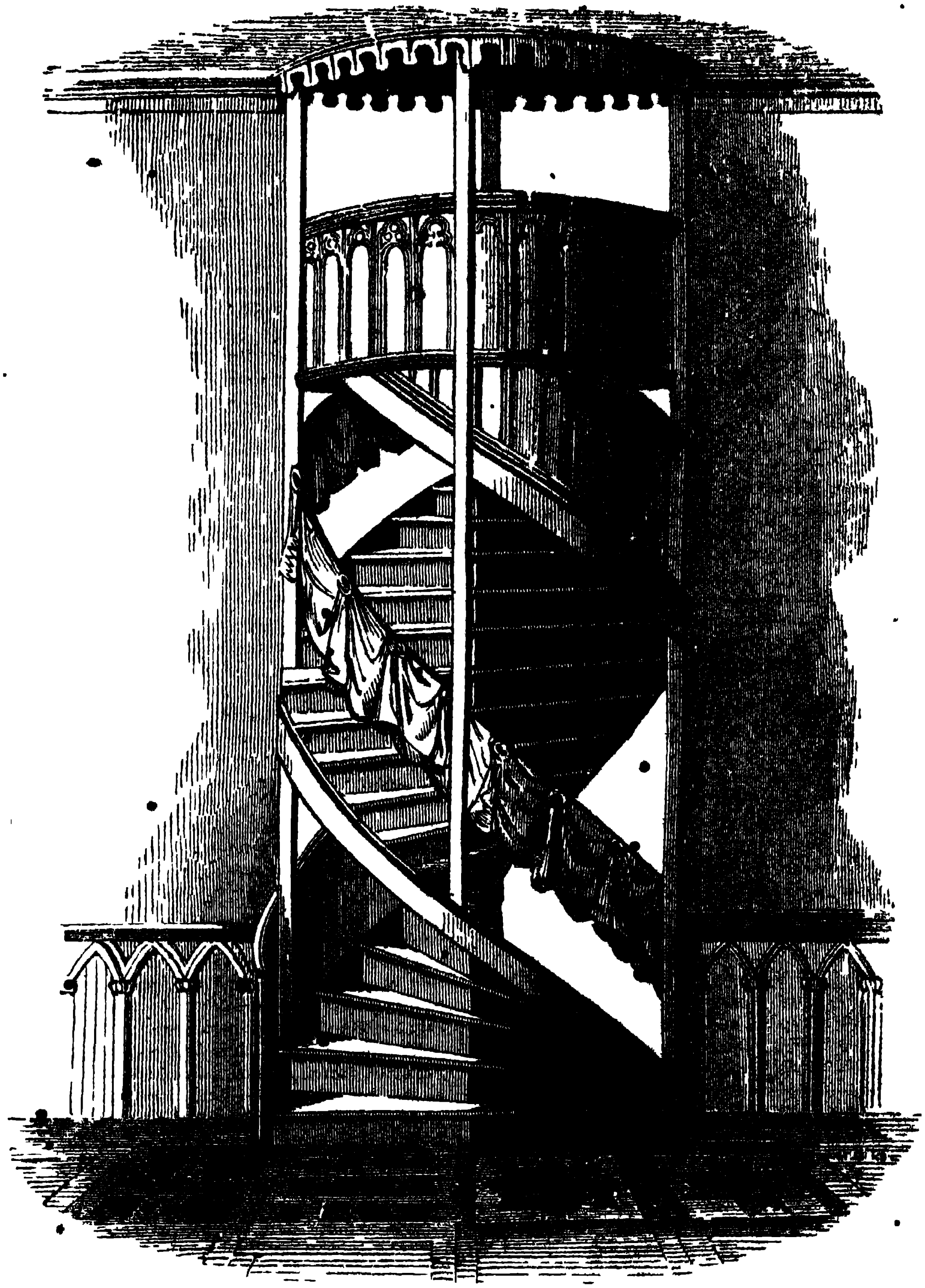
If the solution is to be applied to the surface of the article, an addition is made to it of one pound of wax or tallow, one pint of spirits of turpentine, and two ounces of India-rubber, dissolved, with one pound of asphalte, in bisulphuret of carbon, for every pound of phosphorus contained in the solution; the wax or tallow being first melted, the solution of India-rubber and asphalte is stirred in; then the turpentine, and after that the solution of phosphorous is added. The solution, prepared in this manner, is applied to the surfaces of non-metallic substances, such as wood, flowers, &c., by immersion, or brushing, the article is then immersed in a dilute solution of nitrate of silver, chloride of gold, or other suitable metallic solution, and in a few minutes the surface is covered with a fine film of metal, sufficient to ensure a deposit of any required thickness, on the article being connected with any of the electrical apparatus at present employed for coating articles with metal. The solution, preferred to be used, is prepared by dissolving four ounces of silver in nitric acid, and afterwards diluting the same with twelve gallons of water; the gold solution is formed by dissolving one ounce of gold in nitro-muriatic acid, and then diluting it with ten gallons of water.

## VARIETIES.

*Erection of Stoves.* — In an anonymous paper 'on the injuries occasioned by breathing impure air in close apartments,' it is recommended that stoves should be constructed of masonry throughout, as in many other countries, or of fire-tiles, or porcelain plates imbedded in mortar, with well-regulated flues, as they would then be far preferable to open fire-places, the substitution of imperfect conductors of heat being not only consistent with the principles of economy in the preservation of heat, and its more uniform distribution through apartments, but more salubrious than the methods usually resorted to in this country, of warming air by contact with iron stoves or pipes.

*To destroy Insects on Trees, Shrubs, &c.*—Tie up some flowers of sulphur in a piece of gauze, and dust the plants with it.

*Tracing Paper.*—In order to prepare a beautiful, transparent, colourless paper, it is best to employ the varnish formed with Damara resin in the following way:—The sheets intended for this purpose are laid flat on each other, and the varnish spread over the uppermost sheet by means of a brush, until the paper appears perfectly colourless, without, however, the liquid therein being visible. The first sheet is then removed, hung up for drying, and the second treated in the same way. After being dried this paper is capable of being written on, either with chalk and pencil or steel pens. It preserves its colourless transparency with becoming yellow, as is frequently the case with that prepared in any other way: it is at the same time cheap, and the operation gives very little trouble.—*From the German.*



STEINITZ'S IMPROVED CIRCULAR STAIRCASE.

## STEINITZ'S IMPROVED CIRCULAR STAIRCASE.

The ingeniously constructed circular staircase of which we have given a sketch on the previous page, is taken from a model exhibited by the inventor, in the Exhibition of Works of Decorative Art, at King Street, Saint James's, an account of which we have given in former numbers. It is one of the supernumerary articles on the landing-place, and has reference to some specimens of wood-flooring, wainscoting, &c., manufactured also by the inventor, at the East London Saw Mills, Berner Street, Commercial Road, East.

The demand for specimens of inlaid flooring, both in stone and wood, for decorating floors of the fore-courts, galleries, halls, staircases, &c., of the new Houses of Parliament, has not been of less consideration than the decoration of the windows with stained glass, or the doors and walls with carvings and paintings. It evidently appears from Mr. Barry's plan, that the flooring will be a very important consideration in the ornamental arrangements of the building; and the designs already submitted exhibit much taste and skill. Among the many specimens of mosaic pavement: tesselated, encautic and inlaid tiles, as well as those composed of variegated stone and marble; those composed of wood appear of a very substantial and durable character; in fact, the adoption of inlaid wood for the corridors, galleries and halls, &c., is just suitable for the building they are required for, where beauty and durability are an important consideration.

The design for the staircase is very simple and complete; and is the adaptation of two staircases comprised in one, whereby the facilities of going up and coming down are obtained in the same staircase, without collision. It will be perceived in the sketch, that the one compartment for going up is surbased with ornamental wood panneling; and the other for coming down, with hangings to shew the object clearer, whilst arrangements might be made for doors at the top to suit.

## METALLIZATION OF WOOD.

Several attempts have been made to render wood thoroughly impervious to rot, the ravages of insects, and the action of fire. To some extent, the patents of Kyan, Margary, Boucherie, and Burnett have succeeded in this object. The merit of the invention which we are now about to consider is, that it does not merely impregnate timber and other vegetable substances with metallic preparations, (those hitherto employed have been the expensive ones of mercury and copper,) but by means of chemical decomposition it actually fossilizes, so to speak, the substance acted upon, and by a combination of agencies, all of them quite inconsiderable in point of cost, creates of the wood an entirely new insoluble, durable, and uninflammable matter.

Mr. James Marsh, the Chemist of the Dockyard at Woolwich, so long ago as October 1841, carefully examined the details of the process under review, and expressed a strong and unqualified opinion as to the thoroughly effectual nature of the means employed to carry out all the objects specified in the patent. Mr. George Stephenson, the Engineer, in like manner, in July, 1843, minutely examined the process, and pronounced it to be the best devised to insure indestructibility. "I have examined," adds Mr. Stephenson, "Mr. Payne's prospectus on the merit of the invention, and I do not think he advances too much in his eulogium of the process. This method of preserving wood must be of immense value in countries where houses are built of wood."

We might therefore *a priori* pronounce that the objects contemplated are likely to be realized by the process. These objects are, as respects wood, 1st. To render it entirely proof against dry rot. 2nd. Capable of resisting the ravages of insects. 3rd. Uninflammable. If these results could be obtained at a small expense and in a short period, and the metallized wood be rendered elastic or non-elastic as required, and be so granulated externally and internally, as to adapt it with perfect safety for pavements, and other purposes, we might reasonably anticipate from such an invention, a revolution in some of the most important branches of industry; in the first place, from the value it would give to timber forests in the vicinity of railways and similar undertakings. it would create a new relation between the proprietors of forests and the projectors of such undertakings, and indeed affect the *modus operandi* of various professions connected with the mechanical arts, from the engineer and shipbuilder to the mechanic and carpenter.

A description of the process, however imperfect it may be, will enable us to form some opinion of its probable result. The substance operated upon is first placed in a vacuum in a solution of sulphate of iron, which is made thoroughly to saturate it by exhaustion and pressure. A similar process is then followed with a solution of the muriate of lime, and within the pores of the wood there is thus created, by decomposition, an insoluble sulphate of lime. It thus appears that the principle acted upon by the inventor was that the source of decay exists in the very nature and properties of the wood itself, and that a complete change must be effected in its structure by the permeation of a substance capable of resisting external influences, and arresting internal decay. By previously discovered processes, various metallic oxides and alkalies had been, by means of exhaustion and pressure, introduced into the cells of the wood; but it was reserved for Mr. Payne's ingenuity to overcome an objection common to all these processes, viz., the liability to a disunion of the solutions. This difficulty is met by the introduction of certain saline substances which prevent any such disunion taking place; and herein consists much of the merit of the patent.

The most porous, the softest and consequently the cheapest wood, under this process are rendered equal, in point of usefulness, durability and strength, to the hardest and best descriptions of timber. Not only is the beech rendered equal to the oak, but made to partake of metallic qualities, even more lasting than the timber which at present exceeds it threefold in price. We may pass over, in this place, with a cursory mention, the economical advantages of the process for other than railway purposes. Wood so prepared, even deal, becomes susceptible of the finest polish, and moreover, by the use of certain solutions, can be stained throughout with any variety of colour. In ship-building and house-building it would come into advantageous use, with the peculiar recommendation that the inferior woods of home and colonial growth would become at once more valuable in the market.

To return, however, to railways: several experiments have been made with the process to test its applicability not only for railway sleepers, but actually as a substitute for iron rails. A wooden tramway was laid down near Vauxhall, on which near 9,900 miles were travelled, equal in traffic, it was calculated, to a year of a great line, without any perceptible deterioration of the machinery; without even the obliteration of the saw marks on the beams; and 1,000 miles of this traffic were performed with 30 cwt. of fuel, costing about 40s., being less than one halfpenny per mile. It is to be observed, that the surface resistance of unprepared wood is about 50 per cent. greater than that of iron. On prepared wood the result is the reverse of this, at the same time that the granulated surface offers a bite to the wheels which enables the engines to mount inclinations impossible upon an iron railway. The process is also extensively used at present on the viaduct, on the Dover line, between the Bricklayer's Arms and New Cross, two miles in length. The London and Guildford Junction line is to be entirely laid with Paynized timber rails, as well as sleepers. The Chain Pier at Brighton has recently undergone extensive repairs by wood submitted to this process.

It is, however, true that no artificial process will give to wood all the properties of iron. Accordingly, it was found that the flange in ordinary use in the carriage wheels was likely, by its abrading action, to destroy the edge of a wooden rail. To counteract this, an invention of a valuable character has originated out of the experience presented in the course of the trials of the process now under consideration. Mr. Prosser's bevel wheel, acting as a guide to the carriage wheels, and by means of a groove precluding the possibility of the carriage going off the rails, renders the flange unnecessary. With this, the carriage-wheels may be perfectly flat on the circumference, and the risk just mentioned entirely obviated.

It is computed that half a pound of iron in solution is required to Paynize one railway sleeper. There are about 2000 sleepers to a mile; this, calculating fourteen sleepers to the load of timber, will give about 143 loads for that length of railway, for the sleepers alone, requiring, of course, 2,000 times half a pound, or about half a ton of iron in solution. For 100 miles of railway, the result is in like manner fifty tons.

| | £ |
|---|---|
| Now fifty tons of copper, (used in other metallizing processes,) at £45 per ton, cost .. .. .. .. .. .. .. | 2250 |
| Fifty tons of iron, at £4. .. .. .. | 200 |
| Saving by this process, as compared with that employing copper .. .. .. | £2050 |

The practical result is, that taking all expenses into estimation, a load of timber may be effectually Paynized at the expense to the public of fourteen shillings; and the sleepers of one mile of railway for £100.

It should be stated, that there is a French process of a very different character, which also employs a solution of iron;—viz. Dr. Boucherie's method, which is to cut off the top and branches of trees, when the sap is rising, and plunge the end of the trunk cut close to the ground in a basin of fluid, which capillary attraction draws up in place of the sap: a process evidently limited in application, and altogether unfitted for the preparation of log timber, or of wood to be in any way made up into furniture or parts of machinery. It should be observed, that it is the combination and chemical action of different elements, producing a new substance, with new physical characters, which constitute the merit of the invention.

## LOUD BEATS OF CLOCKS USED IN OBSERVATORIES.

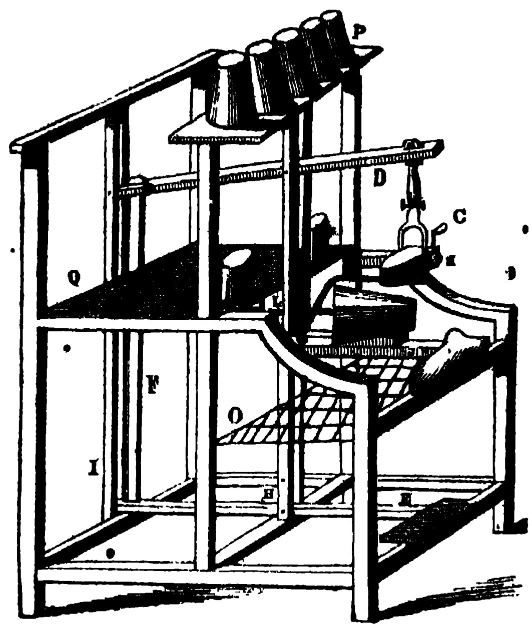
Mr. Eiffe has lately communicated to the Astronomical Society, a paper giving an explanation of a simple and easily applied method of obtaining very loud beats for the astronomical clock. The mode of constructing the apparatus is as follows:—

Two pieces of thin brass are placed at the sides of the frame-work of the clock, in length the same as the space between the pillars; in width, about two inches or more at pleasure; these pieces of brass are placed horizontally, at about the same altitude from the base as the axis of the escape-wheel pinion, and at right angles to it, or nearly so. They should be made of such a size as would insure a sound, distinct, sharp, and short. The little tables can be made to any size. Upon these tables or plates two hammers ply, supported by arbors at the same elevation as all the others. The pivots should be made small for easy motion. The hammers are intended to beat upon the middle of each brass table simultaneously with the drop proper of the escape wheel: through the agency of the pendulum, they are lifted alternately by the heels of the anchors of the pallets, assisted by a passing spring similar to that used in the chronometer escapement. It has just been observed, that the arbors which support those little hammers are placed at the same elevation from the base of the brass frame-work of the clock as the escape-wheel arbor, but at the sides, and as near to the edge as possible. About the centre, or midway between them, are affixed brass collets, about $\frac{1}{8}$ of an inch in thickness, and $\frac{1}{4}$ of an inch in diameter. Two slender pieces of spring are secured to the collets by screws passing through square holes formed longitudinally, to secure power of adjustment for bringing the arms into proper contact with the anchor of the pallets. The little hammers beat upon the plates or tables at one end, and at the other the lifting action takes place, assisted by the passing spring. The strokes upon these brass tables have a peculiar sharpness of tone, which can be accounted for in some measure, when it is considered that they are very different from the sounds produced by the teeth of the wheel itself; in the dead-beat escapement the teeth have a sliding motion in the moment of drop, but not impulse, for it is well known that that is subsequent to the sound. By such application it is proposed to obtain sound, so loud as to be *distinct in the most stormy night*; but as the constant connexion of such apparatus would neither be desirable as concerns the action of the clock, nor pleasant to the ear as a companion, a mode has been introduced of readily detaching it altogether. By a certain method, which shall be explained, the hammers are raised from the tables at one end, and the arms at the other entirely disengaged from the anchor at the pallets, without inconvenience or disturbing action to the clock itself. The apparatus within is immediately, and at pleasure, acted upon through the agency of a bolt, which is placed vertically, immediately over the sixty minutes, or about two inches back, sufficiently long to reach a spring of hard brass, which is about half an inch wide, and which passes transversely over the frame-work of the clock, and is fixed securely to the backboard of the clock-case. Now the mode in which the spring unites its action with the rest of the apparatus is by slight cross-bars, which extend to the extremities of the sides of the frame, so that the ends are immediately over the hammers, with which they are connected by silk threads. Therefore, by pressing down the bolt before named, the hammers are allowed to fall into action, and do their duty simultaneously with the teeth of the wheel upon the pallets. While the little hammers are in action, the teeth of the wheel are no longer heard.

The Astronomer Royal declares by letter, that he has examined the plan, and is enabled to say that it answers completely for its proposed purpose; and that it appears likely to be very useful. Moreover, that the rate of the clock will not necessarily be disturbed during the time of its connexion—though that will greatly depend on certain conditions.

## THE PENNY POST.

The Rev. John Barlow, has just submitted to the Royal Society, a very interesting communication on the chemical and mechanical processes, and the social influences of the Penny Post. Mr. Barlow said that he took this subject because it exhibited one of those instances where immense mental labour, ingenuity, and applied science were required to produce the most familiar articles of common use. The notion of separating, by a system of stamps, the financial department of the Post-office from the transmission and delivery of letters, originated with Mr. C. Whiting, fourteen years since. This gentleman has been rewarded by the government for the taste and mechanical skill exhibited in the method in which he proposed to adjust his plan to the penny-rate adopted at the recommendation of Mr. Rowland Hill. With this notice of the history of letter-stamps, Mr. Barlow entered on the manufacture of the adhesive label. These are executed by Messrs. Perkins, Bacon, and Petch, on Mr. Perkins's principle of steel engraving by transfer. The process depends on the property of iron to become hard or soft as it receives or loses a small quantity of carbon. This was demonstrated by experiment; and the description of the process was illustrated by the exhibition of hard and soft steel rollers, plates, and impressions furnished by Messrs Perkins and Co. Mr. Barlow laid great stress on the absolute identity of every engraving, however numerous, produced by this method. He then observed, that the engine-work on the adhesive labels is of so close a pattern, that it cannot be taken off by lithography, or any similar contrivance, while, on the other hand, the eye is so accustomed to notice slight differences between one face and another, that the most skilful imitators of a minute engraving of a human countenance (as that of the Sovereign on the label) could not possibly avoid such a deviation from what he was copying as would ensure the detection of a forgery. Mr. Barlow next adverted to the qualities of the coloured inks with which the labels are printed. Though sufficiently permanent to withstand the effects of sun-light, rain, &c., they would be discharged by any fraudulent attempt made to remove the obliterating stamp, for the purpose of issuing the label a second time. The gum used for fixing these labels to letters, Mr. Barlow described as being probably derived from potato-starch, and therefore perfectly innoxious. The manufacture of the postage envelope is effected by many powerful, yet accurate machines. The paper is pervaded by coloured threads as a security against fraud. When sent from the manufactory of Messrs. Dickinson, it is delivered to the firm of Messrs. De la Rue. It is there cut into lozenges by the engine of Mr. Wilson. One of these was exhibited, and its power contrasted with that of the old bookbinder's plough. Thirteen thousand five hundred lozenges for folding were cut in a few seconds. To exhibit the precision of this engine, 1000 strips of paper, each exactly $\frac{1}{80}$th of an inch in width, were cut in the same short time. Previously to being stamped, each lozenge has a notch cut in each side, for the convenience of folding: this is done by an angular chisel. The envelopes are then stamped at Somerset House. The machine used for this purpose, combines the operation of printing and embossing, and was invented by the late Sir W. Congreve. Mr. C. Whiting enabled Mr. Barlow to exhibit the whole process, by sending one of these machines, which executed several stamps, slightly differing in device from that on the postage envelope. One of Mr. De la Rue's folders also attended, and showed the rapidity with which the envelopes are folded and gummed after they are stamped. The government envelopes employ at Messrs. De la Rue's thirty-nine folders on an average, and a quick hand can fold 3,500 in a day. Mr. Barlow then noticed some statistical conclusions. One engraving on Mr. Perkin's hard steel roller will afford 1,680 transfers to soft steel plates: these again will, when hardened, admit of 60,000 impressions being pulled from each other, so that one original will afford 100,800,000 impressions of labels, enough to paper one thousand apartments twenty-four feet by fifteen feet, and twelve feet high, making allowance for door, two windows, chimney, pier glass, and dado. Twelve years ago, common envelopes were sold 1s. the dozen: now, the postage envelope, with its medallion, may be bought, wholesale, at half a farthing (exclusive of the stamp), and yet, though the manufacture is peculiarly costly, it returns a small profit to the Government. More than two hundred and twenty millions of chargeable letters were posted in 1843. Now, taking a common sized letter as an unit, this quantity would pave a road twenty-five yards wide, (the average width of Oxford Street, pavament included) from the General Post Office in London, to the entrance of Oxford. Or, supposing all the letter-boxes in the United Kingdom to be open twelve hours in the day, and to communicate with one large spout, the letters would keep flowing through it at the mean rate of fourteen in a second. Mr. Barlow then briefly noticed some of the social advantages of the penny post. He touched on the strength and permanence it afforded to the influence of home—on the motives for self-education which it supplied—on the aid it ministered to the inquirer after truth. He stated, that at present about five millions sterling are forwarded through the Post-office by money-orders, and noticed the advantage of this arrangement to all, but especially the humbler ranks. He asserted that nothing is too valuable or too fragile to be trusted to this cheap conveyance: birds' eggs and diamonds, living insects, and watches, pills, plaisters, and bills of exchange, are committed to it with equal confidence. Mr. Bagster sends each sheet of his Polyglott edition of the Holy Scriptures ten times through the Post-office, some of these transmissions being to learned men residing at a distance from London, so that under the old system the postage on each volume of this work would have amounted to £165. Mr. Barlow concluded by a short but expressive quotation from an anonymous writer, declaratory of the manifold benefits of the Penny Post, and of the obligations which the country owes to the originator of the system.




## PRICE'S MACHINE FOR BLOCKING AND PRESSING STRAW BONNETS.

A Blocker named Vincent Price became so afflicted from an aneurism, that he found he must abandon the business unless he could contrive a machine which would effect the pressing without the bodily pressure. He accordingly set about the task, and has succeeded so well, as to produce an apparatus by which, not only the bodily pressure is dispensed with, but twice the number of bonnets is pressed in a given time, than can be turned out of hand in any other way. The Society of Arts awarded to Mr. Price their silver medal for his invention; and our present account of it is made up partly from the last part of their *Transactions*, and partly from some communications made directly to ourselves by the inventor.

A is one of the blocks in a position to receive a bonnet; B is the box iron with its handle C, which is hung with double joints and swivel to the lever D, which is connected to the treadle E, by means of the vertical bar of iron F, the weight of which is sufficient to over-balance the box-iron B and the treadle E.

Instead of standing, as usual, the blocker sits on a stool, and by his feet on the treadle lowers the box-iron, the pressure of which he can vary from an ounce to upwards of 5 cwt., and which he can also guide and turn in any direction by the handle C.

The middle upright bars, H and I of the frame, are made double, to serve as guides to the lever D and treadle E, and also to receive the movable cross bar, which supports the block. When the sides are to be blocked, the axis is drawn forward out of the metal socket, and the block placed on the end of it. To the axis is attached an arm which is moved by either hand of the blocker, so that the bonnet may be turned quickly round under the iron: the arm has a balance weight.

O O is a net stretched across the whole space before the blocker, on which the bonnet may be laid. P and Q are two shelves on which to place blocks of different sizes.

## EFFECTS OF CAMPHOR ON CUT FLOWERS.

The stimulant effects of camphor upon the human and some other animal bodies are well known; but those on vegetables are not only new, but astonishing in their nature. A piece of the woody stem of the tulip-tree, with one flower and two leaves, taken out of a pot of water, containing several other flowers of the same plant, all, to appearance, in the same state, was placed in eight ounces of water, which had been stirred up for some time with one scruple of good camphor; while the others, though they had the benefit of a larger quantity of water, were sensibly drooping. The two leaves first elevated themselves considerably on their footstalks; the flower expanded more than in a natural state; the stamina orchives receded from the pistillum; and the three leaves of the calyx, or flower cup, were remarkably reflected back, and grew extremely rigid and elastic. The internal surface of the petals of the flower, perspired considerably, though a similar perspiration could not be perceived in the flowers of the same plant, in the same room and temperature. The camphorated plant continued in a very invigorated state for two whole days, after which it began to droop; but the leaves drooped and decayed sooner than the flower. The other flowers and leaves of the tulip-tree left in simple water, did not live more than half as long as that in the water impregnated with camphor. Notwithstanding these surprising effects, no odour of camphor could be traced in any part of the branch, except what was immersed in the fluid. This circumstance seems to render it probable that the camphor was not absorbed by the plant, but that it exerted its remarkable influence entirely through the solids to which it was immediately applied. The appearance, however, was very striking, and might be compared to the beneficial effects of opium on the human constitution. Several other experiments were made with camphor on plants, in all of which it was very evident that camphor operated as a powerful and wholesome stimulant. A stalk of yellow iris, with one expanded flower, was taken out of a phial of water, in which it had been placed more than a day. The flower had begun to droop; but, in a very few minutes after being put in a phial of the same size, containing a few grains of camphor, it began to revive, and continued in a vigorous state for many hours. As camphor is but very sparingly soluble in water, it is natural to conclude that the stimulant effects were produced by a very small part of the quantity mingled with the water. This discovery might induce us to make experiments with camphor as a manure, if the expense of trying them on a scale sufficiently large were not excessive. But still, we may apply the camphor in the manner before mentioned; and can that be termed a useless purpose? A few grains of camphor, acting as a cordial, will revive a drooping plant, increase its beauty, and prolong its existence. In the eye of a florist, these are objects of no mean importance.

This observation is given on the authority of Burt's observations on the curiosities of nature, and may be accurate, but the experiment is so easily tried on common flowers, that every body should try for himself in as many ways as are available to him. We remember well, however, seeing a gentleman from a distance unpack a box of carnations and picotees, which looked shrivelled and bad; all we heard from him at the time was that he had "put too much," and afterwards, while bewailing his fate, "I have made it too strong." From these we gathered that he had mixed something with the water in which the flowers were placed for travelling, but what that something was we heard from a third person, who seemed to rejoice at the failure, and who informed us it was nitre; we were then assured that a little nitre was a very good thing for flowers that had to be kept long after they were cut. We confess our ignorance of these things, having always found plain water sufficient for our purpose; but, if anything half so advantageous as is pointed out in this paper be found, for the use of those who travel far with flowers, it will be of great service. All we recommend is that people satisfy themselves by actual and repeated experiments before they venture to adopt it with their show flowers, for every bloom is an object on the day of exhibition, and nothing should induce them to run the risk of spoiling one in their endeavours to improve it.

## ERRATIC BLOCKS.

One of the most curious subjects of modern research, relates to what are called Erratic blocks, or large masses of rock sometimes rounded, and often angular and unworn, which after having been detached from their native beds, have been transported by some unknown power to great distances. The most remarkable of these occupy a belt along the Jura range, about 800 feet above the lake of Neufchatel. These granitic masses must have travelled sixty or seventy miles from those parts of the Alps where alone the same granite occurs; but it is difficult to assign any known power by which such masses could have been conveyed. The most remarkable of these blocks, the *Pierre a Bot*, or Toadstone, was, as Professor Playfair informed the writer of this article, 64 feet long, 32 high, and 16 wide*—numbers which are easily remembered. In the arctic regions, large blocks have been transported to distant localities by floating rafts of ice; and hence it has been supposed by M. Charpentier and M. Venetz, and also by Agassiz, that erratic blocks had been carried to their present sites by the extension of existing glaciers, which, in the course of ages, have disappeared or shrunk back to their present dimensions.

The influence of icebergs, as the carriers of blocks and boulders, has been very recently studied in America by Mr. Hayes and Dr. Jackson. In the State of Maine, erratic blocks have been traced to a distance of 126 miles from their native bed. Blocks of granular granite from Viborg, in Finland, have been found near St. Petersburg and Moscow, at distances varying from 140 to 150 leagues; and blocks of sandstone have travelled from Lake Onega to Memel, a distance of 245 leagues. That icebergs perform, in many cases, the task of transportation, cannot be doubted. In the arctic regions, these icebergs are detached from glaciers which descend into the sea. When they tumble into the deep, huge waves are produced, which lift up large vessels upon the shore. It appears from oral accounts, that these icebergs are above 200 feet high, and from two to fifteen miles in length; and from careful admeasurement, some have been found from two to thirteen miles long. The limits on each side of the equator, beyond which icebergs are not found, are 40° of north, and 36° of south latitude.

The insufficiency of the glacial theory to account for the movement of erratic blocks, has led Mr. Hopkins, Professer Sedgwick, and others, to call to their aid the action of great currents of water, produced by the upheaval of the bottom of the sea. In ordinary waves, the water is moved only to a small depth from the surface; but Mr. Scott Russell, in his very valuable researches on this subject, has shewn, that when a solid mass has been suddenly raised from beneath the water, the surface of the fluid rises, in a similar degree, and produces a *wave of translation*, which does not rise and fall like the common wave, but advances above the general level, and sweeps, at the same time, along the bottom of the sea with a tremendous agency, capable of transporting the largest boulders. Mr. Hopkins has deduced from calculation the probable effects of such waves when elevations of from 160 to 200 feet are assumed; but though this theory may explain the transport of certain classes of boulders, there are cases of erratic blocks not water-worn, to which it is less applicable; and Professor Forbes has mentioned one of the *blocs perches* described by Charpentier, as situated on Mont Catogne, on a steep face of limestone, and at such a height above the bed of the Val de Ferret, that he considers it "impossible to conceive a block of that size deposited by the mere force of water."—*From a splendid paper on Cuvier's discoveries, in the North British Review.* No. 1.

* Von Buch gives other measures, viz, 50 feet long, 46 high, and 20 wide, or 40,000 cubic French feet.

## REFORM OF RAILWAYS.

The Secretary to the Society of Arts has lately read a paper on the reformed system of laying out and constructing railways, with a view to extending the benefits of the railway system to every part of the United Kingdom.

In 1839, Mr. Wishaw laid his plan of working single lines before the Institution of Civil Engineers, and in 1840, after completing a detailed survey of all the railways in the United Kingdom, and making practical experiments to the extent of 15,000 miles as to the working of the trains on all the British railways at that time open to the public, revised and corrected his plans, and then made it public in the "Railways of Great Britain and Ireland."

Since that period, the single way has made considerable progress, and engineers who scouted the idea of carrying on a large amount of traffic by the reciprocating system, are now laying out some of the principal lines on this system in a modified form, and it is understood that the great Holyhead line is to be constructed on this principle.

The mode of working a railway by this plan with any amount of traffic, may be thus described:—

The distances between the terminal and the nearest principal intermediate station, and between the two principal intermediate stations, are twenty miles respectively, which distances are made up of two engine-runs of equal lengths meeting together at the half-way stations.

To illustrate the mode of exchanging the trains which takes place at the exchange stations nearly simultaneously every hour, we need only describe this process between one of the terminal stations and the first principal intermediate station.

An engine (No. 1) starts from terminal station A, and another (No. 2) from the first principal intermediate station D, as the clock strikes eight, at an average speed of twenty-five miles an hour, including stoppages; the engines No. 1 and No. 2 will arrive by twenty-four minutes after eight.

At the exchange station C, where each engine run is furnished with a large twintable, capable of holding the engine and tender together, an engine (No. 3) is already on the up-line, ready to proceed with the up-train, and another (No. 4) on the down line, ready to proceed with the down train.

The engines No. 1 and 2 which have just arrived are turned into the engine sheds on either side, and the engines Nos. 3 and 4 are connected with the up and down trains respectively, and proceed forward precisely at 8 hours 30 minutes, there being six minutes (for the sake of example) allowed for the exchange for attaching or detaching carriages, &c., and for receiving and disembarking passengers.

At 8 hours 54 minutes, engine No. 3 will arrive with the up-train at the arrival platform of the terminal station A, where the passengers and luggage will be dispatched by omnibuses, &c.

In the meantime the nine o'clock down-train is preparing to start with engine No. 5, which has its steam up, and is waiting for the nine o'clock bell to be rung, or bugle sounded. The clocks at each station throughout are required to be of uniform construction, and by first-rate makers, and regulated twice in twenty-four hours by means of the electro-galvanic telegraph, which is considered a necessary appendage to all main lines of railway.

At twenty-four minutes past nine, engine No. 5 will arrive with the second down-train at exchange station C, and engine No. 6 will also arrive within a minute before or after with a second up-train at the same station as on the first exchange; so, again, engines Nos 1 and 2 are ready to proceed on the signal being given at 9 hours 30 minutes with the up and down-trains respectively; engines Nos. 5 and 6 are turned into the engine-sheds as before, and prepared to make the next exchange at 9 hours 54 minutes; engine No. 1 arrives at the terminal station A, as before, and engine No. 3 is again ready to start with the ten o'clock train, and so the reciprocating process is continued throughout the twenty-four hours at each of the intermediate exchange stations.

Intervals of one hour each for the starting of the trains, and also ten mile runs are taken, merely for the sake of easy illustration, but intervals of ninety minutes, which would give sixteen daily trains, and longer runs, according to each particular case, would answer equally well.

The estimated cost of construction of a line 60 miles in length, taking the prices throughout on a liberal scale, is, including stations, furnishings, plants, &c., at the average rate of only £15,435 2s. 5d. per mile.

The annual revenue, with the amount of traffic, would amount to £324,339 1s. 4d; and the annual expenses, including fund for depreciation of locomotives and stock, &c., and interests on loans, &c., £115,879 18s.

Thus the disbursements would amount, on an average, to £35·72 per cent. on the gross revenue.

| | | |
|---|---|---|
| The English railways at present in operation extend to . . . | 1,608 | miles. |
| The Scotch . . . . . . . . | 219 | ,, |
| The Irish . . . . . . . . | 80 | ,, |
| Making a total of . . . | 1,907 | |

The latter part of this paper was devoted to a consideration of the atmospheric system of railways, giving an account of its progress from the publication of Mr. Ballence's plan in 1824 to the present time.

## RESEARCHES ON LIGHT.

*(Continued from page 72.)*

"I may here mention, that some very remarkable changes take place in the colours of many vegetable powders, in which we may least expect such alterations to occur. Experience has shown to the pharmacopolist the necessity of preserving the powdered leaves of the fox-glove, the hemlock, the henbane, the aconite, and other green vegetable powders, of active medicinal powers, in the dark. It is found that these powders do not merely lose colour, passing slowly from a green into a slaty grey, and ultimately into a dirty yellow, but they undergo some decomposition, by which, at the same time, they lose much of their medicinal activity, and indeed after a season they become nearly inert.

"Few pharmaceutical articles suffer more in this respect than the powder of the jalap root; the ipecacuanha also loses much of its emetic power by exposure to Light. This is entirely independent of any action of the air or moisture. I have observed these deteriorating influences on those powders, which have been kept in the most carefully closed bottles.

"The powders of Cascarilla bark, of the Valerian root, and some others, particularly some of the varieties of rhubarb and the ginger root, are found to adhere with considerable firmness to the sides of the bottles next the Light, whereas the sides in shadow are left clear. I have also observed that a deposit will take in a similar manner on the sides of bottles containing some of the vegetable tinctures. This of course depends upon the same function which occasions camphor to be deposited in crystals upon the side of the glass next the Light, and maintains them there; whereas if that side is turned from the Light, the crystals will be gradually removed and again deposited on those parts upon which the rays of Light first impinge. These phenomena must have been long and often observed, yet we have not any satisfactory explanation of them. It does, however, appear, that we are advancing gradually towards the elucidation of these and many other matters, which have often excited the wonder of observers without leading to any particular enquiry.

Under the "Germination of Seeds," we find the following:—

"One very remarkable result must be noticed. Under all circumstances plants bend in a very decided manner *towards the Light*. In all my experiments with red fluid media *they have as decidedly bent from it*. I do not know how to explain this as the effect of mere heat; it would appear that some property resides in the red rays which acts in opposition to the general law. Further investigations are required on this point."

We are much struck with the following on

*The Aeration of Plants.*

"We have now certain knowledge. We know that all the carbon which forms the masses of the magnificent trees of the forests, and of the herbs of the fields, has been supplied from the atmosphere, to which it has been given by the functions of animal life, and the necessities of animal existence. Man and the whole of the animal kingdom require, and take from the atmosphere, its oxygen for their support. It is this which maintains the spark of life, and the product of this combustion is carbonic acid, which is thrown off as the waste material, and which deteriorates the air. The vegetable kingdom, however, drinks this noxious air; it appropriates one of the elements of this gas—carbon—and the other—oxygen—is liberated again to perform its services to the animal world. It is not possible to conceive a more perfect, a more beautiful system of harmonious arrangement than this, making the animal and the vegetable kingdoms mutually dependent. The existence of the one ceases when the other is destroyed. If the vegetable world was swept away, animal life would soon become extinct; and if all animal existence was brought to a close, the forest would fall, and the flowers of the field, which now clothe the earth with gladness, perish in the utterness of lamentable decay. It has been supposed that the vegetable world was called into existence long previous to the creation of animals, and to this period is referred the formation of the coal strata. There might have been an epoch when the disturbed condition of the earth—its earthquake shocks, and volcanic strugglings, may have poured so large a quantity of carbonic acid into the atmosphere, as to have rendered this planet unfit for the habitation of animals, until a teeming and most gigantic vegetation, by exhausting it for their own supply, purified the air, and rendered the more quiet earth a fitting abode for creatures endowed with reason and with instinct. But such events do not appear again likely to occur, and it is not within range of probabilities that the animal or vegetable kingdoms will ever have an independent existence."

Annexed is an attempt to account for the property possessed by certain animals of

*Seeing in the Dark.*

"It has been supposed that some animals may have the power of distinguishing such colours, that is that their eyes are affected by those rays of high refrangibility, which produce no impression of *Light* upon the eyes of man. M. Biot has, it would appear, found that some such effect is produced upon the eyes of some of the night-roving animals, by rays invisible to us. This may be. That which is *darkness* to us when we come from the sunshine into it, is found after a little time, when the lenticular arrangement of the eye has been adjusted to the required condition, to produce the sensation of tolerable Light. May we not, therefore, explain on the same principle, the power which the cat, the owl, and other animals possess of seeing in the circumstances we might regard as darkness? This reasoning is not calculated to settle the question, whether the eyes of any animals receive sensations of Light from the rays of heat, or of those producing chemical change. It does appear to me that a broad distinction is established between the solar influence, Heat, and the solar influence Light. That in many phenomena their operations so run together, that it is impossible to separate the one from the other, I am ready to admit; and also that it would appear from the experiments of Delaroche that Light and Heat are convertible into one another. The curious fact, discovered by this philosopher, that radiating heat becomes more and more capable of penetrating glass as the temperature increases, till at a certain temperature the rays become luminous; almost seem to confirm this, did they stand alone. The results obtained by Melloni with the solar rays do, as it appears to me, compel us to consider Light and Heat as two distinct powers, intimately connected with each other in their operations.

[*To be continued.*]

## DECORATIONS OF ROOMS.

Among the novelties of interior decoration is the following patented process by Mr. Drake, Surveyor, St. John's Wood, "for improvements in lining walls of houses."

They consist in covering walls with a lining of cotton or other cloth, coated on the back with a solution of caoutchouc. Where the walls have plain surfaces, the cloth is applied to them before the coating of caoutchouc is dry, and is retained in its place by means of wooden stretchers along the edges of the cloth, while the central parts of it are being rubbed down. When the walls are panelled, styles or battens are to be formed by mixtures of sand or cement. The panels are then to be first covered over with the cloth as before described, and afterwards the styles or battens, by which means a good finish will be given to the joinings; but instead of first coating the cloth with varnish previous to applying it to the styles or battens, the patentee puts a coat of varnish upon the latter, and then rubs on the cloth in such a manner that it may come in contact with, and adhere to, the various parts, as the members of mouldings, &c.

## VARIETIES.

*Thin Watches.*—Mr. Mylere, of Islington, has patented an improvement by which watches having vertical movements may be made thinner and flatter than usual. This is effected chiefly by inverting the fusee, that is, cutting it the reverse way. The pillar plate is also made with recesses, which are turned out to receive the end of the barrel containing the spring, fusee, &c.

*To escape the Effects of Lightning.*—Avoid standing under trees, to escape from the rain during a thunder storm, but boldly expose yourself to the wet; it will preserve you from the lightning Avoid standing close to any metallic bodies, as lead pipes or iron railings, &c. When in doors during a thunder-storm, sit or stand as near to the middle of the room as convenient; avoid standing at the window, or sitting near the wall.

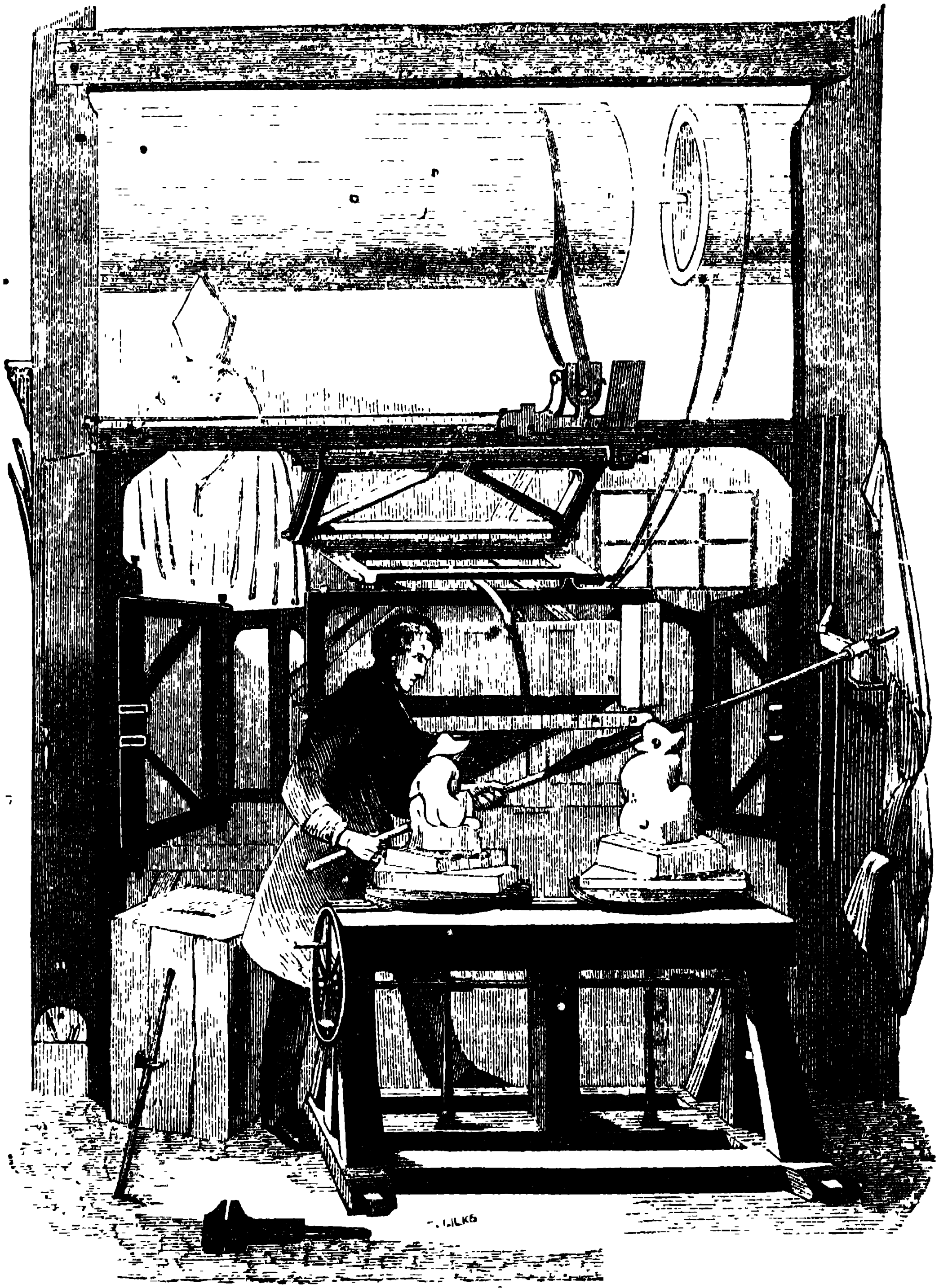
*Light Phial for seeing the Time by a Watch at Night.*—Dry phosphorous 1 part, olive oil 6 parts, put them into a phial, cork it, and place it in warm water for two or three hours. For use, pull out the cork, and sufficient light will be emitted to enable you to see the time by a watch. One bottle will last for years if well corked as soon as used. Æther may be employed instead of olive oil.

*To transfer Engravings to Plaster Casts.*—Cover the plate with ink, and polish its surface in the usual way; then put a wall of paper round it, and when completed, pour in some finely powdered plaster of Paris mixed in water; jerk the plate repeatedly, to allow the air bubbles to fly upwards, and let it stand one hour, then take the cast off the plate, and a very perfect impression will be the result.

*Slugs, &c.*—To preserve your annuals, marigolds, &c., from slugs and other vermin, scatter long shag tobacco (not pig-tail) round the stems. It has been tried with much success.

*Substitute for Yeast.*—Wheat flour, 8 lbs.; water to make it of the consistence of cream; boil for an hour; then add sugar 1 lb.; yeast ½ pint; ferment.

*To free trees, &c., from Worms and Caterpillars.*—Flowers of sulphur, 1 part; starch, 3 parts; make into a paste with water, and supply hot with a painter's brush.



NEW FRENCH SCULPTURE MACHINE.

## SCULPTURE MACHINE.

This machine is the invention of an ingenious Frenchman, and some of its mechanical products may be seen in the quinquennial *Exposition de l'Industrie*, just opened at Paris. We have not ourselves seen the instrument itself, but copy the annexed representation from *L'Illustration*, wherein the machine is described as a series of articulated parallelograms, which sustain between them a frame provided with arms, fitted with wheels and pinions; the nerves, the chains, and ropes, are innumerable; the iron fingers have nails, pointed, round, and beveled, to serve as a vice, and to work spirally round a cylinder; and the arms being set in motion by a steam-engine, one of them produces in a block of marble in the most delicate manner the respective features, as the hollows of the eyes, the projection of the nose, and the several hairs; whilst the other arm rigorously follows the movements of the first, by means of two hammers working over each other, which rough-hew out the material; then, shears work over the parts which the hammer has left; and, at length, in the course of an hour, a perfect bust is produced. The specimens in the *Exposition* bear the name of M. Coutzen.

## ON THE QUALITIES OF TIMBER AND DEALS.

Mr. G. Bailey, Honorary Secretary to the Royal Institute of British Architects, has lately read to that Society the following important communication.

In the practical part of the profession of an architect, and especially in those branches which occupy by far the greater portion of the time and labour of most of us, the security of our foundations is certainly the most important object to which we have to direct our attention,—the second in importance is undoubtedly the choice of our timber. The properties of the various descriptions of wood coming under the denomination of timber, their relative strength and durability, their fitness for the various purposes of building, with regard to their stiffness in different situations and under different conditions, have all been treated scientifically and practically, in a manner highly useful to the architect, and the results have long been in our hands.

The attention of the profession has even been called, both in ancient and modern works, to the planting, growth, and felling of timber, and the varieties which local circumstances and soil may produce in the same species. That information of this kind is in the highest degree useful to the architect, and indeed indispensable to be known, is not to be doubted, and the important practical results which may be derived from inquiries strictly scientific, must be familiar to all of us, who, on a former occasion, have had the pleasure of listening to the Botanical discourses of our friend Mr. Dickson. But in the ordinary routine of our profession it is seldom, comparatively speaking, that we have to refer even to the original principles from which our practice is derived, and still less to questions connected with the organization and natural history of timber trees.

The architect, in fact, has seldom any connexion with the choice or conversion of his timber beyond certain limits. His choice is restricted to such qualities of timber, of such length and scantlings as he can find in the market, and on this point less information has been placed in the hands of the architect than any other connected with this subject. It has been thought, therefore, that a few words on the qualities of timber, to be found in the market as imported from the Baltic and from America, might not be unacceptable to the meeting. We will begin with European timber in the log, then proceed to American timber, and afterwards to the subject of deals.

### BALTIC TIMBER.

*Memel Timber.*—The largest supply of square fir timber brought from any part of the Baltic to this country at the present time is from Memel: it is divided into three qualities,—the best, termed crown, the best middling, and second, or brack Memel.

Of the first quality little comes to the London market, but a considerable quantity to the outports. It is of admirable quality and manufacture, nearly as clear of knots as the Riga timber, but not quite so close in the grain, nor so rigid, nor so durable: the more free it is from knots, the more liable it is to be shaky at the core. The knotty timber is less liable to this defect at the heart, because the knots serve as bolts through the timber to keep all the parts together. Crown Memel timber is usually somewhat more than thirteen inches square, and the best of it is from twenty-eight to fifty-five feet long, that which is longer being usually knotty at the upper extremity. The best middling is the highest quality of Memel timber commonly imported into London. Much, likewise, of the second middling, or brack timber, comes to the London market. The chief defect of this quality of timber is that it contains large knots, which renders it unfit to be cut into small scantlings.

*Dantzic Timber.*—Whenever squared fir timber of great length and size, coupled with durability, is required, the Dantzic timber is to be employed. On the average, Dantzic timber is the longest and largest fir timber that comes here from any port in the Baltic. It may be procured, upon order, as much as seventy feet long and sixteen inches square—it commonly runs fourteen or fifteen inches square. The cheaper sort of brack timber has the defect of being full of large knots; the best middling is knotty in a moderate degree, but the crown Polish-squared Dantzic timber, that which has been squared in the province where it was felled, may be considered, upon the whole, the very best timber that the north of Europe supplies: next to that of Riga it is the most durable of fir timber.

The timber from Pillau, Konigsberg, and Stettin resembles that of Dantzic, but is rather coarser in the grain and more knotty; that of Stettin, though not very long, is sometimes of very large size, as much as twenty inches square.

*Riga Timber.*—Riga used formerly to be the port from whence almost all the fir timber in the log, from twelve to thirteen inches square, required in this country for building purposes, was imported. As timber in the log, it is peculiarly applicable for beams, girders, and joists, being very rigid, and bending little under great weights; it is, moreover, very regularly squared, very straight, clear of knots, straight in the grain, and very durable, owing to its rigidity and freedom from knots. It is however, more liable than some other timber to the defect of being rent and shaken at the heart, for which reason the fir timber from other ports on the eastern coast of the Baltic is by many preferred for building purposes, and less of this species of timber is consequently now imported into this country.

Formerly a considerable quantity of timber in the log was imported from Narva, St. Petersburg, and Archangel, but scarcely any now comes from these ports—the St. Petersburg timber is defective as being very subject to rend itself and become shaky as it dries.

*Norway Timber.*—But little timber, and that of small scantling, is now supplied from Norway, although at one time large quantities were imported from Longsound, Porsground, and Berwick, but owing to the change in the mode of taking the duty some years since, by which the small timber of Norway was made liable to the same duty as the large timber from the Baltic (an exception being made only in favour of timber used in the Cornish mines), the importation of timber from that country almost ceased; it is now, however, again making its appearance in the London market. Some of the superior Longsound timber is of an excellent quality, and is, perhaps, the most durable of fir timber.

The timber from Gottenburg, Stockholm, and Geffle, is not usually well squared, seldom exceeds thirty feet in length, indeed is generally much shorter, and has, moreover, the bad property of rending and becoming shaky if kept in the state of the log, so that unless immediately converted, it loses much of its value; very little, however, of this timber is now imported into England.

(*To be continued.*)

## NEW APPARATUS TO PREVENT DROWNING.

Mr. R. Greville Pigot, of Old Cavendish Street, has patented the following improved Apparatus for supporting the human body, when immersed in water, for the purpose of preventing Drowning.

The improved method of supporting the human body in the water, which forms the subject of this patent, is intended to give the greatest amount of auxiliary buoyancy to the human frame, in the smallest space consistent with efficiency, and with the least possible inconvenience to the wearer; it is adapted in form, and method of appliance, to that part of the human frame which more particularly requires an additional buoyancy, and, at the same time, it is applicable to all classes, and both sexes—of continual wearability, yet permitting at all times by its form, of such convenient concealment, as shall render it imperceptible to the eye of the common observer.

Secondly, as from long immersion in the water, at inclement seasons, even the strongest and most proficient swimmers become chilled, and the physical powers of endurance so much paralyzed and perished, that, though supported by such an agent as the improved apparatus, few but the hardy and inured could survive a protracted immersion; it is of the utmost necessity, as a provision for the worst, that mariners and voyagers by sea should, as much as possible (in northern latitudes), clothe themselves warmly; whereby they will be enabled to resist much longer the chill incident to long immersion, which is more particularly felt about the kindeys and region of the loins; in which sensitive part the blood soonest loses its caloric, and entails that palsy so fatal to the physical powers, to retain which, and to keep up the warmth in the lower limbs and trunk, the apparatus is combined in such a manner that it is both a buoyant power and a protection from the chill of the water as will hereafter be described.

The form and external appearance of the invention, is a life-preserving shirt front, or chemisette, to be worn over the shirt, and assuming then the appearance of the front of that garment; containing within it an apparatus constructed with air-proof cells, of capacity proportioned to the weight and size of the wearer, communicating with each other, and simultaneously inflatable by means of an air-valve, and enclosed between any two waterproof fabrics. When put on, by passing the head through the aperture, the front of the apparatus assumes its place exactly over and upon the cavity of the chest and lungs; forming, as it were, an additional artificial lung, the lateral air-cells of which extending in a narrow band over either shoulder, expand into the two shoulder flaps, that fall upon the scapulas, and are there confined by ties. The shoulder flaps are fastened down upon the back region of the lungs by two loops, suspended from their outer angles, through which the strings or bands affixed to the front of the apparatus, pass, and are then tied in front, whereby the whole is immoveably and safely fixed upon the chest and back, without the possibility of slipping; the whole shielding, by its position, the chest and collar bones from external injuries. The apparatus may be worn, either inflated, without inconvenience or unsightly appearance, or inflated only previous to being used, by means of the air-valve depending on the left side of the breast, close to the mouth. When worn alone as a bathing companion, it may be taken out of its covering, and used either with the shoulder flaps fastened down on the back in the way described, or by merely tying the front bands round the waist, when the shoulder flaps will rise, and form an agreeable support and pillow for the head, if the bather is floating on his back; thus greatly relieving the fatigue felt in the vertebræ of the neck by long immersion in the water. Upon the occasion of bathing with the apparatus as described, additional convenience is moreover felt by the use of a martingale, which may be affixed to the bottom of the front, passed between the legs, and fastened either to buttons on the bottom of the inner angle of each flap, when worn down, or to buttons on the centre of the back of the waistbands. The addition of this martingale enables the buoyancy of the apparatus to diffuse its action, and lift equally the lower and more heavy parts of the body, as also to steady the buoyant power of the chest.

The shirt front, or chemisette, may also be worn with a waterproof hose, for supporting the body, and, at the same time, resisting the evil effects of long immersion in the water. The lower garment, or hose, composing at once a foot and leg covering, worn with shoes, ascends in the form of a continuous hose or pantaloon, without opening, embracing the chest, under the breast, by a waistband of broad India-rubber web, to which the chemisette is affixed; which belt, on immersion, prevents all access of water between it and the body, without inconvenient ligatnre. This garment is made of an inner casing of flannel, which, at the same time that it keeps up the warmth of the limbs and body, acts as an absorbent of all perspiration. The external covering of the hose is cloth, or other woollen fabric, having on its internal surface a light waterproof composition.

To the shirt front, or chemisette, may also be added an inflatable cravat or stock, communicating therewith. The following are likewise modifications of this invention: without the shoulder flaps, or with decreased length thereof, as adapted to a mariner's woollen comforter; as a rowing chemisette, as adapted to a civilian's cravat, or stock and tie, alike applicable to bathing, with the others, and recommended as a skating companion; applied to upper male garments, such as mariners' jackets, waistcoats, coats, Guernsey frocks, &c., into which clothing it is admitted between the linings; applicable also to bathing, having strings and ties attached. As a garment for females, in the form of a pelerine, covered according to taste; applicable also without the latter, as a safeguard worn over the bathing dress, adapted to the use of light troops, and boarding parties, in war time.

The patentee does not confine himself in any particular material for the construction of his apparatus, as it may be made of any waterproof fabric containing air-cells, either communicating with each other, and inflating simultaneously (which form of structure, for general purposes, is deemed the most economical, where air is the floating agent), or distinct and separate air cells, or air tubes of metal, or other material, or of cork, the pith of alder, and other vegetable productions, the buoyancy of which is made permanent, by preventing that tendency to gradual absortion which, otherwise, eventually destroys their floatability, and particularly as regards the cork, of which the interior of the apparatus adapted to light troops, &c., is made. As cork is liable to decay, from access of insects, and from frequent contact with water (in which it soon loses one-fifteenth of the buoyancy), it is coated with a waterproof composition in thin solution, or any hydraulic varnish. The patentee claims the mode and form of the apparatus, and method of applying the same to the human frame, as above described, for the purpose of supporting the body in the water, and, of preserving the same from the effects of cold; he also claims the modes and forms by which the apparatus is covered and concealed from the eye, and further, the use of independent and unconnected air-cells or air tubes, of metal, or other materials, as also of the pith of alder, and other vegetable productions, prepared as above detailed, and of the employment of cork, prepared and preserved, after the manner above expressed, from decay and absorption, when such materials and structure are employed for the purpose, and in the way above described.

## RESEARCHES ON LIGHT.

(*Continued from page 80.*)

THE next quoted facts are strikingly illustrative of *The Independence of Light and Energia.*

"When M. Arago made his 'Report on the Daguerreotype,' before the Chamber of Deputies in 1839, he used these words—'Upon examining several of the pictures to be submitted for your inspection, all will consider the immense advantages which would have been derived, during the expedition to Egypt for example, of a means of reproduction, so exact and so rapid; all will be struck with this reflection that, if Photography had been known in 1798, we should this day have possessed faithful representaitons of many valuables antiquities, now, through the cupidity of the Arabs and the vandalism of certain travellers, lost for ever to the learned world.' Now, this hope has not been entirely fulfilled. It was of course imagined that, under the brilliant sun and clear skies of the south, photographic pictures would be produced with much greater quickness than they could be in the atmosphere of Paris. It is found however that a much longer time is required. Even in the clear and beautiful light of the higher Alps, it has been proved that the production of a photographic picture requires many minutes more, even with the most sensitive preparations, than it does in London. It has also been found that, under the influence of the brilliant light of Mexico, twenty minutes, and half an hour, are required to produce effects, which in England would occupy but a minute; and travellers engaged in copying the antiquities of Yucatan have on several occasions abandoned the use of the photographic camera, and taken to their sketch-books. Dr. Draper has observed a similar difference between the chemical action of the light in New York and in Virginia. This can only be explained on the supposition that the intensity of Light and Heat of those climes interferes with the action of the ENERGIC rays on these sensitive preparations which are employed. Dr. Draper furnished a prismatic image, impressed upon a Daguerreotype plate in Virginia, which exhibits some remarkable peculiarities, it has been described in a previous chapter. Nothing could be more valuable than a series of such spectral pictures, produced in different degrees of latitude, and at different elevations. It would be very easy to procure them from our magnetic observatories in different parts of the world, and these would afford much valuable information on this point. Captain Sir E. Belcher, of the Samarang, was furnished with very complete Daguerreotype and Calotype apparatus; the value of these in such an expedition must be exceedingly great. I endeavoured to impress upon Sir E. Belcher, the valuable assistance he would render to science by procuring, at different places in the progress of his voyage, impressions of the prismatic spectrum; and I hope, on the return of the Samarang to England, we shall find that some such have been obtained by her scientific commander, or some of his talented officers.

"In the last memoir of M. E. Becquerel, the conditions of the prismatic spectra, impressed upon various materials at Paris, are given with much minuteness; and an engraving accompanies the memoir, in which most of the spectra described are represented. In this series the maxima are found in the violet and indigo spaces, and the blue ray appears in all cases to produce a minimum effect, or nearly so. Now, all Sir John Herschel's, Draper's, and my own experiments give a high maximum to to the chemical influence of the blue ray. Are these differences due to some peculiar atmospheric absorption, arising from geographical position, or are they dependent on some peculiarities in the prisms employed, or on the manner of performing the experiments?

"The Roman astronomers state that they have procured Daguerreotype impressions of the Nebula of the Sword of Orion. Signor Rondoni has a secret method of receiving photographic images on a lithographic stone: on such a prepared stone they have succeeded in impressing an image of the Nebula and its stars; and 'from that stone they have been able to take impressions upon paper, unlimited in number, of singular beauty, and of perfect precision; each star, each filmy nebulous streak, faithfully depicting its own position.' Professor Robinson, of Armagh, stated at a meeting of the British Association at Cork, that he was led by the report of these experiments to endeavour to procure a Daguerreotype impression of the moon's surface. A portion of the disc of the moon was brought within the range of a powerful reflecting telescope, at which time the Crater of Copernicus was in active operation, and giving out a most intense Light. This brilliant image was thrown upon a Daguerreotype plate, which was placed in the focus of the reflector, and left exposed to its action for twenty minutes. Although a good impression of a building could be procured upon plates similarly prepared in a minute, yet this prolonged exposure to this Light produced no impression. The experiments of Forbes have shown that no heating power exists in the moon's rays; and this experiment of Dr. Robinson proves, in the first place, that lunar LIGHT will not act chemically upon the iodurct of silver, and in the next that it is not combined with that chemically active principle which I have called Energia, and which exists, according to Signor de Vico, in the rays of the remote star which form the Nebula of Orion's Sword and of Andromeda."

With another page or two, we take leave of Mr. Hunt's treasurable results:

"In 1840, I communicated to Sir John Herschel some very curious results obtained by the use of coloured media, which he did me the honour of publishing in one of his memoirs on the subject, from which I again copy it.

"A paper prepared for washing with muriate of barytes and nitrate of silver, allowed to darken whilst wet in the sunshine to a chocolate colour, was placed under a frame containing a red, a yellow, a green, and a blue glass. After a week's exposure to diffused Light, it became red under the red glass, a dirty yellow under the yellow glass, a dark green under the green, and a light olive under the blue.

"The above paper, washed with a solution of a salt of iodine, is very sensitive to Light, and gives a beautiful picture. A picture thus taken was placed beneath the above four glasses, and another beneath four flat bottles containing coloured fluids. In a few days, under the red glass and fluid, the picture became a dark blue, under the yellow a light blue, under the green it remained unchanged, whilst under the blue it became a rose red, which in about three weeks changed into green. Many other experiments of a similar nature have been tried since that time with like results.

"In the summer of 1843, when engaged in some experiments on papers prepared according to the principles of Mr. Fox Talbot's calotype, I had placed in a camera obscura a paper prepared with the bromide of silver and gallic acid. The camera embraced a picture of a clear blue sky, stucco-fronted houses, and a green field. The paper was unavoidably exposed for a longer period than was intended —about fifteen minutes,—a very beautiful picture was impressed, which, when held between the eye and the light, exhibited a curious order of colours. The sky was of a crimson hue, the houses of a slaty blue, and the green fields of a brick red tint. Surely these results appear to encourage the hope, that we may eventually arrive at a process, by which external nature may be made to impress its images on prepared surfaces, in all the beauty of their native colouration."

## ENERGIATYPE.

### A NEW PHOTOGRAPHIC PROCESS.

WE copy the following from *the Athenæum*:—

While pursuing some investigations, with a view to determine the influence of the solar rays upon precipitation, I have been led to the discovery of a new photographic agent which can be employed in the preparation of paper, with a facility which no other sensitive process possesses. All the Photographic processes with which we are at present acquainted, sufficiently sensitive for the fixation of the images of the camera obscura, require the most careful and precise manipulation; consequently, those who are not accustomed to the niceties of experimental pursuits are frequently annoyed by failures. The following statement will at once show the exceeding simplicity of the new discovery.

Good letter-paper is first washed over with the following solution—

| | drachms. |
|---|---|
| A saturated solution of succinic acid .. | 2 |
| Mucilage of gum arabic ... ... ... ... | ½ |
| Water .. ... .. .. .. ... .. | 1½ |

When the paper is dry, it is washed over once with an argentine solution, consisting of one drachm of nitrate of silver to one ounce of distilled water. The paper is allowed to dry in the dark, and it is fit for use; it can be preserved in a portfolio, and at any time employed in the camera. This paper is a pure white, and it retains its colour, which is a great advantage. At present, I find it necessary to expose this prepared paper in the camera obscura for periods, varying with the quantity of sunshine, from two to eight minutes, although from some results which I have obtained, I am satisfied that by a nice adjustment of the proportions of the materials, a much shorter exposure will suffice. When the paper is removed from the camera, no trace of a picture is visible. We have then to mix together one drachm of a saturated solution of *sulphate of iron*, and two or three drachms of the *mucilage of gum arabic*. A wide flat brush saturated with this solution is now swept over the face of the paper rapidly and evenly. In a few seconds, the dormant images are seen to develope themselves, and with great rapidity a pleasing *negative* photographic picture is produced. The iron solution is to be washed off as soon as the best affect appears, this being done with a soft sponge and clean water. The drawing is then soaked for a short time in water, and may be permanently fixed, by being washed over with ammonia—or perhaps better, with a solution of the hyposulphite of soda, care being taken that the salt is afterwards well washed out of the paper. From the pictures thus produced, any number of others correct in position, and in light and shadow, may be produced, by using the same succinated papers in the ordinary way; from five to ten minutes in sunshine producing the desired effect.

The advantages which this process possesses over every other, must be, I think, apparent. The papers are prepared in the most simple manner, and may be kept ready by the tourist until required for use: they require no preparation previously to their being placed in the camera, and they can be preserved until a convenient opportunity offers for bringing out the picture, which is done in the most simple manner, with a material which can be anywhere procured.

Anxious to give the public the advantage of this process during the beautiful weather of the present season, I have not waited to perfect the manipulatory details which are necessary for the production of portraits. It is sufficient, however, to say, that experiment has satisfied me of its applicability for this purpose.

Prismatic examination has proved that the rays effecting this chemical change are those which I have elsewhere shown to be perfectly independent of solar light or heat. I therefore propose to distinguish this process by a name which has a general, rather than a particular application. Regarding all photographic phenomena as due to the principle ENERGIA, I would nevertheless wish to distinguish this very interesting process as the ENERGIATYPE.

I inclose you a few specimens of the results already obtained. The exceeding sensibility of the Energiatype is best shown by an attempt to copy engravings or leaves by it. The three specimens I enclose were produced by an exposure of considerably less than one second.

I am, &c.,
ROBERT HUNT.

*Falmouth, May 27th,* 1844.

## THE AMERICAN STEAM-FRIGATE PRINCETON.

A PAINFUL interest is attached to this stupendous vessel from the frightful calamity which occurred in one of her trial excursions—viz: the bursting of one of her immense guns, by which several persons were killed and wounded. We subjoin a description of the entire vessel, her engines and armament, as reported by the Committee of the American Institute, to whom was referred the examination of the Steam-Frigate.

The ship is 164 feet in length, 30 feet beam, 22 feet hold, making her about 700 tons measurement. She draws 17 feet of water aft, and $14\frac{9}{12}$ feet forward. The peculiarity of her construction is great sharpness of entrance and run, with nearly flat floors, midships, which effectually prevent her being crank, notwithstanding the great weight of her battery.

The most obvious peculiarity of the Princeton's model is the great extent of her dead-wood, terminating with a stern-post of unusual thickness, being 26 inches through at the centre of the propeller shaft, but tapering both above and below. The object of this uncommon form is to give sufficient strength to the stern-post, as a hole of 13 inches diameter passes through it, in which the propeller shaft revolves. The stern-post also requires unusual strength, because the bearing which supports the whole weight of the propeller is attached to it, the shaft having no bearing abaft the propeller. The rudder is of an entirely novel construction, consisting of a frame of wrought iron filled in with five-inch pine plank, the whole of which is cased with copper plates, three-sixteenths of an inch thick, thus making the entire thickness of the rudder five inches and three-eighths. The mode of supporting the rudder is equally novel. It is hung to an outrigger of wrought iron, covered with half-inch copper-plate, the upper part being attached to a strong oak knee under the counter, and the lower part being attached to a solid frame of oak timber, 3 feet 6 inches wide, and 14 inches deep, firmly bolted to the after part of the keel and dead wood of the ship. The thickness of the outrigger is five and three-eighths inches, the same with that of the rudder, measuring two feet fore and aft, the forward part being made as sharp as a ploughshare. This sharpness and the thinness of the rudder prevent the current produced by the propeller from retarding the progress of the ship.

The steam-engine of the Princeton is styled by the inventor and patentee, Captain Ericsson, the "Semi-Cylindrical Steam-Engine." It has been constructed apparently with two main objects—that of being placed entirely below the water-line, and of giving a *direct* motion to the propeller shaft, which requires a greater velocity than can be obtained by the ordinary engine. These objects have been fully accomplished; indeed, so compact is the engine, that its highest point is placed more than four feet below the water line, and so far below the berth deck, that it affords space for lodging from two to three feet of coal above it, as well as on the sides.

The peculiarity of this engine consists in the use of semi-cylinders, instead of entire cylinders. These semi-cylinders are 72 inches in diameter, and eight feet long. The pistons are parallelograms attached to wrought iron shafts, forming the axis of the semi-cylinders, and are made to vibrate through an arc of 90 degrees, by the admission of steam alternately on opposite sides, ordinary side valves being engaged for that purpose. The piston-shafts pass through stuffing boxes at each end of the semi-cylinders; and at the forward ends, crank levers of 34 inches throw are attached, which, by means of connecting rods, only 74 inches in length, give motion to the main crank of the propeller shaft. The active surface in each piston measures 96 inches by 26, presenting an area of 2496 inches. The centre of pressure of each piston moves through an arc of precisely 36 inches: and thus, the Princeton's engines have equal power two ordinary marine engines, having cylinders of $56\frac{3}{4}$ inches diameter and three feet stroke,

At the opposite ends of the piston shafts, crank levers of 16 inches throw are attached, for the purpose of giving motion to the air pumps and force pumps. The Committee cannot refrain from noticing particularly the ingenious disposition of the working parts connected with these pumps, and the remarkably simple mode by which the requisite parallel movements are obtained.

The maximum speed of the engines is 37 revolutions per minute. The maximum pressure of steam in the boilers is 25 pounds to the square inch; and the steam in the semi-cylinders is invariably cut off at one-third of the stroke. The greatest speed of the vessel, as ascertained by Captain Stockton, in the Deleware, has been nearly 14 statute miles per hour. At the ordinary speed of 12 miles, the consumption of fuel has been found to be eighteen hundred pounds per hour.

The propeller of the Princeton is constructed by Captain Ericsson, of composition metal. The extreme diameter is 14 feet, and the upper part is full 3 feet below the water-line.

The boilers of the Princeton are also placed below the water-line, and resemble those of the ordinary marine engines; but their furnaces and flues are so constructed as to burn anthracite as well as bituminous coal.

Attached to the boiler is a heating apparatns possessing very remarkable properties, by which the water feeding the boilers is constantly heated before entering the same. The committee view this apparatus as perhaps the greatest improvement of which the low-pressure engine for ship use is susceptible. It not only continually supplies the boiler with hot water, but enables the engineer, when at sea, to "blow off" very freely, without any material loss of pressure or expenditure of fuel.

The smoke pipe of the Princeton is constructed upon the principle of the telescope, and may be elevated in lighting the fires, or when it is desirable to work the engines by natural draft. The contrivance made for this purpose is efficient, being a simple application of the endless screw, turned by a crank; and it enables two men to raise and lower the chimney with great facility, precluding the possibility of an accident from negligence, as the smoke pipe will remain stationary, whenever the men at the hoisting apparatus discontinue working it.

The fire draught is independent of the height of the smoke pipe, being promoted by centrifugal blowers placed in the bottom of the vessel, and worked by separate small engines. Thus, the steam machinery of the Princeton realizes all that can be desired for a war steamer, as the whole of it is placed out of the reach of the enemy's fire.

The steam machinery was built by Messrs. Merrick and Towne, of Philadelphia.

The armament of the Princeton, previously to the late accident, consisted of twelve forty-two pound carronades, and two two-hundred-and-twelve-pound Stockton guns. These last were made of wrought iron, said to have been thoroughly proved, and all were placed on the upper or spar deck. One of the Stockton guns, weighing fourteen thousand pounds, was placed eight feet forward of the mizenmast, and in a line with it; the other, weighing twenty-three thousand pounds, was placed at the bow. Both were mounted on carriages traversing on beds of timber, which are secured in the centre by strong pivots, around which they turn. These beds are supported by four friction rollers, inserted in the four corners, and travelling on a flat ring of composition metal let into the deck. The bulwarks, being moveable and very light, are readily unshipped, to give full play to the large guns in the direction required.

The carriages are made entirely of wrought iron, each side being composed of two plates, five-sixteenths of an inch thick, four and a half inches apart, and connected by a series of stay bolts. In the space between the two plates, a simple mechanism is ingeniously concealed, which enables four men with the utmost facility to roll the guns back and forward on the beds, and removes altogether the anticipated difficulties in managing ordnance of such immense calibre. It need hardly be stated that the difficulty of checking the recoil attending the heavy charge necessary for such a piece is even greater than that of moving the gun, and here again mechanical skill has triumphed to all appearance over the supposed insuperable obstacle. The ordinary breeching is entirely dispensed with, and the recoil is checked by opposing a gradually increasing friction to the carriage on which the gun is mounted. The means employed for this purpose exhibit a happy application of one of the fundamental principles of mechanics—that of the inclined plane, in connection with the laws of friction; and so successfully has this principle been applied, that although the friction-apparatus, at the termination of the recoil of the gun, becomes what is technically called *jammed*, with a force perhaps of many millions of pounds, yet by slightly touching a lever, it becomes instantly disengaged, leaving the gun and carriage perfectly free. A contrivance having the same object in view is applied to the carronades, which in them also dispenses with the ordinary breeching.

In connection with the Stockton guns, besides the carriage, &c., of which they have spoken, your Committee have to notice two other contrivances: Of these, the first is a lock so constructed that it is discharged at any desired elevation, without human interference, by a peculiar mechanism, in which the law of gravitation, in connection with the rolling of the vessel, is rendered subservient to this purpose. The second contrivance referred to is an instrument to measure distances, by which the requisite elevation to be given to the gun may be instantly determined.

The heaviest of the Stockton guns was forged in the city of New York, by Messrs. Ward and Co., and was bored and finished by Messrs. Hogg and Delamater, of the Phœnix Foundry. It was composed entirely of American iron.

The Princeton is sparred and rigged in the ordinary manner of sloops of war. The cabins are arranged in a very neat and tasteful manner.

## HOW TO DETECT SPURIOUS ARROW ROOT. &c.

M. Gobbley has lately instituted some very beautiful experiments, showing the influence of iodine vapour on the different *Feculæ*, or starches. Having exposed them to the iodine, after twenty-four hours' contact, he obtained the following degrees of colouration:—starch, a violet colour; potatoe fecula, dove colour; genuine arrow-root, the colour of café au lait clair; arrow-root with one-fourth of starch, a grey lilac; factitious arrow-root, dove colour; genuine tapioca in its entire state, all the grains of a yellowish colour; genuine powdered tapioca, a chamoy colour; genuine powdered tapioca mixed with one-fourth of starch, a violet colour; factitious tapioca in its entire state, some grains of greyish violet, others, yellowish; powdered factitious tapioca, chamoy colour; powdered factitious tapioca, mixed with one-fourth of starch, a violet colour; white sago in its entire state, some grains, a grey violet, the others, yellowish: powdered white sago, a chamoy colour; powdered white sago, mixed with one-fourth of starch, a violet colour; dextrine, no change of colour. By this table, it may be seen that starch and the potatoe fecula assume, under the influence of the vapour of iodine, very different kinds of colouration; that arrow-root, when it is pure, assumes the colour of café au lait clair; when mixed with a fourth part of starch it becomes of a grey lilac (the potatoe fecula would not serve for this purpose, as on account of the greater diameter of its granules, the fraud would be readily discovered), and that factitious arrow-root becomes of the dove colour, that is to say, the same colour as the potatoe with which it is prepared. Tapioca and sago, in the entire state, both genuine and factitious, sensibly assume the same yellowish tint, and the powder of tapioca and sago, both the genuine and factitious, which many pharmaciens purchase in the market, on account of the difficulty of preparing them, all assume a chamoy colour. Thus, by means of iodine vapour, starch can be distinguished from potatoe fecula, genuine arrow-root from that which is factitious or adulterated with starch; we may also ascertain whether the powder of the genuine and factitious tapioca has been replaced by the fecula of wheat or potatoe, or mixed with them; but it will be impossible to ascertain whether the powder of the genuine tapioca and sago has been replaced by the powder of the factitious articles, as they all assume a chamoy colour. M. Gobbley enquires why the potatoe fecula, starch, and arrow-root assume, under the influence of the vapour of iodine, a more or less deep tint, whilst genuine and factitious sago and tapioca, in the entire state, or when powdered, become of a yellowish colour only, and he answers the question by the fact that the latter have undergone the action of fire, which, as it is known, changes fecula into gum or dextrine. This latter, as has been said, is not coloured by the vapour of iodine; if then the genuine and factitious tapioca and sago assume a yellowish tint, it must be, because the feculent matter has not been changed into dextrine. The colouration of the feculæ is due to the property that these bodies possess of absorbing the vapours of iodine and of water. Experience shows that feculæ are only coloured by iodine, because they are humid: in fact, if, before exposing them to the action of iodine, they are dried at 212°, they will not become changed in colour, by a contact of twenty-four hours, providing they are so placed as not to regain their moisture. Although under these circumstances the feculæ remain colourless, they have nevertheless absorbed iodine, for, if they are brought into contact with water, they become coloured in the same manner as they would have done, if they had been used in their ordinary condition.

As a general result, M. Gobbley states that factitious arrow-root presents the granulated appearance of the genuine article. Genuine sago in its entire state, is easily distinguished from the factitious article. Genuine sago, such as it is met with at present in commerce, is in form of small irregular grains, very hard under the teeth, sometimes white, sometimes of a rose-colour. Genuine rose-coloured sago is very rare, almost all that is met with in the market being merely white sago, coloured with carmine. It is easy to discover this, either by treating the rose sago with ammonia, as Planche advises, or with alcohol. The ammonia or alcohol will dissolve the colouring matter, and assume a rose tint. Factitious sago is almost as hard as the genuine, but the grains are larger and more uniform; they are also much whiter than those of the true white sago. Thus these two sagos are easily distinguished from each other. Genuine tapioca in its entire state is easily recognised from the factitious. The first is in the form of irregular lumps, opaque, or of a dull white colour, very hard, always composed of small grains agglomerated together; whilst factitious tapioca is in almost regular fragments, less white in colour, softer under the teeth, but more brilliant than those of true tapioca; they are homogeneous in structure, and have not the granular appearance of the genuine tapioca. It is, therefore, very easy to distinguish between these two substances at sight, when they have been once carefully examined.

## VARIETIES.

*Vegetable and Animal Membranes.*—M. Payen has read to the Academy of Sciences, at Paris, a paper on the distinctive properties which exist between vegetable membranes and the coverings of insects and crustacea. The more prominents facts and conclusions are the following, derived from the treatment of the tissues of caterpillars, spiders, flies, &c., and cray-fish, cleansed from all foreign matter by boiling alkaline solutions, water, alcohol, and ether, and by muriatic acid when incrusted with a calcareous carbonate:—1. Sulphuric acid, with 1·5 of water, instantly separated and dissolved the insect-cases, but did not affect the vegetable epidermic tissues for some hours. with 3 proportions of water animal tissue was dissolved in a few hours, whilst vegetable epidermis resisted it for fifteen. 2. In ordinary nitric acid, with 3 of water, the insect coatings volume for volume disappeared immediately; but the structure and external forms of the vegetable pellicle remained in it for more than a month. 3. Muriated acid at 21°, or 6 proportions of water, penetrated, rendered transparent, broke up and dissolved the teguments of insects in a few minutes; but it acted very slowly on the epidermis of plants. 4. All the foregoing solutions of animal matter, extended and neutralised with a soluble base, were precipitated by tannin; the deposit, washed and dried, yielded, on calcination, alkaline vapours: nothing similar occurred in the like treatment of vegetable tissue 5. A solution, almost saturated, cold, of powdered chloride of lime, put into contact with each of these two substances, and then made to boil for some seconds, separated and burned rapidly the coverings of insects; whilst it attacked slowly the epidermis of a *Cactus Peruvianus*, affecting more the cuticle than the subjacent cellular tissue. The distinctive properties given above may, however, be attempted to be explained by peculiar cohesion, and not by real difference of composition. Elementary analyses, however, give three and four times more nitrogen to the animal than to the vegetable tissue

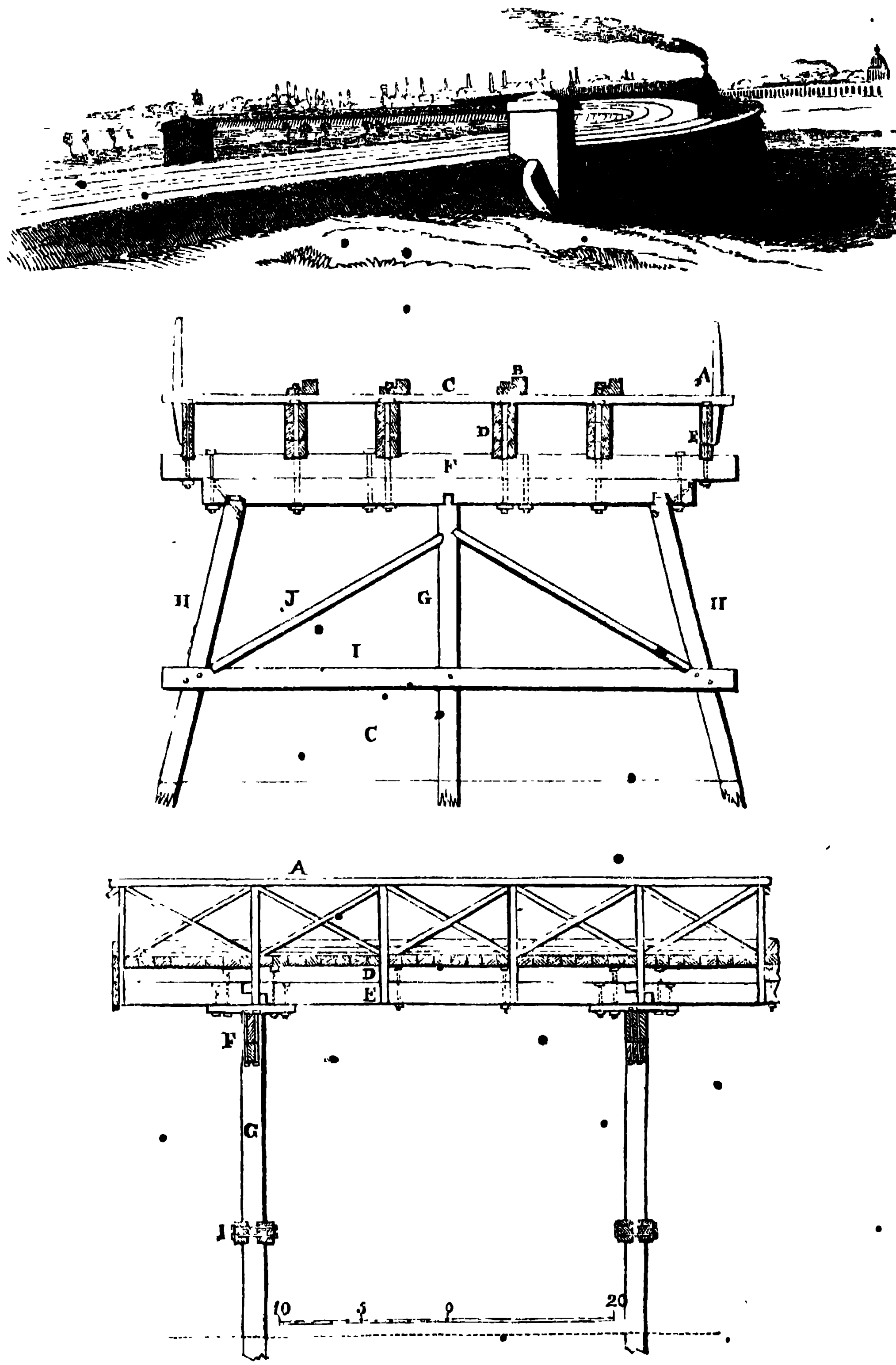
*To Estimate Distance.*—Observe how many seconds elapse between a flash of lightning and the thunder, and multiply them by 1142, the number of feet sound travels in a second, the product will be the distance in feet. The same process may be applied to the flash and report of a gun, or any other sound, provided we can ascertain the time at which it is produced, and the interval that elapses before it reaches the ear.—*Illustration.* Saw a flash of lightning five seconds before I heard the thunder; required the distance.

$$\frac{5 - 1142}{3 - 1760} = 1\tfrac{73}{528} \text{ inches distance.}$$

In the absence of a watch, the pulsations at the wrist may be counted as seconds, by deducting one from every seven or eight.

*To cure the habit of Drunkenness.*—In a small treatise on naval discipline, lately published, the following whimsical and ingenious mode of punishing drunken seamen is recommended:—"Separate for one month every man who was found drunk, from the rest of the crew: mark his clothes 'drunkard;' give him six-water grog, or, if beer, mixed one-half water; let him dine when the crew had finished; employ him in every dirty and disgraceful work, &c., This had such a salutary effect, that in less than six months not a drunken man was to be found in the ship. The same system was introduced by the writer into every ship on board which he subsequently served. When first lieutenant of the 'Victory' and 'Diomede,' the beneficial consequences were acknowledged; the culprits were heard to say, that they would rather receive six dozen lashes at the gangway, and be done with it, than he put into the 'drunken mess' (for so it was named) for a month

*To gather and preserve Herbs.*—Herbs should be gathered early in the morning, at the season when they are just beginning to flower. The dust should be washed, or brushed off them, and they should be then dried by a gentle heat, as quick as possible.




TIMBER VIADUCT, ON THE SOUTH EASTERN RAILWAY.

## TIMBER VIADUCTS, ON THE SOUTH EASTERN RAILWAY.

THESE great works are constructed in such a manner, as to combine great lightness of appearance, and economy of materials, with prodigious strength, at a tithe of the cost of an embankment, or brickwork arcade. The timber used in these viaducts has been subjected to Payne's anti-dry-rot process, by which it is not only protected from vegetable decomposition, but from any contingencies of fire, to which it might be subjected from the falling on it of ignited coals from the engines, as they traverse its surface.

The annexed engravings show a transverse section and elevation of the Timber Viaducts adopted at the above Railway on the branch from New Cross to the Bricklayers' Arms: and also at the Shakspere Viaduct between Folkestone and Dover; under the direction of Mr. William Cubitt, the engineer in chief.

The parapet, or railway A, stands 4 feet above the platform, the top rail is 4 inches by 3 inches, rounded on the top, the uprights posts 4 inches by 4 inches, with intervening cross rails; the guards or timbers B, lying alongside the iron rails, are 6 inches square. The platform C, on the top is 30 feet wide, out-to-out, and consists of timber laid close together, 4 inches thick; the four longitudinal bearers in the centre D, consist of two pieces of whole timber 13 inches square, and one piece of half timber, 5 feet long, 13 by 6½ inches, lying on the top of the transverse beams; the two outer bearers E are half the scantling horizontally, and the same vertically The transverse bearer F consists of two pieces of timber, 30 feet, and 26 feet long, and 13 inches square. The posts, or piles, G, H. are 13 inches square, the two outer piles H, are placed 23 feet apart, from out-to-out, and are driven in with a batter of 3 inches in a foot. The piles are prevented from spreading by two horizontal ties, I, 30 feet long, 12 by 6 inches, and are bolted on each side of the piles; there are also two diagonal struts, J, above 9 inches square, abutting at the feet on cleets nailed on the inner side of the outer piles.

It will be perceived that the whole of the timbers are well secured with iron bolts.

The distance in the middle on the top of the platform, between the centre of the rails is 6 feet, 2½ inches, and between the centre of the railings 4 feet 11 inches.

The horizontal dotted line at the bottom is Trinity Datum.

## NEW PUNCTIUNCULA STENOGRAPHIC SYSTEM OF EMBOSSING FOR THE BLIND.

THIS is the most ingenious system of embossing for the blind which has ever been brought before the notice of the public; no one can for a moment doubt, who is at all acquainted with the method now in use, and has witnessed the slow, tedious, and expensive process by which the blind are enabled to record their thoughts, by using the embossed type. In place of this costly apparatus, Mr. Hughes has invented a single instrument, which occupies no more space in the pocket than a common pencil-case; and with this instrument only, a cushion on which to place the paper, and a formula to guide the hand from line to line, the blind of all nations are enabled to record faithfully all that is required, either in language or the keeping of accounts. All this is done by the simple formation of two dots, one smooth and the other rough, which, by the addition of a single line, used horizontally, obliquely, and perpendicularly, represent every letter in the alphabet, and every figure in arithmetic. Added to this, all the various combinations are so definitely arranged, and in such a clear and simple manner, that even a child may become thoroughly acquainted with them, and, after very little application, be enabled to teach others. Nor is it in point of utility alone that this system will become an invaluable blessing to the blind; it will also afford them much amusement, and enable them to while away the too many tedious hours which they, amid "darkness visible," are, alas! doomed to endure; as the student can, immediately after having committed the alphabet to memory, commence writing. Neither is it in clearness and distinction alone, that Mr. Hughes's system excels all others which have hitherto been invented, but there is also a brevity about it, owing to the principal characters being perpendiculars; as an example of which, we would point out the Lord's Prayer, which is embossed in the volume, and which contains 278 letters; while in the stenographical characters which Mr. Hughes has invented, 120 only are employed, being 158 fewer than the number of letters of which the prayer consists. Thus, it will be readily conceived, that the blind will henceforth have the power of corresponding with each other, without submitting their epistles to the inspection of a third person. There is also another great advantage which this system possesses over all others, that is, its enabling all who can read, including the deaf and dumb, to correspond with the blind, by only studying the alphabet, and making the character for each letter in every word: to such correspondents the blind would have to emboss every word in full, instead of using the abbreviation which enable them to read so rapidly, nor would this require much more space than is used in general writing. Turn we now to the act of embossing, which is executed by placing a sheet of paper on a cushion, over which is laid a brass formula, cut into square holes, similar to the squares of a multiplication table, the bars between serving to separate distinctly each word that is embossed, and to guide the hand from line to line, whilst writing or embossing; thus rendering every line, and every word, clear, bold, and distinct, without either joining or running one word into the other.—*Literary Gazette.*

## GEOLOGY AND LAND DRAINING.

THE following very important and interesting paper, "On the Application of Geology to Land-Draining," has just been read to the Royal Institution, by W. Ogilby, Secretary to the Zoological Society.

Mr. Ogilby commenced by stating some of the more prominent injuries inflicted on the soil by stagnant water. He explained more especially how the land was rendered cold and late by the *great capacity of water for heat*, as compared with clay or sand, the same quantity of heat which is sufficient to raise the temperature of earth or mould four degrees of Fahrenheit, and of common air five degrees, being only sufficient to raise that of water one degree; the residue being absorbed by the water and rendered latent. Consequently, when the land is saturated by water, the sun's rays, instead of being expended in heating the soil, are absorbed and rendered latent by the water which it contains, and the soil derives but one-fourth of the warmth which it would do were it filled with common air instead of water. Other injurious effects were, that it soured the land, and gave rise to to the formation of substances hurtful to vegetation. These were caused by the exclusion of common air and the oxygen which it contains from the pores of the soil. Vegetable and animal manures thus remained imperfectly decayed, or decay was converted into putrefaction, and acetic, malic, tannic, gallic, and other acids, substituted for carbonic acid and ammonia, the products of simple decay, and which, with the elements of water, are now recognized as the chief agents in the nourishment of plants. Superabundant moisture, likewise, rendered the climate of a country insalubrious; but its injurious effects were more immediately recognized in supplying the roots of growing plants with a greater quantity of moisture than they are able to digest, and thus rendering them weak and dropsical,

Mr. Ogilby next proceeded to explain how these injuries might be remedied by efficient draining; and observed that land was rendered wet and unproductive from two sources; first of all by rain falling on the surface of a stiff clay soil, or stagnating within the pores of a loamy soil, incumbent on an impervious subsoil; and, secondly, by springs overflowing the surface from some higher ground, or oozing up from beneath the soil itself. These two different forms of disease required different modes of treatment; the system which would accomplish a radical cure in the one case, might, indeed, alleviate the effect, but could never remove the cause in the other; and Mr. Ogilby stated that the great error of modern writers on draining consisted in not being aware of, or at least not sufficiently distinguishing, these different causes of wetness in land, and the different modes of treatment which were applicable accordingly. The common method of *surface draining*, which was so much in vogue at present, and which was necessary and efficient for the discharge of rain water, would produce but a partial effect in alleviating the injuries caused by subterraneous springs; and that too at an enormous cost, compared with the expense of simple and more appropriate modes. High-lying arable soils, especially in Ireland, Scotland, and the West of England, were frequently injured by both causes; but the greater part of the mischief commonly arose from the rains which fell so abundantly in these localities, and it was to such lands that the system of *furrow draining* was peculiarly applicable. The principles of this system consisted in cutting parallel drains at equal distances of from fifteen to thirty or forty feet asunder, according to the tenacity or lightness of the soil, and leading them all into one or more main drains, according to the inequalities and size of the field.

Great differences prevailed among practical drainers as to the distance, depth, width, fall and direction of the parallel drains, which Mr. Ogilby ascribed to the different circumstances of soil, climate, and situation in which the several observers had found particular modes most efficient, and deprecated the idea of any one system or set of rules being universally applicable to all circumstances and localities. The distance of the drains he stated to depend entirely on the nature of the soil, of which it should vary inversely as the tenacity; in the stiffest soils experience proved that the drains were perfectly efficient at fifteen feet apart, and in very light soils at from thirty to forty feet. The depth was not subject to much variation or controversy; from 30 to 36 inches was generally sufficient, it being always understood that the main drains should be at least 6 inches deeper than the parallel, The width of the parallel drains should depend on the quantity of water they had to carry off; if the flow be insignificant the drain should be cut very narrow, generally not more than 2 or 3 inches wide at bottom, otherwise the water will stagnate, instead of running freely off; if the flow be more considerable, the drain must be made wider in proportion, to prevent a too rapid current from tearing up the bottom, and in time choking the drain. As to the fall and direction of the drains, it was stated that great differences prevailed, especially where the land lay on the face of a hill, and had a considerable slope; one party maintaining that they should be run perpendicularly up and down the face of the hill, another that they should be run diagonally across it. Mr. Ogilby believed both opinions to be right, under particular circumstances, but that neither of them was a correct expression of the actual principle upon which the direction of the drains depended, which he stated to be that the parallel drains should cut the different strata of the land perpendicular to the line of strike, whilst the main or leading drains should be in the direction of the dip. This position was illustrated by a large section of the Isle of Wight, and strengthened by the well-known geographical fact, that it is consonant to the system which nature presents in the direction of large rivers and their tributary streams. After explaining the various methods of filling these drains, by tiles, broken stones, wood, straw, &c.

Mr. Ogilby proceeded to consider the case of land injured by subjacent water contained in the bowels of the earth, and forcing itself up in springs from beneath, or trickling down from the tail or outcrop of some overlying strata. This was stated to be the cause of all the great bogs, fens and morasses which covered so large a surface in Ireland, Scotland, and some parts of England, and which, when laid dry, produced some of the finest land. This part of the subject was illustrated by numerous geological sections, explanatory of the formation of springs, and the origin of the fens and bogs to which they gave rise. The proper mode of draining such land was discovered and practised extensively during the latter half of the last century, by J. Elkington, a Warwickshire farmer, who had the merit of perceiving the relation which this species of wetness, and the origin of springs in general, bears to the geological stratification of the surrounding country, at a period when the knowledge of stratification was yet in its infancy, and confined to a few inquirers. The great success which attended Elkington's practice, attracted the attention of the government of the day, and a Parliamentary grant of 1,000*l.* was voted to him, on condition that he should impart his secret, as it was then considered, to certain individuals appointed by the board of Agriculture. This was done; and the result, published by Johnstone, one of the persons appointed, displays one of the most beautiful and important applications of scientific principles to practical purposes within the whole range of human knowledge. Yet, strange to say, the very memory of Elkington's system seems to be lost at the present day, or remembered only to be condemned as inefficient, though it rests on indubitable scientific principles, and the works of Arthur Young and the various County Reports are filled with testimonies of its efficiency and success. The truth, however, is, that its application requires a more extensive and scientific acquaintance with the origin of springs, the laws of hydrostatics and the principles of levelling, as well as a more practical knowledge of the stratification of the earth, than common land-surveyors, or most writers on this subject, can be expected to possess; and of all the practitioners of the present day, Mr. Ogilby stated, that Mr. Stephens, of Edinburgh, was the only individual whom he knew to be aware of the real importance of Elkington's system, or to have practised it extensively. The principles upon which this mode of drainage depends are purely geological. Elkington divides the different strata, which compose the globe, into two great classes, those which, like sand, gravel, &c., are of a porous nature, and permit water to sink into and percolate freely through them; and those which, like stiff clay, compact rock, and that species of gravel cemented by iron, which is commonly called till, are impervious to water. Suppose, as in the case of the plastic clay, and other geological formations, numerous alternations of porous and impervious strata occur, the rain-water which falls on the outcrop of the porous strata will percolate down through its substance till it arrives at the lowest point, where it will lie upheld by the subjacent bed of impervious clay, and confined by a similar bed above. The porous bed will thus resemble a bent tube, into one or both ends of which water is poured: if one or more holes be bored in the upper wall of the tube at its lowest point, the water will spout out of them like a little fountain; or, if the tube be filled, it will at last overflow at the ends. This is the cause of the wetness which gives rise to bogs and morasses. These swamps always rest immediately on a till or clay bottom, incumbent upon a stratum of sand or gravel filled with water, and cropping out on some high ground in the neighbourhood from which the water descends. The rains of hundreds or thousands of years gradually fill these porous strata, till they at length trickle over the lower edge of the outcrop, forming a continuous line of springs which overflow all the surrounding low lands, or burst up at the lowest point through accidental crevices or weak points of the superjacent clay beds, and give rise to the green welleys and shaking quagmires so frequently met with in fens and turf bogs. The former case happens along the edges of the London Basin, where the clay comes in contact with the subjacent sand beds of the plastic formation; in Kent and Sussex where the weald clay meets the Hastings sand on the one side, and the chalk ranges of the North and South Downs on the other; the latter is almost universally the case in the bogs and fens of Ireland and Lincolnshire. To cure the former species of wetness, it is only necessary to draw a trench along the line of the springs at a short distance below where they burst out, and sufficiently deep to cut into the porous stratum containing the water, and thus intercept it before it rises to the surface or overflows the land. The line of the drain is determined by the application of the spirit level, upon the principle that water always stands at the same elevation in the same reservoir or in reservoirs communicating with one another; and in cases where the porous stratum containing the water lies too deep to be reached by the bottom of the drain, wells are sunk at intervals, or a large auger is used to make bore-holes in the bottom, up which the water ascends, and of course lowers the spring or reservoir to the level of the bottom of the drain. In the second case, where the bog lies nearly level, and the springs burst up at intervals through accidental crevices in the till or clay bed on which it rests, one or more deep trenches are cut across the bog, in the proper direction to secure a good fall, and wells or bore-holes sunk as in the former instance through the subjacent clay to let the water escape: its level will consequently be reduced to the height of the bottom of the trench, which is always better to cut down to the clay or till, where the bog is not more than ten or twelve feet deep. Sometimes, when the bog lies perfectly landlocked or surrounded on every side by hills which afford no outlet, the water may still be carried off by sinking a well or bore-holes into a *dry* subjacent stratum of sand or gravel, and thus letting the water escape beneath. These principles, Mr. Ogilby stated, where applicable to many districts, and afforded the only cheap and efficient system for lands injured by subjacent water.

## IMPROVED BANK NOTE PAPER.

### PREVENTION OF FORGERY.

MR. W. NEWTON, the ingenious Editor of *The London Journal*, has patented the following elaborate improvements in the preparation of paper designed for bank notes, Government documents, bills, cheques, deeds, and other purposes, wherein protection and safety from forgery or counterfeits are required.

These improvements (communicated to the patentee by a foreigner residing abroad) consist in covering both sides of the paper used for bank notes, Government documents, bills, cheques, deeds, and other purposes, with designs arranged and printed in such a manner, that they can neither be imitated by hand nor through the agency of machinery, nor be transferred upon stone and then reproduced by any of the means known in lithography.

It is well known that stamped paper used for deeds may be washed, and used again for other deeds, the Government stamps being preserved unmutilated, and that part of the writing may be taken out, and other words substituted; also, that figures and indications of sums of monies may be altered by chemical processes, the stamp remaining entire, as well as the body of the document.

The designs printed on the surface of the paper, and on each side thereof, must be so organized as to render it impossible, Firstly,—to imitate the matrix plate from which the design is obtained; Secondly,—to trace or copy by hand all the elements or parts of the design with lithographic ink, for the purpose of transferring it upon stone; and, Thirdly,—to transfer the whole design upon lithographic stone, and from which proofs may be afterwards taken.

These results are said to be attained by the present improvements: the nature of the paper to be used, the designs to be employed, the mode of organising and engraving them, the printing of the same, and the nature of the inks, are thus described:—

The paper used for deeds and documents of all kinds must be of durable quality. Two sorts of paper are manufactured, one called "hand-made," and the other "machine-made" paper. The manufacturer of machine-made paper cannot conveniently use pulp pounded by mallets or beaters, as is the case for paper made by hand; the fibres of such pulp being too long to drain on the endless wire cloth. From hence arises the necessity of using grinding cylinders of great power, in order to convert the rags into a very fine pulp, and, as a necessary consequence, the machine-made paper is of a finer quality, but not so strong as the hand-made paper.

The papers made from pulp which has been bleached by chlorine, ought not to be used for making a safety paper; for the chlorine weakens the pulp, and opposes obstacles almost insurmountable, to the making of the safety paper. When manufactured in this manner, however carefully made, the paper will always retain certain chemical agents, which, after a time, may act upon, and eventually destroy, the vegetable substances used for colouring the inks. It is, therefore, of the utmost importance, in the production of safety paper, to employ that only which is manufactured by hand, with rags naturally white, and not bleached by chlorine. This observation has only for its object the production of a paper of the greatest possible durability, and not containing any chemical agents likely to attack the ink; but the improved method of preparing paper for all the purposes above mentioned, may be applied to continuous or machine-made paper, in the same way as to paper made by hand.

With respect to the engraved designs, it is not sufficient that they should be difficult or impossible to copy; it is also necessary that any falsification may be easily detected, and that the subscriber of a promissory note, the drawer of a bill of exchange, or any one else, should be able, at a simple inspection of the documents, to ascertain whether the design has or has not been reproduced by hand at the place where the amount of money is generally written, without being under the necessity of bringing another bill to compare with it.

The design must therefore be composed of regular parts, easily perceptible and recognizable by the naked eye; but it is essential that the "type figure" or device be geometrically regular, and present a distinctness in the lines, and a great symmetry in the disposition of its constituent parts. In its composition, there should be no straight lines, because they are too easily made with a rule; nor any curve which may be traced at once by compasses. The imitation of this regular element must present insurmountable obstacles to forgers.

The regular elements are to be distributed symmetrically on the whole surface of the sheet of paper, and must be repeated a great number of times, to offer a great number of points of comparison.

What has been stated with reference to one of the regular elements, taken individually, applies equally to the whole of the elements constituting the design. It is, therefore, indispensable, in order that these regular elements may be inimitable by hand, that they should be distributed on the surface of the paper with a mathematical precision, so as to offer a uniform tint. They are, consequently, to be engraved and distributed on the surface of a matrix plate, in steel or other metal, or on stone, by the agency of a machine. A regular element of design must, therefore, be mechanically produced, and repeated identically and at regular intervals on a given surface, so that the most skilful hand, assisted by the keenest sight and the most obstinate patience, would find it impossible to reproduce one of those elements, if it were obliterated.

The same impossibility would exist with reference to any attempt made to charge the whole of the lines constituting the regular element with lithographic ink, in order to transfer them on to stone, and strike off proofs from the same.

A design, produced in the same manner as above described, although it could not be imitated by hand, might be copied by mechanical means, and as a guarantee against that contingency the inventor has recourse to the following contrivance:—

The spaces left between the regular elements, are filled up by a design of a different aspect, but no confusion with the regular elements must take place; and, moreover, this design, as an indispensable condition, is produced by chance, so that it is impossible to obtain two similar drawings by using the same or any other means; the latter design is microscopic, that is to say, the elements constituting it can only be properly seen by means of a magnifying glass. This second design, produced by accident and not imitable, has for its object to render the counterfeit of the matrix plate impossible, and also stamped papers, which have been written upon, being washed, in order to produce another design upon them.

The organisation of the designs is thus described by the inventor:—A matrix composed of regular elements in the conditions above stated is to be engraved by means of a point and a suitable engraving machine. This design may be engraved or marked on a lithographic stone, or on a plate of metal, or even on a block of wood, but a steel plate is preferable, as this description of work requires great precision. A proof is taken from this plate in the ordinary manner of copper-plate printing, and transferred on to a lithographic stone by the means usually employed by lithographers. The transfer being thus made, a coating of gum arabic dissolved in water and slightly coloured (or any other substance soluble in water) is applied to all the regular elements constituting the design transferred on the stone. This coating, which is not spread over the intermediate spaces left between the regular elements of the design, is allowed to dry. Then a second drawing is transferred on to the whole of the same stone; this latter drawing being composed of irregular elements, much smaller than the regular elements of the first drawing, and which may be microscopic. It will be understood, that the regular elements being protected by the gum covering, and the intermediate spaces alone being left bare, it is only on the latter parts that the stone will receive the second drawing. This drawing is previously to be made on a sheet of metal or stone, or even on wood. It may be etched and engraved, either by the hand, by machinery, or by a chemical process; but, whether made on a metal plate, on stone, or by a typographic operation, it must necessarily be obtained by chance, so that it cannot be reproduced, either by the process that effected it, by any other process, or by the hand of an artist.

*(To be continued.)*

## ATMOSPHERIC TIDES.

Dr Sigmond has lately read to the Royal Medical Botanical Society, an interesting paper on the influence of the tides on the atmosphere in the production of the regular return of disease at periodical intervals. He pointed out that there existed tides in the air, recurring daily with the same certainty as do the tides of the sea, and that there is an ebb and flow twice in twenty-four hours, during which there is greater or less pressure upon the human body, which particularly affects the organs of respiration and the heat of the frame; and thus the periodic returns of asthmas, of fever, and of most diseases, were to be accounted for. The barometer indicated the different states of atmosphere with sufficient accuracy to enable medical men in all quarters of the globe to ascertain the diurnal variations, and to watch the influence upon man. Meteorological science had not yet sufficiently advanced to enable us to arrive at fixed conclusions upon the subject of the tides; they have, however, been completely established, and to the observations of La Place they were indebted for the first examination of the subject. The ardour of modern men of science would soon shew how climate and latitude would act upon the tides in the production of the return of the symptoms of disease. Dr. Sigmond brought forward many illustrations of this curious inquiry, and shewed how much the withdrawal of the smallest quantity of air, even that which is exhausted in the cupping-glass, produced a sense of weight and pressure on the body. If there was an oscillation of 1-25th of an inch of atmosphere (which affect at the least was shewn by the barometer to occur four times a day) it would materially influence the state of health and disease.

## ON THE QUALITIES OF TIMBER AND DEALS.

(*Continued from page 83.*)

AMERICAN TIMBER.

The only description of American timber known in this market in the state of the log, are the red pine and the yellow pine—for although pitch pine has been brought here, *via* Halifax, from the southern ports of the United States, yet that species of fir timber is scarcely known in this country as an article of consumption: it is said to be extremely brittle.

*Red Pine.*—The red pine approaches very nearly in quality to Riga timber; it is almost as stiff and is free from knots, but the irregular manufacture and tapering of the logs occasion much loss in the conversion of the timber for use in buildings; the manufacture of this timber is, however, improving, and it is consequently rising in public estimation. It is the produce of Upper Canada and the adjacent portions of the United States; it is brought down in rafts from the great lakes (on the borders of which it grows), by means of the River St. Lawrence to Quebec, where it is shipped for England. Great caution is necessary in the use of this timber; if the voyage from Quebec was as short as that from Riga it would not, perhaps, be more liable than Riga timber to take the dry rot, but owing to the length of time that it remains in the ship, or owing to the yellow pine wood, which, as deals or timber, is generally in the same hold with it, a cargo of red pine timber seldom arrives which does not exhibit, on some part or other of the surface of the logs, indications of the presence of dry rot, and therefore, although the timber, if not so treated, might not be liable to this defect, yet treated as it has been before it arrives here, it often is infected, and if then placed under circumstances only slightly favourable to the growth of the fungus, it will be the means of introducing the dry rot into a building, unless a closer examination be made of the surface of each log to be used than is usually done, or some means adopted to counteract the infection.

*Yellow Pine Timber.*—The yellow pine timber in the log comes from Quebec, from St. John's, from Miramichi, and from some other ports in New Brunswick. That from Quebec is not so fit for the better purposes to which yellow pine is applied as that of St. John's, nor is that of St. John's so fit for those purposes as that from Miramichi. That of Miramichi is the lightest and most spongy, and the least fibrous of all. It is exceedingly mellow, to use the joiner's term, has no tendency to warp, and preserves the form that the workman gives it. Yellow pine timber ought not to be used for rafters, joists, girders, or plates, in any building; for no purpose, in short, and in no situation, where strength and stiffness are required, and where the ends or any part of the timber come in contact with brick-work or masonry, or are liable or subjected to damp. Yellow pine timber is not rigid; it is deficient in strength; will break with a less weight than almost any other kind of timber; and, except in perfectly dry situations, or where it is thoroughly well ventilated, is extremely liable to take the dry rot.

DEALS, PLANKS, AND BATTENS.

The first thing to be considered, as regards deals, is the quality of the wood. Many deals are of durable quality, and fit, on that account, for rough out-of-door purposes, and coarse floors or carpentry, but they are wholly inapplicable for fine joiner's work; for when the saw has passed through and reduced them to small dimensions, they warp and twist like a piece of whalebone. Deals of this character are termed by carpenters "strong." Such deals have likewise the bad property, in general, of rending themselves to pieces as they dry, and become shaky. Deals that, when acted upon by the saw, do not form saw-dust, but are torn into long strings or fibres, and, on that account, termed "stringy," are in general of this strong nature. Such deals are likewise less uniform in their texture, and vary more in the alternate fibres and cellular parts than the deals which are fit for the joiner. The deal to be good should have a certain degree of softness, easily yielding to the knife or chisel. Such deals are to be distinguished by their light weight, in comparison with the strong fibrous deals, and when planed, they exhibit a silky texture. Some deals, and particularly the stringy deals, are very hygrometric, and never lose the property (however long they have been seasoned) of expanding and contracting with change of weather. White Petersburg deals are said to have that property. The deal to be good should be straight in the grain; if cross-grained, it generally becomes shaky diagonally upon drying, and falls to pieces under the saw; or, if cross-grained in a lesser degree, it does not yield a smooth surface to the plane, but remains rough and fuzzy. The deal should, of course, be without coarse knots, and the more nearly it is perfectly clean the better. As to the manufacture of the deal; it should be square-cut; above all things, it ought not to have the centre or pitch of the tree left within it, since, where that is the case, the deal rends on drying. In yellow deals the sap, or albumen of the tree, ought to show itself only at the very edge of that part of the deal which was furthest from the centre of the tree. Deals are usually cut of three different widths, each of which has its appropriate name. Those from eleven or twelve inches wide are called planks; those from eight and a half to ten inches are called deals;

and those from six and a half to seven inches are called battens.

YELLOW DEALS.

*Norway Deals.* —The yellow deals of Christiana, in Norway, have always been considered to be of the very best description;—they are so in two senses—they are both durable and mellow; mellow meaning soft, light, and fit for the joiner. Though soft, they are not wanting in a proper degree of stiffness. When properly seasoned, previously to being used, they remain (however minutely divided) precisely of the form that the joiner gives. This quality applies to the white, as well as to the yellow deals of Christiana—and to those above the deals of any other part of the world—and, therefore, the deals of Christiana will always be the material that the consumer will endeavour to obtain, if the price will allow him to do so.

Of late years the mode of taking the duty caused the deals to be cut in longer lengths than the timber would afford, so that the inferior wood has been brought into the London market, and the high estimation and price diminished to a certain extent; it is said, however, that they are now rapidly regaining their former character.

The yellow deals from Frederickstadt, in Norway, are very nearly the same in quality with those of Christiana, and generally obtain nearly the same price in the market. The white deals would be as good as those of Christiana, but for one defect, which is that the bark of the tree adheres to the knots, which, therefore, have a black ring round them; when the deal comes to be cut into board, a knot of this kind is apt to fall out. It may be observed that neither the deals of Christiana nor Frederickstadt are of as good quality as they used to be, particularly as respects the yellow deals.

There are several kinds of yellow deals not quite so good as those of Christiana in the quality of the wood, and yet coming near to them, which formerly used to be imported from Norway in very large quantities, and still are imported from some of the places of shipment referred to, but to a moderate extent only. The principal of these ports are Longsound, Porsground, Larwig, Krageroe, and Dram. The cloister deals from Longsound two inches thick, and the broad and clean deals from Krageroe one inch and a half thick and fourteen feet long, were noted for their excellence. From Dram, an immense quantity, both white and yellow, were imported, usually ten feet long and two inches thick. The "lowland" deals from this port are of inferior quality, but the "upland" of superior quality.

Of the deals of most of the above-mentioned ports, it may be said that they are good as regards the texture of the wood, but small in size, as they are seldom more than from eight inches and a half to eight inches and three-quarters wide. Some few deals (principally white deals) used to come from Tonsberg; occasionally there was a considerable supply from from Freserickstadt and Moss. The yellow deals of those ports are of bad quality, and the white deals not much better. Of the white lowland deals of Norway, in general it may be said that they resemble in quality the white spruce deals of America; they have the same tendency to warp and rend on drying.

*Deals of Sweden.* The yellow deals of Sweden nearest in quality to the best yellow deals of Norway, as regards their being at the same time durable and mellow, are those which come from Stockholm and from Geffle in the Gulf of Bothinia. If Stockholm or Geffle deals were quite as mellow as Christiana deals, they would be preferred to those of Christiana, on account of their full size and freedom from sap, but they are somewhat more disposed to warp, and with regard to Geffle deals have coarse knots. There are some other ports in the Gulf of Bothinia, viz., Hernosand and Sundswall, from which cargoes of yellow deals are shipped, occasionally little inferior in quality to those from Stockholm and Geffle. But it may be said of most of the deals from those ports, that in them there is in general an exaggeration of the faults perceptible in the deals of Stockholm and Geffle. A large portion of the deals from Hernosand and Sundswall are from eighteen to twenty-one feet long and ten inches wide. The deals of Soderham and Sconwick are of a still harder and coarser nature than those last described. The yellow deals of Gottenberg, although very free from sap, and durable, yet have the fault of being rigid and unfit for the joiner; they are, however, well adapted for rough purposes, both in and out of doors, on account of their durability.

[*To be continued.*]

## TO PREVENT VESSELS FROM SINKING.

THAT vessels receiving injuries at sea, short of utterly destroying them, should invariably sink to the bottom, carrying with them numbers of their unfortunate crew and passengers, is by no means creditable to the genius of an age to which such prodigious advances have been made in the useful arts. With little trouble and expense, every ship, which goes to sea should be rendered proof in most cases against submersion. The first thing to be observed is, that the specific gravity of a vessel, no matter what be its size, is usually less than that of an equal bulk of water. The addition of iron machinery, of course, greatly increases the specific gravity of steam vessels, and causes them to sink more readily than sailing craft, nevertheless, even in the case of steamers receiving severe contusions, it is to be observed that they do not sink all at once. Generally speaking, in the worst species of accidents, sailing vessels require from half an hour to an hour, and steam vessels from fifteen to twenty minutes, to disappear below the water. In nearly all instances there is manifested, as it were, a reluctance to sink. Trembling in the balance between existence and extinction, any little addition which could at the moment be imparted to the bouyant properties of the mass would turn in its favour. We believe it has been repeatedly proposed to occupy all the spare cavities of vessels with air-tight metal tubes, by which sinking in almost any circumstances would be impossible; but on account of the expense and the necessary structural alteration required in any such plan, it has never been practically adopted. Supposing, then, that a permament means of extra-buoyancy is unadvisable, the following simple expedient may be resorted to in relation to all vessels already or to be built.

In each of the cabins, and other parts usually containing vacant space, let there be hung up conveniently on the wall, in the manner of a rolled-up hammock, or concealed behind a loose screen, an air-tight bag, communicating by air-tight tubes to force-pumps on deck. The instant the vessel strikes, and is supposed to have received an irreparable injury, let the tyings of the rolled-up bag be cast loose, and the force-pumps set in motion. The bags inflating with air like a balloon, would speedily fill the cabins, or other vacant spaces in which they were allowed to expand, and would sustain the vessel on the surface of the ocean, although logged to the level of the deck with water. As a variation on the plan, the air-tight bags might be attached to the sides or other exterior parts of the ship; but as the liability to injury would be greater in these situations than in the cabins, it appears that the bags would have their fittest receptacle in the interior of the vessel. There cannot be the slightest doubt that by the expedient suggested the sinking of vessels of every description would be rendered a physical impossibility. Nor could the expense of the apparatus—a few pounds at most—any more than the trouble of its application —be considered an obstacle to its adoption.—*Tyne Mercury.*

## IMPORTANT IMPROVEMENT IN THE MANUFACTURE OF IRON.

It is stated, in the *New York Tribune*, that a discovery has been made by Mr. Simeon Broadmeadow, of New York, in the manufacture of iron, by means of which the iron ore is by only one process converted into wrought-iron without being first made into pig-iron, and at a less expence than the pig-iron can be made. The iron ore is placed upon the floor of a reverberatory furnace, the flame of fire passing over it, when a chemical compound is used to unite the elements of the iron by separating the "slag" from it. By this first and only operation the wrought iron comes out as perfect in every respect as that by the double operation of "puddling" and piling pig-iron, and for the purposes of manufacturing steel, even surpasses it. By this process wrought-iron of the best quality can be produced at a cost not exceeding 25.50 dollars per ton. To make the iron ore into balls of wrought-iron will require no blast, nor machinery of any kind; the anthracite or bituminous coals being used with equal advantage in a common air-furnace, a good draft being all that is required. These balls of wrought-iron can be made with a good profit (if the furnace is built near the mines of mineral and coal) for 14 dollars per ton. In the single article of railroad iron it will be a saving of millions of dollars to the United States; for, by statistical tables, we have already sent to England for that article alone the sum of 32,000,000 dollars. The inventor says that with a capital of 100,000 dollars 40 tons of railroad iron can be manufactured every twenty-four hours.

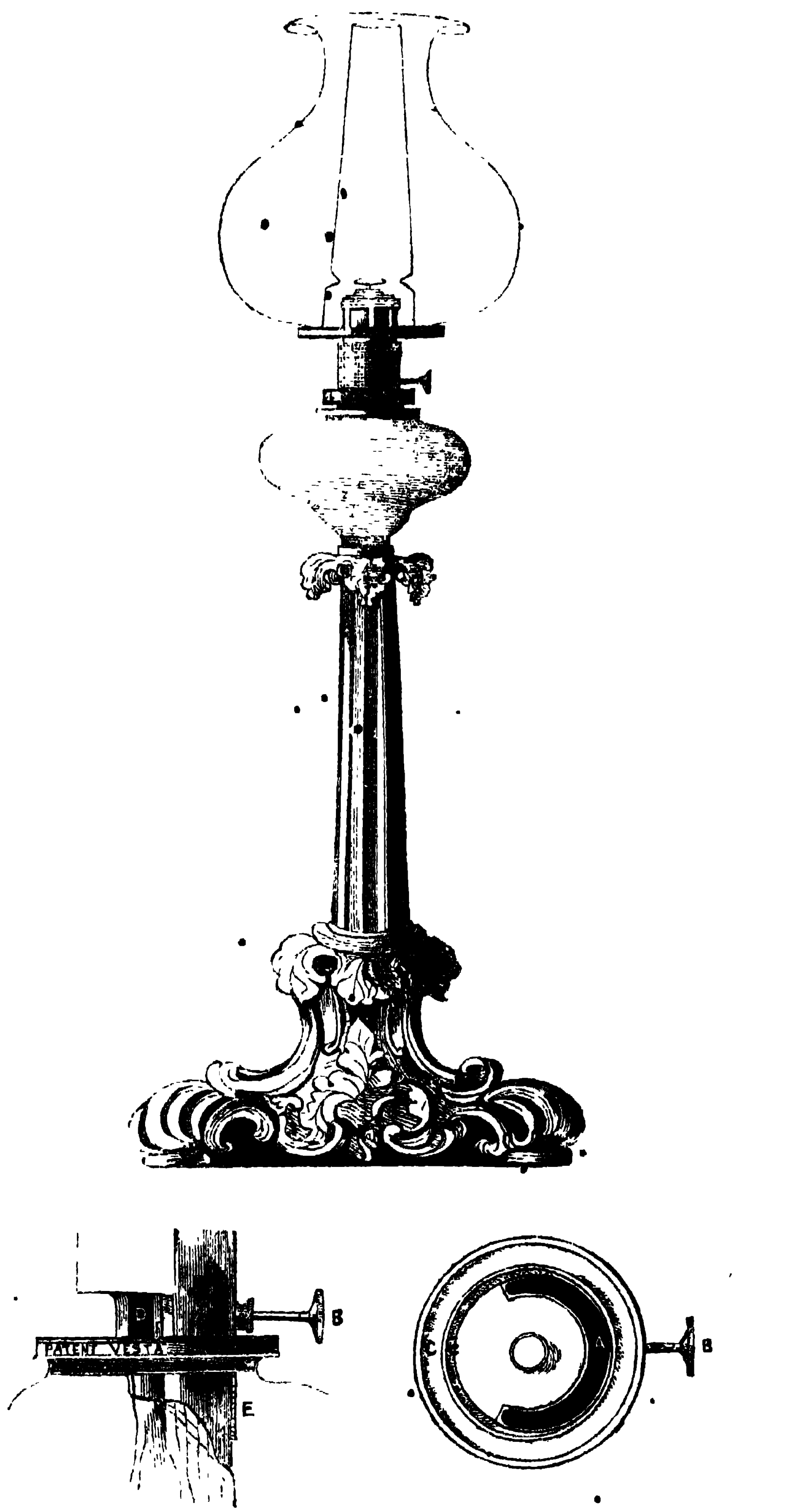
## VARIETIES.

*Cement for Floors.*—Earthern floors are commonly made of loam, and sometimes, especially to make malt on, of lime and brook sand, and gun dust or anvil dust from the forge. The manner of making earthern floors for plain country habitations is as follows:—Take two-thirds of lime and one of coal-ashes well sifted, with a small quantity of loam clay; mix the whole together, and temper it well with water, making it up into a heap; let it lie a week or ten days, and then temper it over again. After this, heap it up for three or four days, and repeat the tempering very high, till it becomes smooth, yielding, tough, and gluey. The ground being then levelled, lay the floor therewith about 2½ or 3 inches thick, making it smooth with a trowel; the hotter the season is the better; and when it is thoroughly dried it will make the best floor for houses, especially malt-houses. If any one would have their floors look better, let them take lime of rag-stones, well tempered with whites of eggs, covering the floor about half an inch thick with it, before the under flooring is too dry. If this be well done, and thoroughly dried, it will look, when rubbed with a little oil, as transparent as metal or glass. In elegant houses, floors of this nature are made of stucco, or of plaster of Paris beaten and sifted, and mixed with other ingredients.

*Compound Colours in Dyeing*, are produced by mixing together two simple ones; or, which is the same thing, by dyeing cloth first of the simple colour, and then by another. These colours vary to infinity, according to the proportions of the ingredients employed. From blue, red, and yellow, *red olives* and *greenish grays* are made. From blue, red, and brown, *olives* are made from the lightest to the darkest shades; and by giving a greater shade of red, the *slated* and *lavender grays* are made. From blue, red, and black, *grays* of all shades are made, such as *sage, pigeon, slate,* and *lead grays.* The king's or prince's colour is duller than usual; this mixture produces a variety of hues or colours almost to infinity. From yellow, blue, and brown, are made the *goose dung* and *olives* of all kinds. From brown, blue, and black, are produced *brown olives*, and their shades. From the red, yellow, and brown, are derived the *orange, gold colour, feuille-mort*, or faded leaf, *dead carnations, cinnamon, fawn,* and *tobacco*, by using two or three of the colours as required. From yellow, red, and black, *browns* of every shade are made. From blue and yellow, *greens* of all shades. From red and blue, *purples* of all kinds are formed.

*To preserve Fish.*—Salmon and some other kinds of fish are often preserved by placing them in jars and pouring sweet salad oil over them until covered, then bunging up quite air-tight. Fish may be preserved in a dry state, and perfectly fresh, by means of sugar alone, and even with a very small quantity of it. Fresh fish may be kept in that state for some days, so as to be as good when boiled as if just caught. If dried, and kept free from mouldiness, there seems no limit to their preservation; and they are much better in this way than when salted. The sugar gives no disagreeable taste. This process is particularly valuable in making what is called kippered salmon; and the fish preserved in this manner are far superior in quality and flavour to those which are salted or smoked. If desired, as much salt may be used as to give the taste that may be required; but this substance does not conduce to their preservation. In the preparation it is merely necessary to open the Fish, and to apply the sugar to the muscular parts, placing it in a horizontal position for two or three days, that this substance may penetrate. After this it may be dried; and it is only further necessary to wipe and ventilate it occasionally, to prevent mouldiness. A table-spoonful of brown sugar is sufficient in this manner for a salmon of five or six pounds weight; and if salt is desired, a teaspoonful or more may be added. Saltpetre may be used instead, in the same proportion, if it is desired to make the kipper hard.

*Woods.*—The woods that contain aromatic oils are remarkable for their indestructibility, and for their exemption from the attacks of insects; this is particularly the case with the Cedar, Rosewood, and Cypress. The gates of Constantinople, which were made of this last wood, stood entire from the time of Constantine, their founder, to that of Pope Eugene IV., a period of 1100 years.




YOUNG'S PATENT VESTA, OR CAMPHINE LAMP.

## THE CAMPHINE LAMP.

THE Argand lamps, for burning oil, are susceptible of great amendment; for, as at present constituted, they are liable to be soon clogged, and their rather complex and unnecessarily inconvenient arrangement renders it difficult to clean them. The liability to soil furniture, by spilling the oil, is also an objection which requires to be remedied; but for the purpose of general illumination in large apartments, the suspended Argand oil lamps, including the recent improvements of burners and with ground-glass shades, have not been surpassed by any of the recently invented substitutes so prominently brought into public notice.

The Camphine lamp, the most recent of these inventions, gives a more brilliant light; it is not liable to the objection of soiling, and it is also cheaper than oil; but against these advantages there are some serious drawbacks. What is called *camphine* is in fact only rectified spirits of turpentine, a liquid more rich in carbon than oil, and if its combustion be perfect the illuminating power is greater. The difficulties to be encountered in the combustion of turpentine are the prevention of evaporation by heat and the consequent danger of its taking fire: also the prevention of smoke, which. owing to the abundance of carbon, requires great nicety of arrangement to guard against. In the camphine lamps the reservoir of turpentine is placed at a considerable distance below the flame, and great precautions are taken to prevent its heating. There is a disc of metal placed in the centre of the circular wick, to cause the air rushing up the tube to be deflected and to strike against the inner part of the flame, which thus assumes a butter-cup shape. The glass chimney is conical, and provision is made for regulating the supply of air, which, if too abundant, or dificient, or if it be not directed in the right current, destroys the efficacy of the lamp, and produces volumes of smoke. Should the glass chimney crack, for example, the room would be quickly filled with smoke, and particles of soot would fall like a shower. An anecdote is told, we know not how truly, of a gentleman and his wife having been changed into negroes during the night by the accidental cracking of a camphine lamp glass.

The prefixed engraving represents Young's Patent Vesta or Camphine Lamp, entire, and in Section, the details of which are also explained below. Dr. Ure, in a Report of Photometric Experiments upon this Lamp, made to determine the cost and quality of its illumination, compared with those of the best lamps and candles, has arrived at the following results:—

The Vesta Lamp, burning with its utmost brilliancy, without smoke, emits a light equal to very nearly twelve wax or sperm candles of three or four to the pound; and in so doing it consumes exactly one imperial pint of spirits of turpentine (value sixpence retail) in ten hours, hence the cost per hour for a light equal to ten such candles is one halfpenny; whereas that from wax candles would be nearly sixpence; from spermaceti ditto, fivepence; from stearine ditto, fourpence; from Palmer's spreading wick ditto, nearly threepence; from tallow moulds, 2½d.; from sperm oil in Carcel's Mechanical French Lamp, 1½d.

One peculiar advantage of the Vesta Lamp is the snowy whiteness of its light, which is such as to display the more delicate colours of natural and artificial objects, flowers, paintings, &c. in their true tints, instead of the degraded hues visible by the light of candles and ordinary lamps.

The size of the flame from which so much light is emitted in the Vesta Lamp, is greatly smaller than that of oil or gas Argand flames of equal intensity; a circumstance to be accounted for from the difference in chemical composition, between spirits of turpentine and fat oils. The spirits consist entirely of carbon and hydrogen; in the proportion of 88½ of the former element, and 11½ of the latter, in 100 parts; and they consume 328 parts of oxygen; whereas, sperm and other unctuous oils consist of 78 parts of carbon, 11½ of hydrogen, and 10½ of oxygen, in 100 parts; and these consume only 287·2 of oxygen, in being burnt; because the oxygen already present in the oil neutralizes 2·6 parts of the carbon and 0·4 of the hydrogen, thus leaving only 85½ parts of the combustible elements for the atmosphere to burn. For this reason, 87½ parts by weight of spirits of turpentine, will consume as much oxygen as 100 parts of sperm oil; and will afford, moreover, a more vivid light, because they contain no oxide, as fat oils do, which serves to damp the combustion. In the spirits of turpentine, the affinity of its elements for oxygen is entire, whereas in fat oil, the affinity is partially neutralized by the oxides it contains; somewhat as the flame of spirits of wine is weakened by their dilution with water.

Naptha has for some time past been employed in street-illumination, but the difficulty attending its use is greater than that of turpentine. It is more inflammable, consequently more dangerous than the latter; and instances are known of the explosion of naphtha lamps, when the vapour has been mixed with atmospheric air. In consequence of the difficulty of effecting perfect combustion in the lamps usually employed, the quantity of essential oil permitted to come to the wick is limited, and though the flame is very brilliant, it constitutes little more than a line of light, and its illuminating power is consequently inferior to that of a larger flame of gas. The arrangement of the camphine lamp would, we conceive, be well adapted for burning naphtha, and would admit of a larger flame.

A French lamp has recently been invented the object of which also is to overcome the difficulty of burning essential oils. In this lamp, the reservoir is placed farther from the flame than in the Camphine lamp, and the wick does not rise within an inch of the burner; it merely serves to attract a portion of the essential oil so near to the flame as to become evaporated by the heat, and the vapour thus formed rises through the apertures of the burner, and is then converted into gas, and burns with a brillant white light. An adjustment of this kind promises to remove the objections to the Camphine lamp, but the lamp has not yet had a sufficient trial to determine whether it is practically available. It is so often the case with inventions of this kind, that the advantages are merely specious, some radical defect being hidden beneath the surface, that until experience has tested their merits, it is hazardous to approve.

*Description of the Engraving.*

Cotton passing through into the spirit.
Handle for heightening or lowering the cotton.
Wood non-conductor of heat, joining on the bowl containing the spirit.
Opening for draft to pass through perforated screen (*see lamp*).
Cogs attached to cotton-holder to raise or lower it, by the cog wheel at B.

## ON THE QUALITIES OF TIMBER AND DEALS.

*(Continued from page 95.)*

*Deals of Northern Russia.*—The yellow deals of Archangel and Onega are very similar to each other in quality, and of all deals, they approach in one respect the nearest to the yellow deals of Christiana; they are exceedingly mellow, and fit for the joiner; on the other hand, they are not very durable, or capable of resisting damp, for which reason they ought not to be used in the ground-floor of a house; the knots are apt to be surrounded by dead bark; they are imported of the average length of twenty feet. Archangel deals formerly were imported only of the width of eleven inches, or seven inches, that is, in the state of plank or of batten, but more recently they have been imported of the width of nine inches, and from the certainty of obtaining entire cargoes of the very first quality, without any admixture of inferior goods (an object which could seldom be accomplished with regard either to Norwegian or Swedish deal), these Archangel deals were made to supersede the use of almost every other superior description of European yellow deals. St. Petersburg and Narva yellow deals come of the breadth of eleven, nine, and seven inches: in quality the wood is inferior to that of Onega or of Archangel: Petersburg deal is less durable and not nearly so mellow as either the Archangel or Onega deal; it is said to be nearly as liable to take the dry rot in a damp and confined situation as the yellow pine deal of America. A few yellow deals are likewise imported from Riga.

The yellow deals from Memel and from Dantzic may next be noticed :—the former eleven inches, the latter twelve inches wide; both of these are very durable. Memel planks are well adapted for all rough purposes out of doors, for barn floors, and for the steps of stairs when clean; Dantzic planks are used by brewers and Distillers for making the large vessels for holding the liquor, called backs. The very best of the Dantzic planks are likewise extremely fit for joiners' work, as they are soft and mellow, and retain the shape, but this only applies to a small portion of them, and those which are soft are not so durable. Dantzic likewise affords the long yellow plank forty feet long, three inches thick, and twelve inches wide, used for the decks of ships. Memel planks, until of late years, were not imported in any large quantity.

There are likewise yellow deals from Finland; Nyland deals, fourteen feet long, resembling some of the coarser varieties of Sundswall deals, are of late introduction. The broad yellow planks, twelve inches wide and twenty-one feet long, from Bjorneburg, in the gulf of Bothnia, are of a quality very nearly approaching to the plank of Archangel, but far more knotty.

### WHITE DEALS.

We now come to the white deals, manufactured from spruce fir, the yellow deals of Europe being manufactured from the Scotch fir. All that has been said of the qualities of yellow deals applies likewise to white deals, except that the sap in white deals is not discernible from the heart, and therefore the manufacturer of white deals has so far one difficulty the less to contend with.

Norway is the only country from which white deals of the very first quality are imported in any quantity; for although the white deals from Stockholm and Geffle in Sweden, like the yellow from those parts, are very good, yet the quantity is too small to render them worth particular notice. The white deals, like the yellow, shipped at Christiana, are the very best in the world, well fitted for joiners' work, being above all other deals of the kind, light and mellow. The white deals of Frederickstadt also are very good, yet rather subject to a small black knot surrounded by dead bark. All the other ports in Norway which have been mentioned as yielding yellow deals, supply white deals of good quality likewise; but from the smaller ports generally, the deals are somewhat narrow (from eight inches and a half to eight inches and three quarters wide), whereas the deals of Christiana and Frederickstadt are full nine inches wide; the narrow deals fetch a proportionately less price in the market. The white deals from Wekkeroe are sold by the name of Christiana deals, the least mellow and the hardest of which they resemble; they are of greater average length than the deals of Christiana, being perhaps of a mean length of nineteen feet.

The lowland white deals of Norway form the exception to the general good quality of the white deals of that country, the lowland white deals having most of the bad properties of the white spruce of America, that is, a tendency to warp and to split upon drying. From Dram two qualities of white deals used to come, the upland and the lowland, the former as good in quality as the latter is bad, although it may be observed that both have of late years improved considerably. The white deals of Moss, though showy to appearance, are of this bad quality. Those from Longsound, Schien, and Larwig, are good. A considerable quantity of white deals have of late years been shipped from Gottenburg—with few exceptions, they are of a hard, stringy nature; the saw on passing through them tears their substance into strings instead of sawdust: the white deals, of the width of eleven and twelve inches, from this port are, on account of their cheapness, one of the materials used by the makers of packing cases.

*Russia.*— Northern Russia exports hardly any white deals, although the few that come occasionally from Archangel, mixed by accident with yellow deals, are of excellent quality—the white deals from that country that come nearest to those of Norway in quality are those of Narva—they are brought of the width of eleven and nine inches—when properly seasoned they can be used for all purposes to which Norway white deals are applied—next in quality to those of Narva are the white deals from Riga, which are brought both nine and eleven inches wide. White deals are imported from St. Petersburg, both nine and eleven inches wide, in considerable quantities—they are not uniform in texture, but contain hard veins, and they have the defect (however long they may have been kept) of expanding and contracting with change of weather, so that if used in the panel of a door, the wood alternately enters and recedes from the groove into which it fits, as the paint will show, when that kind of deal has been used for a panel.

*Battens* are deals seven inches wide, and are principally used for floors. The best yellow battens are imported from Christiana; a large number of both white and yellow battens were formerly imported from Longsound in Norway, but battens of this description are now imported from Dram; they are from about six and a half to six and three-quarters inches wide. The white, especially, are of an excellent quality; and so are such of the yellow as are not sappy: the sappy ones preponderate in number, and on account of their cheapness are frequently used as a substitute for timber in building the smaller description of houses. The next in quality to the battens of Christiana and Frederickstadt are those which are imported from Archangel and Onega, though few have of late come from the latter port. Yellow Archangel battens cost usually somewhat more per Petersburg standard than the eleven inch planks. Both Archangel and Onega battens have the defect of having black bark round the knots, the wood of which is dead; whereas the knots of Christiana wood are bright, and firmly united to the substance of the tree. Yellow battens are imported also from Petersburg, considerably inferior in the quality of the wood to those of Archangel and Onega.

*American Deals* are of three descriptions, viz., the yellow pine, the red pine, and the white spruce. A fourth, the hemlock-spruce deal, is sometimes brought, but it is too bad in quality, and the quantity too small to deserve further notice.

*Yellow Pine Deals.*—The best of the yellow pine deals are shipped from the St. Lawrence: some are floated down the river from the mills to the port of shipment, and when taken on board are saturated with water, and covered with river silt; others are put on board craft, and some bright from the saw to this country. Of the bright deals, the very best quality are those from the Rivière de Loup. In a very good parcel of yellow pine deals about two-fifths will be perfectly clear of knots.

Yellow pine is of a very light and spongy texture; and the more completely it is of that texture, and the opposite to what is hard, fibrous and stringy, the better it is for all the purposes to which it is properly applicable, such as the panels and mouldings of doors and shutters, and other internal fittings of houses, the framing of cabinet work; all those purposes, in short, for which lightness and no great strength is required. It preserves the form which the joiner gives it without warping and this property, coupled with the facility of obtaining it free from knots fits it admirably for the carver, the musical instrument maker, the maker of Venetian blinds, for patterns for iron castings, and similar purposes: the inferior yellow pine deals being coarser in the texture of the wood and more knotty, are mostly used for ordinary packing cases. If the yellow pine is exposed to damp in any confined situation it rapidly decays; but in the open air, for palings raised from off the ground, weather-boarding to sheds, and wherever it is completely well ventilated, it lasts a long time, although exposed to alternations of wet and dry. Its spongy texture prevents it being rent so much as deals of a more rigid substance are liable to be, by exposure to the weather. It is now much used for the decks of ships, as it resists the effects of the sun better than the European deals.

[*To be continued.*]

## IMPROVED BORAX.

Mr. Sautter, of Austin Friars, has patented the following improvements in the manufacture of borax, in producing, without the employment of water, an article possessing the same chemical properties as the crystallized borax now generally used, but having a different appearance, it being in a granular state, and, when pure, of a dull white colour. The advantages stated to be derived from this invention are, a great saving in the cost of manufacturing borax, and also, a more ready application of the borax, so produced, to the making of glass, &c.

To manufacture this borax, take about 38 parts by weight of pure crystallized boracic acid, and sift it; then add about 45 parts by weight of fine crystallized carbonate of soda, reduced to powder, and mix them thoroughly together. When this is effected, place the mixture, in layers of about one inch thick, upon wooden shelves, arranged in a suitable apartment. The temperature of the room is then raised to from 90° to 115° Fahr., and the layers are occasionally raked. By keeping up the heat, the boracic acid and soda become combined, and the carbonic acid in the soda is driven off, together with the water contained in it. A perfect borax is thereby formed, containing all the chemical properties of the crystallized borax, without the aid of water. The time necessary for effecting this operation, will vary from twenty-four to thirty-six hours.

The patentee states, that impure acid may be also used for manufacturing borax after the improved mode, and although the result will not be so good an article as that made from the pure acid, yet it will not be objectionable for certain purposes to which it might be applied.—*Newton's London Journal.*

## POTATOE SOAP.

Mr. Snell, of Bridge-road, Lambeth, has patented certain improvements in the manufacture of soap, in mixing with the saponified fats or oils, materials, prepared from potatoes and other vegetable matters containing farinaceous substances.

The method of preparing these materials from potatoes is as follows:—The potatoes, after being washed, are reduced to a pulp, in any suitable apparatus, from which the pulp is allowed to fall upon two inclined sieves or screens, having a slight horizontal motion. At the top, and midway down the upper seive (which is covered with wire-cloth of thirty meshes to the inch), are pipes, extending across the sieve, and perforated with numerous holes, from which water issues; the coarse parts of the potatoes are, by this means, separated from the finer parts, and discharged into a vat, while the finer parts pass through the upper sieve on to the lower one, (which has sixty meshes to the inch,) where a further separation takes place, the coarse parts descending into the vat, and the finer parts, which the patentee calls *dextrine*, falling on to an inclined plane of wood, placed beneath the lower sieve, but inclined in the opposite direction. The dextrine is conducted by the inclined plane into a vat, where it is repeatedly washed in sieves of finer wire-cloth, until deprived of all its impurities; it then sinks to the bottom of the vat, and may be taken up in pails, ready for use. The coarse part of the potatoes, termed *fibrine*, is washed in coarse sieves, and remains in a vat, covered with water, until it is wanted. If preferred, the dextrine may be dried, and kept until it is required for use; in this case, to each ton of saponified fat or oil, an addition is made of from 3 to 3½ cwt, of dextrine, which is first mixed with from 1 to 1½ cwt. of cold water, and, after standing for an hour, 6 cwt. of nearly boiling water are added; it is then mixed with the soap in the manner hereinafter mentioned.

White soap is made by the patentee from tallow or oil and alkali, in a boiler heated by a steam jacket, using as much alkali as the tallow and oil will take up; and when the soap is in a fit state "to cleanse into a frame," he takes, for each ton of saponified matter, from $4\frac{1}{2}$ to 5 cwt. of dextrine, in its wet state, and adds thereto about 6 cwt. of boiling water, so as to make it into a thin paste. This paste, as soon as all the spent lye is pumped out of the boiler, is added to the soap, and, when properly mixed and heated, the soap may be cleansed into frames, in the usual way. Yellow soap is made in a common soap pan, with tallow or oil and alkali, and either with or without resin; after the soap is "fitted," it is heated in the boiler before mentioned, and the above quantity of dextrine is added, in the manner described. If no resin is put in the soap, a much larger quantity of dextrine may be used; and it may be added either with or without "fitting" the soap.

When fibrine is used in the manufacture of common soap, as much water is taken from it as will leave a thick body, which is then put into a boiler, heated by steam, together with an equal quantity of tallow or oil and resin; alkali is added in the usual way, and the whole is boiled until it is ready to be cleansed into frames.

Common soap, made in the ordinary manner, and containing a large quantity of alkali, may be remelted, and dextrine added thereto, for the purpose of improving its color, and preventing it from wasting so fast in hot water as it would otherwise do.—*Newton's London Journal.*

## OPEN GRATES AND STOVES.

Few circumstances, perhaps, have tended so much, in modern times, to alter the state of health, as affected by the internal arrangements of dwelling-houses, as the great reduction in the altitude of the chimney-piece, and the more skilful disposition of the fire-place for the economy of fuel. The practical consequence has been, that a less amount of air is necessarily forced through individual apartments, when the coldness of the weather renders it necessary to keep the windows shut; and, above all, that the air which does pass to the fire is, in general, below the level of the head, and exercises, accordingly, little or no purifying influence upon that portion of the atmosphere which is within the zone of respiration. The cottage grate, so very generally introduced of late years, is extremely comfortable, from the low position of the fuel, the comparative absence of iron, and the powerful radiating influence of the fire-bricks that form the backs and sides; but the smaller the apartment, and the more perfect its construction, the less must it alone be trusted to in securing ventilation. A common fire heats an apartment, in general, almost solely by radiation, excepting the influence of the flue upon the wall. In some few cases, fire places have been constructed so as to partake in part of the character of stoves. The peculiar advantages of a fire-place are not merely its power of warming an apartment, the circulation of air which it induces, its accessibility, and the influence of the light which it evolves; but the very grateful effect which it produces after the body has been chilled by any special cause, whether in doors or out of doors, stimulating it, and exciting the circulation to the greatest degree which may be considered agreeable, and permitting each individual to adjust the distance which is most suitable to his own constitution, and the previous exposure to which he may have been more immediately subject. The light, also, is not to be considered a mere nominal advantage, but a real and positive benefit, affecting the whole system by its physical action, independently of the cheerful impression which its liveliness is calculated to excite, and which, to many, is so engaging, that they feel as if they were not alone when they have the company of a glowing fire. These considerations will probably always sustain the open fire-place, in countries where fuel can be procured with sufficient economy; but its disadvantages, in other respects, compared with the stove, are marked, particularly its expense, its local action, the dust it is apt to produce, and the frequent attendance which it requires.—*Reid on Ventilation.*

## IMPROVED BANK NOTE PAPER.

### PREVENTION OF FORGERY.

(*Continued from Page 93.*)

In order to attain this result, take resin or colophony, in powder of a middling fineness, and sift it on to a lithographic stone, previously heated. When the grains or atoms of resin are fixed by the heat, the stone must be corroded by a solution of nitric acid, and thus an irregular ground is obtained. The size of the grains of resin, the degree of heat necessary to be given to the stone in order to fix the said grains, as well as the acid employed for the corrosion, must vary according to the results to be obtained.

An irregular ground may also be made on a lithographic stone by taking a brush with short hairs or bristles, dipping this brush in thickened lithographic ink, and striking gently and irregularly on the surface of the stone with the extremity of the brush; the ink thus laid on the stone is to be fixed by the ordinary process. Also, a lithographic stone may be covered with lithographic ink, which is allowed to dry; then, on the whole of the blackened surface, an engraver's roller is to be rolled irregularly, to obtain white points on a black ground. The above are only a few of the many modes which may be employed to produce an irregular ground.

It must be understood, that the owner of this plate may take proofs from the same, and transfer them on to stone; that he may take casts from it, and cause it to be reproduced by the polytype and electrotype process, but neither the author himself, nor any other person, could make a second plate identical with the first, except by some of the above means of multiplication.

The irregular ground being obtained by one of the modes above stated, or by some mode equivalent, a proof is taken from the plate, and transferred on to the lithographic stone, which has received the regular drawing as above stated.

When the transfer is made, and fixed on the stone, the gum, by which the regular elements have been covered, is removed, and from it lithographic impressions can be taken, in which may be distinguished, by the naked eye, the regular elements surrounded, but not covered, by irregular and microscopic elements.

Instead of composing the matrix plate by transfers taken from two separate plates, this object may be effected by executing on the same plate on which the regular design has been already engraved, by any of the means above indicated, or by any other appropriate mode, the irregular design forming the ground, so as to obtain a matrix plate without transfer. From this plate, twenty or a greater number of plates should be produced, in order to guard against any accident which might happen to the original. These plates, which the inventor terms *seconds*, are obtained by taking proofs from the first plate, transferring them on to stone, and fixing them thereon. From the seconds, impressions may be taken, *ad infinitum*; these proofs may be transferred on to lithographic stone, the lineaments are brought up in relievo by the ordinary process of engraving upon stone, and then the impression may be introduced by the typographic press.

Having now described the improved mode of producing the visible design, which cannot be imitated, either by hand or by machinery, the inventor proceeds to state his method of preventing any impression of these drawings from being transferred on to stone, and afterwards multiplied at will.

This is effected by the employment of peculiar inks, which are preferred to be delible, and made with a mixture of oil, gum, or resin, because they are more easily employed in typographical impressions. The ingredients and process of mixing are as follows:—First, make a certain quantity of white ink, composed of balm of Capahu, Venetian turpentine and chalk previously washed and dried; and grind these substances together until they are brought to the consistency of ordinary printing ink; this ink is called No. 1. Take one-half of it and set it aside, and in the other half introduce a sufficient quantity of ordinary ink reduced to powder by evaporation, this must be done in order to give the necessary colouring, that the design to be printed with this ink may be visible to the naked eye, and at the same time, that the writings made on the prepared paper may be perfectly apparent. This second sort of ink is called No. 2.

Instead of dried ink for colouring ink, No. 2, any other coloring substance may be used, which is equally delible as common ink powder, in order that any attempts to extract part of the writing formed on the paper, may cause the extraction or obliteration of the visible design printed on the paper with this delible ink.

An impression is made on both sides of the paper with ink No 1: old plates and those which are defective, may be used for taking this first impression, which not being visible, need not be made with plates free from defects.

The visible design is then printed with ink No. 2. This latter impression is made from a lithographic stone, or engraved or prepared with great care, and after these two impressions, the paper is dried, pressed, and cut for use.

A very good ink for printing the visible design may be made as follows:—

| | | |
|---|---|---|
| 1. Chalk, well washed . . | 20 to 25 parts. | |
| 2. Common ink reduced to powder, or by preference gallate of iron . . . | 4 | ,, |
| 3. Ultramarine blue . . . | 1 | ,, |
| Varnish *(quant. suff.)* | | |

This varnish, as well as the one above stated, is composed with equal parts of balm of Copahu and Venetian turpentine, melted together, and to be used when cold.

The results of the new combination of inks, and of the double impression, are thus stated:—If a forger attempt to extract a word, a sentence, or any quantity of writing formed on the safety paper, he will begin by using chlorine: this agent will destroy the colour of the writing, and that of the visible impression, the coloring principle of ink No. 2, being the same as that of ordinary ink. He will then use an acid, to remove the oxide of iron, which will still leave traces on the place of each letter, and each lineament of the visible design, which traces cannot be obliterated by chlorine. In this second operation, the acid will have destroyed also the chalk contained in ink No. 1, and ink No. 2. The safety paper, thus treated, will retain at the spot obliterated only the slight marks produced in the substance of the paper by the pressure of the two impressions and the resinous principles of the two inks employed, for no vestige will remain of the ink with which the writing was formed. But neither the slight marks left in the paper by the printing of the visible design, nor the vestiges left by the resinous varnish of ink No. 2, will be of any use to the forger in his attempt to reconstruct the design at the place obliterated; for the marks made by the printing of the visible and invisible designs, and the vestiges of the resinous principles left on the paper by the inks No. 1, and 2, will be so complicated, and so much worked into one another, that it will be impossible to retrace the pattern.

If, moreover, the conditions of the designs or the principles upon which they are constructed, are referred to, the numerous points of comparison which the same piece of paper will naturally offer, the perfection of the part executed by machinery, the impossibility to imitate by hand or machinery the part executed by chance, every one will be convinced that the reconstruction of part of the design will be utterly impossible, and the reproduction of the design by a lithographic transfer, will be equally impossible. In fact, whatever be the process employed to transfer the design, on to stone, it will be impossible not to transfer the two designs together, —the visible and invisible one, as both are printed with a resinous ink, and the only substance which distinguishes the two printing inks, is a small quantity of dried ink powder, which can have no influence on the transfer, it being mixed with a resinous body, which is more readily transferred on to stone than itself.

By counter-proofing the design of the safety paper, a forger, instead of finding on the stone the design he expects, will find a surface perfectly black, or presenting a confusion produced by the instantaneous transfer of the two designs, which may be identical, but are not placed one over the other in their proper places.

It should be mentioned, that the receipts of inks, above given, are only for the sake of illustration, and that other combinations of appropriate ingredients might produce an analogous result.

The patentee claims the covering of paper intended for all the purposes indicated in the title of the patent, with two designs, composed of elements regular and irregular, and obtained by the means herein before described; one of the designs being printed in visible ink, and the other in invisible ink, both these printings being delible; by employing which means, it will be found impossible to reconstruct the design, of which part has been extracted by chemical agents, and equally impossible to transfer the whole design on to stone, in order to multiply it at will by impressions taken therefrom; and thus a complete guarantee is given to government, to trade, and to all private transactions.—*From the London Journal.*

## IMPROVED MIRRORS.

Mr. Faraday has just communicated to the Royal Institution, the following important paper, "On recent Improvements in the Manufacture and Silvering of Mirrors." Mr. Faraday's subjects were: 1. The manufacture of plate-glass. 2. The *ordinary* mode of silvering mirrors. 3. The *new* method of producing this result, lately invented and patented by Mr. Drayton.

1. Mirrors are made with plate glass. Mr. Faradas described glass generally as being essentially a combination of silicia with a alkaline oxide. The combination, however, presents the character of a solution rather than of a definite chemical compound, only it is difficult to affirm whether it is the silica or the oxide which is the solvent or the body dissolved. From this mutual condition of the ingredients, it follows that their product is held together by very feeble affinities, and hence, as was afterwards shown, chemical re-agents will act upon these ingredients with a power which they would not have, were glass a definite compound. Mr. Faraday noticed, that as glass is not the result of definite proportionals, there are many combinations of materials capable of producing a more or less perfect result. Each manufacturer, therefore, has his own recipe and process, which he considers the most valuable secret of his trade. It is, however, well known, that the flint-glass maker uses the oxides of lead and of sodium, the bottle-glass maker lime, (an oxide of calcium) and the plate-glass maker, in addition to soda, has recourse to arsenic. Mr. Faraday then adverted to the corrosions which takes place in the inferior qualities of glass, owing to the feeble affinity with which their ingredients are held together. He stated, that from the surface of flint glass a very thin film of soluble alkali was washed off by the first contact of liquid, leaving a fine lamina of silica, the hard dissoluble quality of which protected the substance which it covered. If, however, this crust of silica chanced to be mechanically removed, the whole of the glass became liable to corrosion, as in ancient lachrymatories and other glass vessels. Mr. Faraday illustrated this by the corroded surfaces of two bottles, one obtained from a cellar in Threadneedle Street, where it had probably remained from the period of the great fire of London, another from the wreck of the *Royal George*. A still more striking instance of the instability of glass as a compound was exhibited by formations in the interior of a champagne bottle, which had been filled with diluted sulphuric acid. In this case the acid had separated the silica from the inner surface of the glass, and formed a sulphate with its ingredient, lime. The result was, that the bottle became incrusted internally with cones of silica and sulphate of lime, the bases of which, extending from within outwards, had perforated the sides of the bottle so as to cause the escape of the liquor it contained. Mr. Faraday referred to the long period of annealing (gradual cooling) which glass had to undergo as a necessary consequence of glass wanting the fixity of definite compounds. He concluded this part of his subject by describing the mode of casting plates, and the successive processes which gradually produce the perfect polish of their surface.

2. Mr. Faraday next exhibited to the audience the mode of silvering glass plates as commonly practised. He bade them observe that a surface of tinfoil was first bathed with mercury, and then flooded with it. That on this tinfoil the plate of glass, having been previously cleansed with extreme care, was so floated as to exclude all dust or dirt; that this was accomplished by the intervention of ½ in, of mercury (afterwards pressed out by heavy weights) between the reflecting surface of the amalgam of the mercury and the glass; and that when the glass and amalgam are closely brought together by the exclusion of the intervening fluid metal, the operation is completed.

3. The great subject of the evening was the invention of Mr. Drayton, which entirely dispenses with the mercury and the tin. By that gentleman's process, the mirror is, for the first time, literally speaking, ***silvered***, inasmuch as silver is precipitated on it from its nitrate (lunar caustic) in the form of a brilliant lamina. The process is this: on a plate of glass, surrounded with an edge of putty, is poured a solution of nitrate of silver in water and spirit, mixed with ammonia and the oils of cassia and of cloves. These oils precipitate the metal in somewhat the same manner as vegetable fibre does in the case of marking ink—the quantity of oil influencing the rapidity of the precipitation. Mr. Faraday here referred to Dr. Wollaston's method of precipitating the phosphate of ammonia and magnesia on the surface of a vessel containing its solution, in order to make intelligible how the deposit of silver was determined on the surface of clean glass, not (as in Dr. W.'s experiment) by mechanical causes, but by a sort of electric affinity. This part of Mr. Faraday's discourse was illustrated by three highly striking adaptations of Mr. Drayton's process. He first silvered a glass plate, the surface of which was cut in a ray-like pattern. 2. A bottle was filled with Mr. Drayton's transparent solution, which afterwards exhibited a cylindrical reflecting surface. And 3rd. A large cell, made of two glass plates, was placed erect on the table, and filled with the same clear solution. This, though perfectly translucent in the first instance, gradually became opaque and reflecting; so that, before Mr. Faraday concluded, those of his auditors who were placed within view of it, saw their own faces, or that of their near neighbours, gradually substituted for the faces of those who were seated opposite to them.

## VEGETABLE POWDERS.

Mr. Nevill, of Chichester Place, Gray's Inn Road, corn dealer, has patented certain improvements in preparing lentils and other matters for food.

The novelty of this invention consists in ridding lentils of their husks, in order to render them fit for human sustenance. The lentils are first washed and dried, and then split in the manner usually adopted for splitting peas; they are afterwards subjected to the operation of a winnowing machine, which drives off the husks, leaving the lentils in a state suitable for being used as a substitute for split peas. Flour produced from lentils cleansed in this manner, is proposed to be employed for thickening soups and making puddings, curry powder being added to the flour, in the proportion of one ounce of the former to four pounds of the latter, to give it a pleasant flavour. The patentee claims, Firstly, the manufacture of a product of lentils, separated from the husks, and thus rendered suitable for food for man. Secondly, the manufacture of flour from lentils, prepared as above described, and adding thereto a small quantity of curry powder.

## WOOL MOSAIC.

This is the name given to a fabric produced by a process lately invented by Messrs. Lebeheim and Muller. The fabric has somewhat the appearance of printed velvet, but the allocation of the different threads by which the pattern is formed is very similar to that in the manufacture of Florentine mosaic. Pictures can be copied by the ingenious machinery employed, and the most delicate tints of the best German wool-work appear as if interwoven in the pile of the velvet, although the process by which the effect is produced is much more expeditious than that of weaving would be. We cannot of course describe the mode of working the machinery without revealing the inventor's secret; but it may, however, be stated that when once the tedious task of selecting and placing the different shades of threads together has been accomplished so as to complete one subject, be it a flower, a figure, a landscape, or even an historical picture, of each of which the persons selecting the yarns has a copy before him, the ends of these threads are closely placed together and then cut even, as the surface of each subject proves. A cotton or woollen cloth, of the same dimension, with a solution of India-rubber, is then pressed upon the surface, and a slice cut off; and by means of a finishing process the wool becomes so embedded on the India-rubber cloth, that the two substances appear like one. The same course of pressing an India-rubber cloth, on the surface and slicing it off is gone through till their remains no more to be sliced off. The applicability of the invention may be carried on to various purposes and a vast extent. Palaces or large mansions could be decorated with this beautiful fabric, which for softness of colour could not be equalled by any tapestry, the Gobelin not excepted.

## PURIFICATION OF COAL GAS.

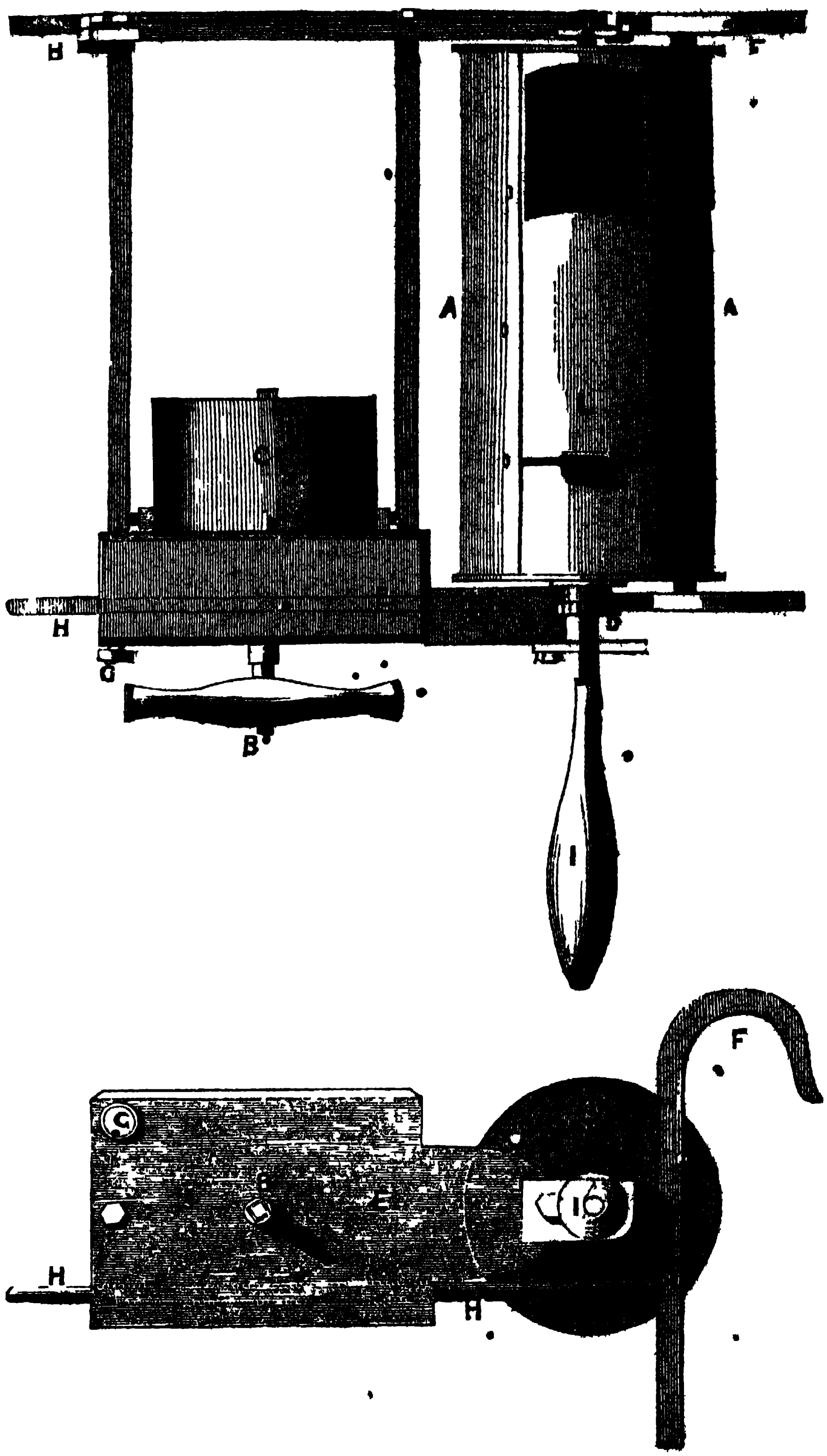
A very efficacious method of purifying Coal Gas has just been submitted to the Institution of Civil Engineers, by Mr. A. Angus Croll. His process consists in passing the gas through a solution of sulphuric acid, of the strength of two and a half pounds of oil of vitriol to 100 gallons water, and by a continuous supply of acid, so that the proper amount of free acid might be always kept in the vessel, the whole of the ammonia in the gas was abstracted, preventing the corrosive effect of this impurity on the fittings and meters through which it was transmitted, and rendering the gas capable of being used in dwelling-houses, and also enabling the gas companies to use dry lime, instead of wet lime purifiers without prodncing any nuisance on opening of the vessels, by which a considerable saving was effected, while at the same time sulphate of ammonia of great purity is obtained, and of such a strength, that the evaporation of one gallon produces eighty ounces of this valuable salt, instead of fourteen ounces, which was the quantity rendered under the former process. The author concluded by showing the advantage to agriculture by the application of this produce; he stated that various experiments upon an extensive scale had been tried with this manure with great success: one example will suffice for giving an idea of its powers. One half of a wheat field was manured with sulphate of ammonia, at the rate of 1¼ cwt. to the acre, and at a cost of £1. 2s., the other half with the ordinary manure; the latter produced only 23¾ bushels, but the former under the treatment of sulphate of ammonia produced 32¾ bushels. In the discussion that ensued, in which Professor Grahame, Mr. Cooper, and many members took part, the advantages of the system were confirmed, and the necessity for its extension insisted upon. The various modes of purifying gas, and the value of the products obtained for agricultural purposes, were canvassed at length. It was stated that seeds steeped forty hours in a solution of one pound of sulphate of ammonia to one gallon of water, sown in unmanured land, produced a heavy crop, and remained green during a dry season, when every other kind of vegetation became yellow and withered. Another remarkable feature was, that faded flowers when plunged in a weak solution of sulphate of ammonia, were in a short time restored, and that plants watered with it attained extraordinary health and beauty. The great loss resulting from the leakage of the gas through the joints and the pores of the cast iron pipes, was incidentally mentioned, and it was stated that in some instances it had amounted to from 25 to 75 per cent. of the total quantity produced.

## VARIETIES.

*Cast Engravings.*—Take the engraved plate you intend to copy, and arrange a support of suitable materials round it, then pour on it the following alloy in a state of perfect fusion:—tin 1 part, lead 64 parts, antimony 12 parts. These "cast plates" may be worked off in a printing press, and offer a ready mode of procuring cheap copies of the works of our celebrated artists.

*Cheap Beer.*—No production of this country abounds so much with saccharine matter as the shell of green peas. A strong decoction of them so much resembles, in odour and taste, an infusion of malt (termed wort) as to deceive a brewer. This decoction, rendered slightly bitter with the wood sage, and afterwards fermented with yeast, affords a very excellent beverage. The method employed is as follows:—Fill a boiler with the green shells of peas, pour on water till it rises half an inch above the shells, and simmer for three hours. Strain off the liquor, and add a strong decoction of the wood sage, or the hop, so as to render it pleasantly bitter; then ferment in the usual manner. The wood sage is the best substitute for hops, and being free from any anodyne property is entitled to a preference. By boiling a fresh quantity of shells in the decoction before it becomes cold, it may be so thoroughly impregnated with saccharine matter, as to afford a liquor, when fermented, as strong as ale.

*Peal of Bells for York Minster.*—In the course of a few days, a very fine and powerful peal of bells will be erected in one of the towers of York Minister, and for melody, richness of tone, and power it is said, they will far surpass any other in the north of England. They are the gift of the late Dr. Beckworth, the eminent physician of York, who, amongst his many charitable bequests, directed £2,000. to be named in his will for the purpose of furnishing the great northern cathedral with a suitable peal of bells. They have been cast at the foundry of Messrs. Mears, in Whitechapel, and are twelve in number, the largest weighing 53 cwt., and being in note C; the smallest 8 cwt., and in the whole being upwards of 10 tons in weight. In addition to the above, a complete "monster" clock bell is about being being cast for the Minster at the same foundry, which is stated to be the largest in the world.




ORPWOOD'S PATENT COFFEE ROASTER.

## ORPWOOD'S PATENT COFFEE ROASTER.

Mr. Orpwood, of Bishopsgate Street, has lately registered an ingenious and useful contrivance (of which we give an Engraving) for Roasting Coffee. It is not of course a part of our plan to dilate upon the merits of this or that mode of making coffee, we may, however, go so far as to say, we believe it is universally acknowledged, that the beverage is very greatly improved by using the ground berry, immediately it is roasted, and the apparatus which is simple and compact, convenient in application, and strong in construction, seems completely to effect this object, its main value is its portability and convenient adaptation to domestic use.

The Coffee is placed in a cylinder A: B the shaft to which a handle is applied to wind up a spring contained in the box C, by the uncoiling of which, motion is given to the wheel D through a train of gearing in the box E. Thus the cylinder A will be kept turning during the process of roasting the coffee.

The apparatus is to be hung upon the fire-bar by the hooks F. F.—G is a stud by which the clock-work inside the box E may be stopped or set in motion at pleasure. The distance of the cylinder from the fire may be regulated by sliding it backwards or forwards upon the rods or bars H. H. It should be observed also that the cylinder may be lifted off its bearings by the wooden handle I, to examine the condition of the coffee, or to supply a fresh charge which is admitted at the aperture K after drawing back the cover L.

Figure 1 is a plan, and Figure 2 an elevation.

## ON THE QUALITIES OF TIMBER AND DEALS.

*(Continued from page 100.)*

*Red Pine Deals* come in very small quantities, so small, indeed, that they are seldom separated from the yellow pine deals with which they come mixed; the best description are such as are brought from the Rivière de Loup. The red pine deals will answer for most of the purposes to which the yellow or Scotch fir deal of Europe is applied. When used for floors in houses these deals have the defects of turning of a very dark colour, but this probably is owing to the resinous texture of the wood, which causes dust to adhere to its surface, and might be prevented by washing the floor with alkaline ley, or any other solvent of resin.

*White Spruce Deals.*—Of the American white spruce deals, none, not even the very best, are to be compared to the white deals of the north of Europe. They have two faults—they are very liable to warp, and the knots in them (owing to the bark adhering to the branch while the wood grows over it), are liable to fall out and leave a hole in the board. However long they may be kept they never lose their property of warping, and are consequently unfit for joiner's work. They are used only for the floors of the most ordinary houses. They are extremely liable, if placed in damp situations, to decay. An instance of this is mentioned by Mr. Warburton, in his evidence upon the Select Committee on the Timber Duties, 1835, as having occurred in the floor of his counting-house at Lambeth, which he had caused to be made of spruce deals as the cheapest material. An unusually high tide in the Thames overflowed it. It was covered at the time with oil-cloth; and the oil-cloth being replaced upon the floor before it was thoroughly dry, in less than a week the dry rot had spread over the whole floor, and had penetrated in some parts below the surface of the deals. Of this species, as well as of every other description of American deal, and most especially of yellow pine deals, it may be observed, that they ought only to be used in situations that are perfectly dry, or if not dry, that are completely exposed to the air. Spruce deals (particularly the spruce planks eleven and twelve inches wide) that come from St. John's and St. Andrew's in New Brunswick, are chiefly used for making packing cases.

It is stated that every deal of yellow pine that has been shipped in America in a wet state, when it arrives here, is covered over by a net-work of little white fibres, which is the dry rot in its incipient state. There is no cargo (even if it has been shipped in tolerably dry condition) in which, upon its arrival here, some deals will not be found with the fungus beginning to vegetate on their surface. If they are deals that have been floated down the rivers in America, and shipped in a wet state only, they arrive quite covered with this net-work of fungus, so that force is necessary to separate one deal from another, so strongly does the fungus occasion them to adhere; they will grow together again, as it were, after quitting the ship while lying in the barges before being landed. Accordingly, if a cargo has arrived in a wet condition, or late in the year, or if the rain falls on the deals before they are landed, and they are piled flat, one on the other, after the usual manner of piling deals, in six months time, or even less, the whole pile of deals will become deeply affected by the dry rot, so that wherever the flat surface of one deal lies upon the flat surface of another deal the rot penetrates to the depth perhaps of one-eighth of an inch. Its progress is arrested frequently by re-piling the deals during the dry weather of the month of March, and by sweeping the surface of each deal before it is re-piled with a hard broom; but, perhaps, the best way is to pile the deals in the first instance upon their edges, by which means the air circulates round them, the growth of the fungus is checked, and the necessity of re-piling them prevented.

As respects the dry rot, it may be noticed that there are but very few cargoes of timber in the log that come from America, in which, in one part or other of every log, a beginning of the vegetation of the dry rot is not apparent. Sometimes it will show itself only by a few reddish discoloured spots on the surface of the log, which, if scratched with the nail, it will be seen that to the extent of each spot the texture of the timber to some little depth is destroyed—it will be reduced to powder: a white fibre will generally be seen growing on these spots. If the timber has been shipped in dry condition, and the voyage has been a short one, there may be some logs without a spot; but if the cargo has been shipped in a wet condition, and the voyage a long one, then a white fibre will be seen growing over every part of the surface of every log. It should further be noticed in connexion with this subject, that there are two descriptions of European timber likewise very liable to take the dry rot, yellow Petersburg deals and yellow and white battens from Dram in Norway. Battens that have beeen received from Dram, and allowed to be a long time in bond in this country without being re-piled in time (as they ought to have been), have been as much affected by the dry rot as many American deals, though this has not happened in as short a time as has been known to be sufficient to rot American deals. That the fungus growing on the surface of American timber is the dry rot appears to be quite certain; it has all its character, as to appearance and as to effect, for whenever it spreads over the surface, the deal, if neglected, is reduced to the state of powder.

These are a few leading facts connected with the important subject of the selection of such timber as is placed within our reach, and to which, for the most part, our choice is limited. For a mass of information on every thing connected with the subject we may refer to the documents from which these few particulars have been chiefly gathered, the Evidence given before the Parliamentary Committees on the Timber Duties.

## DECOMPOSITION AND FERMENTATION.

When that power, which we call life, ceases to be exerted in vegetable matter, by which its particles are held in cohesion, and form certain tissues which compose organs, by which various functions are performed, the molecules separate from each other; the attraction that existed between the particles of which it was composed ceases, and these enter into new arrangements with each other, and with the particles of the bodies by which they are surrounded, and are likewise acted upon by radiant matter, by caloric, and by light; decomposition occurs: but, by one of the wondrous laws of nature, not a single particle of the original body is lost in creation; it only assumes a new form, and combines with some other body, and thus an eternal chain of movement is going forward. The ultimate change is to reduce a vegetable to some of the elementary bodies of which all objects are composed, and which only unite to form the simplest bodies; thus, the hydrogen unites with oxygen to form water, and with nitrogen to compose ammonia, and carbon seizes upon oxygen to form carbonic acid. Still there are many states perceptible; there are different intermediate stages, when striking characteristics and peculiar properties are marked in the subject of decomposition, and when further changes can be arrested, and a compound attained that may be employed for the purposes of supplying the wants of man. There seem to be some circumstances absolutely and indispensably required for the production of fermentation, without which, although certain changes may proceed, they are simple decompositions. Thus, water is a most important agent; indeed, without it, no vegetable matter can undergo the process. This is so evident, that one of the great objects attended to by those who preserve seeds, roots, leaves, flowers, or fruits, is to obtain the utmost dryness. One of the most important cares of the herbalist, and of those who make our pharmaceutical preparations, is to take every precaution that the pulps, the gums, the oils, the extracts which we employ, should be reduced to the most absolute state of dryness; the least humidity admitted would be most injurious. Another point is the due admission of heat; there is a certain temperature at which only this process can go forward; below the freezing point it never can occur; but different vegetable bodies demand different degrees both of heat and of moisture. Some seek only a very small quantity of moisture, and not an elevated degree of temperature; whilst others, again, are not susceptible of the due degree of change, unless large quantities of fluid and much caloric are present. Much of the superiority in the different products, in their qualities and characteristics, are necessarily dependent on our due acquaintance with all the points connected with this interesting series of changes, and the consequent developments.

## COMBUSTION OF FUEL.

Mr. J. A. Detmold, of London, Merchant, has just patented the following improvements in the construction and arrangements of furnaces or fire-places. The plan consists in first generating gas from the coal or coke employed, and subsequently burning that gas by the introduction of jets of heated and compressed air at the bridge of the furnace. To produce this effect, he makes the fire-place much deeper than is usual, so that there may be a depth of fuel of from three to five feet, according to its quality. The fire-place is enclosed so as to prevent the accession of air from any other part than through the fire-bars. The ash-pit is also enclosed, and the fire is supplied with air by means of a blower, the draught being occasioned by a pressure of air greater than that of the atmosphere, instead of depending on the rarefaction of the air by heat in the chimney shaft. The bed of fuel is ignited at the bottom, and is kept at a comparatively low temperature, the object being to generate gas, and not to evolve heat. The carbonic acid gas generated by the perfect combustion of the fuel becomes converted into inflammable carbonic oxide in passing through the carbonous fumes of the coke or coal placed above it, and combined with the carburetted hydrogen gas it passes on to the bridge of the fire-place, where a number of jets of compressed and heated air inflame the gases in the hearth of the furnace, and produce an intense heat. This kind of furnace is intended more especially for refining iron, and it is contended by the patentee, by thus excluding more cold atmospheric air than is absolutely necessary for the conversion of the fuel into gas, the oxygenisation of the metal previous to its being fused is prevented, and the formation of scoriæ diminished. When the fusion of the metal is completed, jets of hot air are introduced on its surface, which keep the molten mass in action, and facilitate the decarbonisation of the iron. It is stated that by this method anthracite coal may be used with great advantage, and the saving effected in refining by this process is represented to be at least eight per cent. on the iron produced.

## ZINC.

Zinc is found in all quarters of the globe. In Great Britain it is abundant, though therein never found in a native state. It usually contains an admixture of lead and sulphur. When purified from these, it is of a blue light colour, between lead and tin, inclining to blue. The ore, after being hand-dressed to free it from foreign matter, is roasted, by which the sulphur of the calamine and the acid of the blende are expelled. The product is then washed to separate the lighter matter, and the heavy part which remains is mixed with one-eighth of its weight of charcoal. The mixture, being reduced in a mill to a powder, is placed in the pots, resembling oil jars, to be smelted. A tube passes through the bottom of each, the upper end being terminated by an open mouth near the top of the pot, and the lower end going through the floor of the furnace into water. The pots being filled with the mixture of ore and charcoal, an intense heat is applied to them by means of a furnace, by which, as the ore is reduced, the zinc is volatilized, and escapes through the tube into the water, wherein it falls in globules, which are afterwards melted and cast into moulds. Thus procured, however, it is not pure, as it almost invariably contains iron, manganese, arsenic, and copper. In order to free it from these, it is again melted and stirred up with sulphur and fat, the former whereof combines with the heterogeneous metals, leaving the zinc nearly pure, and the latter preventing the metal from being oxidated.

Under rollers at a high temperature, zinc may be extended into plates of great tenuity and elasticity, or drawn into wire. These rollers are from 2 feet 8 inches to 6 feet in length, and the original thickness of the plate subjected to them is about 1 inch. A wire, one tenth of an inch diameter, will support 26 pounds. If zinc be hammered at a temperature of 300°, its malleability is much increased, and it becomes capable of much bending, Its fracture is thin, fibrous, and of a grain similar to steel. It can be drawn into wire $\frac{1}{100}$th of an inch in diameter, which is nearly as tenacious as that of silver. The specific gravity is somewhat below 7·0, but hammering increases it to 7·2. When heated it enters into fusion at a heat of about 680° or 700°: at a higher temperature it evaporates; and if access of air be not permitted, it may be distilled over, by which process it is rendered purer than before, although not then perfectly pure. When heated red hot, with access of air, it takes fire, burns with an exceedingly beautiful greenish or bluish frame, and is at the same time converted into the only oxide of zinc with which we are acquainted, consisting of 23·53 parts of oxygen combined with 100 of metal.

On the first introduction of zinc into this country as a material, the trades with which it was likely to interfere used every exertion to prevent its employment; and, indeed, the workmen who were engaged in laying it, being chiefly tinmen, were incompetent to the task of so covering roofs as to secure them from the effects of the weather. Hence, for a considerable period after its first employment, great reluctance was manifested by architects in its introduction. A demand for it has, however, gradually increased of late, and the comparatively high prices of lead and copper will not entirely account for the disparity of consumption. In France, in the year 1836, the quantity consumed exceeded 12,000 tons, whilst, in the same year, in England the consumption amounted only to between 2000 and 300 tons. Zinc, though subject to oxidize, has this peculiarity, that the oxide does not scale off as that of iron, but forms a permanent coating on the metal, impervious to the action of the atmosphere, and rendering the use of paint wholly unnecessary. Its expansion and contraction is greater than those of any other metal: thus, supposing 1·0030 to represent the expansion of it, 1·0019 is that of copper, and 1·0028 that of lead; hence, in use, proper attention must be paid to this circumstance, or a substantial and durable covering of zinc will not be obtained. The method of accomplishing this is, of course, by always allowing plenty of *play* in the *laps*.

The tenacity of zinc to lead is as 16·616 to 3·328, and to copper as 16·616 to 22·570; hence a given substance of zinc is equal to five time the same substance in lead, and about three-fourths of copper. The sheets in general use are 12, 14, 16, 18, and 20 ounces to the foot superficial; and as 18 thicknesses of 16 ounces to the foot are half an inch thick, the following show the thicknesses of the different weights:—

| | ounces. | | inches. | |
|---|---|---|---|---|
| Plates or sheets of | 10 | to the foot are | 0·0611 | thick. |
| | 12 | ,, | 0·0457 | |
| | 14 | | 0·0534 | |
| | 16 | | 0·0611 | |
| | 18 | | 0·0686 | |
| | 20 | | 0·0761 | |

The comparative weights of the different materials used in covering buildings may be roughly stated as follows:—

| | | | |
|---|---|---|---|
| A square of | pantliling will weigh about | | 7½ cwt. |
| ,, | plain tiling | ,, | 14½ cwt. |
| ,, | slating (a mean) | ,, | 6½ cwt. |
| ,, | lead | ,, | 5 cwt. |
| ,, | zinc (15 oz.) | ,, | 1 cwt. |

And as the timbers employed, of course, are less in dimension as the weight diminishes, it follows that a less quantity of timber is requisite when zinc can be employed. And it is a good material for water-cisterns and baths, rain-water pipes,—in short, for almost all purposes where lead has been hitherto employed; and latterly a method has been invented, by which it is formed into sash-bar for skylights and ornamental sashes; for which purposes, strength excepted, it is superior to iron, as not being liable to rust, and loosen the putty and glass. It is, in every respect, equal to copper, and not more than one-third the cost of it.—*Gwilt's Architecture*.

## PLAN OF ECONOMIZING FUEL IN BOILERS OF LOCOMOTIVE ENGINES.

In a paper lately read before the Society of Arts by Mr. Tetley, some great improvements in the plan of Economizing Fuel in Boilers has been suggested, he observed that "The evaporating power of a boiler is dependent chiefly on three causes. 1. The amount of boiler surface exposed to the reception of heat; 2, (and very materially), on the shape of the boiler; and 3, on the intensity of heat. The heat derived from that part of the boiler immediately over and about the fire he calls (according to usage) 'radiating heat.' Mr. Tetley's improvement consists in a division of the boiler into two or more compartments of different heating temperatures, having channels for feeding the compartments with water from that or those containing water of a lower temperature. The first partition is placed vertically over the water space at the back of the boiler, the top of which reaches somewhat above the water-line, and the bottom below the level of the fire-bars, but leaving a passage for the water beneath it. The second partition reaches from the bottom of the tubular part of the boiler, to a little above the level of the fire-box, and is removed but a short distance from the first partition. The third partition is placed in the middle of tubular boiler, and, as the first, runs up above the water level. A communication is formed for the supply of water, by a pipe running from the compartment nearest the chimney-box into the middle compartment, the top of the pipe being just under the top water level, and the bottom of the pipe entering the middle compartment at or near the bottom of the boiler. On evaporation taking place, the steam diffuses itself over the top of the partitions, thus maintaining the same pressure on the surface of all the water. Evaporation commences in the compartment over the fire-box, and the water, converted into steam, is re-in-stated by the surface water from the middle compartment, which is delivered almost or entirely at the evaporating point. In like manner the middle compartment is kept continually fed from the top layer of water in the third compartment, which is supplied by a pump, in the usual way. By this arrangement, Mr. Tetley states, a saving of fuel equal to about 21 per cent. is obtained, the prevention of a deposit of sediment is effected, the steam is got up more rapidly, and the action of a float for regulating a feed apparatus is rendered much more certain."

## CALICO PRINTING.

Mr. Richard Beard, of Egremont Place, New Road, gentleman, has lately obtained a patent for certain improvements in printing calicoes and other fabrics.

These improvements have reference to a previous patent obtained by Mr. Beard, and their object is to facilitate and improve the printing of calicoes from rollers, whereon the patterns are raised instead of being cut in. The principal part of the invention refers to the construction of the inking or colouring rollers. These are made of a composition of glue and treacle similar to the common letter-press inking rollers, and then covered with the felt or sieve-cloth commonly used in calico printing. The proportions recommended for the formation of the composition are from two to three pounds of glue to four pounds of treacle, the glue being well softened in water before it is added to the treacle and boiled. In fastening on the covering of felt, care must be taken that no fissures are left through which the colouring may pass to the composition and injure it. For its better protection a coating of varnish is recommended. When different colours are required to be printed at the same time, the roller is made in separate compartments to prevent the colours from mixing. Calicoes printed in this manner are said to possess the sharpness and finished appearance of the best block printing.

## ON ARCHITECTURE.

The following is an outline of an interesting Lecture on Architecture lately delivered before the members of the Institute at Brecon, by Mr. J. J. Thomas, who introduced the subject of his lecture by remarking upon its connection with the liberal arts, and its being the only record and chronicle connecting the infancy of the world with its present state of adolescence, and eulogised the spirit of inquiry which seemed to pervade all classes of society, and thought it would, ultimately, be productive of the largest and most extended benefit. He then alluded to the origin of building, which he thought little posterior to the creation of mankind, and that man soon found it necessary, in his naked and defenceless state, to erect some habitation which, however rude and inartificial in appearance, would serve the purposes of shelter and defence. He thought it probable, that if inherent wants and his own natural ingenuity were not sufficient to instruct him, he might learn from the irrational creation; and the swallow's nest or the bee's hive may have suggested hints that were by him adopted or improved, but being destitute of all elegance and proportions, could not merit the appellation of architecture, but are yet worthy of observation as the embryo of the noble edifices which have since adorned the civilized nations of the world. As wealth accumulated, decoration was added to the original objects of building, convenience and safety; for, when the few wants of nature are satisfied, and the dangers of a savage state removed, the restless mind of man creates artificial objects of desire, and no sooner are the cravings of necessity silenced, than the calls of imagination gain attention, and taste becomes importunate when the animal appetites are at rest. He then proceeded to shew that the first great efforts of the art were devoted to religion, and that it seemed to be the prevailing opinion of the earliest, and all other nations, that the greatest human skill and industry could not be more properly exerted than to display the glory of the Omnipotence! He then attempted to give an idea of the size of Egyptian architecture, as the most ancient examples of the art extant, and described the Temple of Ammon, and the enthusiasm of Champollion and Belzoni on discovering the collosal wonders of Carnac. After mentioning many other of the grand productions of Egypt, and shewing that they excited rather the astonishment arising from magnificence of design than the delight from delicacy of execution, he glanced at the remains of Babylon, built by Queen Semiramis around the remains of the famous Tower of Babel, and enumerated her many gorgeous works, as described by historians, which appeared more the ideal fancy of a fairy tale than a stern reality, then Nineveh, whose greatness no city has ever equalled; and proceeded with a slight sketch of Biblical architecture. The lecturer then arrived at a period, the most interesting in the history of art, when Cecrops emigrated from Egypt and settled in Attica, and laid the foundation of those arts which soon, under the fostering hand of the Grecians, eclipsed their origin, and assumed that symmetry and form of beauty which excite lofty and pleasing sensations in the beholders. He then compared the remains of Athens with the other great existing monuments of antiquity—and proved the superiority, not only in form and beauty, but in memories and associations, of those master-works of the city of Minerva, which still attract the attention of the scholar and the artist of every other nation. He thought that, although men have sometimes ventured, from motives of vanity and caprice, to deviate from those models, they have commonly returned to them with the clear conviction of having lost sight of excellence in the pursuit of innovation; for the orders of architecture by the Greeks were advanced to that degree of perfection which the united intellect of all the civilized world have not since been able to surpass. He proceeded for some time with the progress of the art in Greece, and expatiated upon the soothing and elevated effect of its general characteristics; yet, although it originally displayed that kind of beauty which, from the universality of its influence, appeared congenial with the human mind, it has at various times been lost by disuse, corrupted by vicious taste, and mutilated by ignorance. He then touched slightly upon the long train of disastrous casualities, which befel the works of the great Athedian architects, the Persian invasion under Xerxes, and its ravaging effects, their sa[illegible]ary domestic wars, the Roman conquest, and the destructive barbarity of some of the Christian emperors who imagined they were doing a service to the Deity by destroying the noblest productions of his creatures. Next, the formidable and barbaric inroads of the northern savages under Alaric the Goth and Genseric the Vandal, the irregularities committed during the crusades and the Turkish conquests. He mentioned this catalogue of disasters with the idea that it may excite those feelings of astonishment and gratitude, which all the lovers of the noble art ought to feel, in the almost miraculous preservation of its models—for the Parthenon still remains though in ruins as a guide to the admirers of the Doric. The Erechtheum, to those of the Ionic and the Moument of Lysicrates in all its faultless elaboration of style to those of the Corinthian.

He then alluded to the great encouragement given to the arts even in little republics, as well as in the great ruling states of Greece, and instanced the temple of Selinus, in Sicily, as an example, and minutely described this magnificent building. He thought he should be invading the province of the historian by tracing the revolutions of the progress of the art through several centuries; he therefore rapidly glanced at a few of the great Roman structures, and thought they invariably partook more of the gorgeousness of the many nations she was mistress of, mingled together, than the simple and severe forms of the early efforts of Greece. Yet he did not for a moment mean to fix the merits of one style over that of another, as both had their own peculiar excellences.

The Romans excelled in luxuriance of fancy, and richness of style; but, in a perfect combination throughout of the highest and purest elements of taste, the Grecians bear away the palm. He then went through a clear and distinct analysis of the three Grecian and two Italian orders, commencing with the Tuscan, as the simplest, and that generally noticed first by all architectural writers; and after giving its general proportions, and the characteristic features by which it may be distinguished, by pointing to large well-shaded drawings representing the principal proportions of each order, he alluded to the Trajan Pillar as the best ancient example, and the Church of St. Paul's, Covent Garden, by Inigo Jones, as the best modern, and described the interior and exterior effect of that church. He then proceeded in the same manner with the Grecian and Roman-Doric orders; he noticed, as an example of the order, the great temple of Minerva Parthenus, and called attention to a beautiful drawing of the front elevation restored. In giving a minute description of the sculptures of this sumptuous edifice, Mr. Thomas lamented the great deficiency of our modern Grecian buildings in this particular, so different from its primary practice, when the two arts always accompanied each other. But in these days of calculating utility, that which contributes more than any thing else to dignify the science of architecture, to raise it above mere necessity, and rank it with that of the imagination; to indicate at once the purposes of the structure, and appear in the most lively manner to the passions of the spectator, is generally entirely omitted, or if introduced at all, on such a petty scale, and distributed here and there with such a miserly hand, that it cannot tell decidedly of itself, or its true impressions be properly tested. In noticing the Roman-Doric, he mentioned the Monument commemorating the great fire of London, by Sir Christopher Wren, and afterwards entered in a similar manner into the details of the Ionic order, and described the Small Temple on the Ilissus as a chaste and beautiful specimen, contrasting admirably with the richer example of the Erechtheum, of which temple he drew an interesting picture, alluding to the many holy objects of Athenian veneration inclosed therein.

He next passed on to a review of the Composite order, and exhibited a large drawing of the Arch of Titus, in which structure the Romans generally introduced the order. He thought the subject of the drawing a most interesting object, as connected with one of the greatest events in history—the destruction of Jerusalem and the dispersion of the Jews. But important as these associations are, it is not these alone which give to this work the interest and importance with which the professional man views it, but because it forms in itself a relic of a new and important epoch, by the introduction of the Arch in Architecture, which, although it may have been practised by some of the primitive nations, was unknown in ancient Greece. And if the Romans could boast of no other inventions; if the origin of all that was beautiful and excellent in many other arts could not be traced to them; if their poets, orators, statesmen, and soldiers were not the greatest ever in existence; if they had not by their own glorious achievements made themselves masters of the whole habitable globe, this one discovery in itself would be sufficient to stamp an immortality on their name, as it in fact forms the true basis of the science of architecture-admitting of the extension and adaptation of its principles to works which the Greeks, with all their genius and taste, could not have executed. He next adverted to the Corinthian order, its supposed origin, characteristic distinctions and proportions, which were clearly exemplified by a drawing on a very large scale of the base, the capital, and the entablature, copied from the remains in the Campo Vaccino, at Rome, after Sir William Chambers. The graceful and elegant proportions of the order had a wonderfully fine effect, and the frieze was beautifully enriched with a classic design by Mr. Thomas. He then compared the Grecian and Roman practices of this order, and minutely described the elegant monument of Lysicratis, as one of the finest Grecian productions, but proved the superiority of the example from the Campo Vaccino in many minute particulars. He concluded his analysis of the orders by eulogising the liberality of the nation in procuring the inestimable treasures of the Elgin Collection. Mr. Thomas then apologized for the unavoidable technicalities of the description of his discourse; but his object was to excite a thirst in the workmen after greater research into the minutiæ of the science, until he is enabled to execute the component parts with truth, taste, and delicacy, without which the finest designs will be very deficient in beauty. He encouraged them to surmount all difficulties in the acquirement of such knowledge, by persevering assiduity, for they were not only increasing the power of the head to contrive, as well as the hand to execute, but elevating themselves from mere mechanical drudges to somewhat of the dignity of an artist. He then descanted upon the merits and advantages of the institutions which have been formed in almost every town in the United Kingdom for the encouragement and enlightenment of mechanics, and strongly urged all who were in any way connected with the building crafts—all who were desirous of distinguishing themselves—of raising the character of their respective employments—of emulating the glorious works of their predecessors—of rearing the prostrate column, and reconstructing the shivered arch, which had been so long a ruined mass, on the pure and firm basis of science; of acquiring those intellectual qualifications, which are as indispensable to the working mason as to the carpenter or any other artizan; of depending on their own resources for the proper carrying out of their different occupations—of restoring the dignity attached to the "masons of the olden time"—all who wish to gain the true ascendancy and superiority assuredly flowing from knowledge, be entreated to join the Mechanics' Institution of the town, which if supported by the hundreds for whose welfare it was chiefly founded, will be enabled to carry out those principles of teaching with a spirit and energy that will be nobly beneficial in its results.

The lecturer, in concluding his discourse, sincerely hoped that the patrons of the art would more extensively use the means so largely in their power, that the barbaric mixtures which now so generally reign may be entirely discarded, and some styles adopted congenial to the history, the climate, the habits, and surrounding aspect of our country; for why should a science so eminently adapted to continue the pride of man's reason, and leave indelible marks of an enlightened and civilized age, even "to the wreck of matter"—why should such a science, capable of such noble and extended results, be perverted by ignorance, and made, by false and erroneous ideas of economy, merely a monument of our folly. He then went on to shew how architecture always flourished during this encouragement of literature, and what an active engine it was to promote tranquillity and civilization; and instanced the restoration of the beautiful models of classic celebrity during the revival of letters under Pope Leo X., and Francis I. The erection of the sublime structures of Rome when Augustus could call around those bright spirits whose genius and learning have since been translated into every tongue. The building of the famous and astonishing edifices which still adorn the Athenian Acropolis, when Socrates and Plato, and a whole host of immortal names, were protected and encouraged by Pericles. The rearing those mighty monuments of Luxor and Carnac, when Sesostris, although the greatest conqueror of the age, seemed to soar above the prejudices of the times, and to devote himself to the enlightenment of his people, by collecting his wonderful library, and transcribing over its entrance, "*The health of the soul.*" It was this love of learning which was the chief incentive to the erection of those grandest works of human power, and which are now invariably the only record of these remote periods. "Surely, then, this establishes the fact, that although empires may decay, and the manners and customs of their people be buried in the impenetrable gloom of ages; that although literature be lost, and languages become unknown, yet the language of architecture will never die."

## RESEARCHES ON LIGHT.

The following important observations are contained in Mr. Hunt's Researches on Light, and are connected with our former notices of this most interesting volume.

"All the experimental evidence connected with the chemical powers exerted by the solar rays which has been gained up to the present time, has now been given, and I feel certain that, notwithstanding the very great progress which has been made in this inquiry during the last three years, the present volume must, in a short time, become merely a record of the stages by which one of the mightiest truths of nature has been revealed. Setting aside the curious and beautiful applications of the solar power in the production of pictures drawn with unerring fidelity, let us consider the conclusions to which the details I have given will lead us.

"It is now established that the sun's rays cannot fall upon any body without producing a molecular disturbance, or a chemical change. Wherever a shadow falls, a picture is impressed. It matters not, whether the material which receives the images be one of these chemical compounds which are so susceptible of change, or a plate of metal, or a block of stone. The surfaces of all material things are constantly, under the influences of sunshine, undergoing a mysterious change, which is communicated by molecular vibrations to the entire mass, and new conditions established, which, with all the powers of chemistry, we cannot yet follow.

"The influence of this power on the vegetable kingdom is strikingly evident, and we are now enabled to trace nearly all the functions of the plant up to the operations of a principle which appears to have its origin in the sun.

"Is it not also evident that the condition of the animal kingdom is not merely influenced, but dependent for health and vigour on this solar power?

"Where the influence which accompanies each ray of Light can penetrate, there we find organization and Life. In those abyssess to which it cannot reach, is an eternal blankness. Even in the pellucid ocean, we find at no very considerable depth, where the faint gleam of Light is dying into darkness, a few animals, and these few of the lowest order of organization, and colourless. Below this region, neither vegetable nor animal food is found. As we ascend toward the surface of the sea, distinct zones of animal and vegetable life present themselves, each differing from the other; those of the superior zone being higher in the scale of organization and of brighter colour than those immediately beneath it; whilst near the surface of the sea the most exquisitely developed forms exist, adorned with all the beauty of prismatic colouration.

Even on the surface of the globe the influence of the sun is shown in the most marked manner. The animals and the plants of the tropical climes glow with the richness of colour; those of the temperate zones are of a duskier hue; whilst in the arctic regions we find them nearly colourless. The races of men are characteristic of the clime in which they are found, not in colour merely, but in physical power, in animal passions, and in mental energy. It has been asked, and the question is deserving the attention of the physiologist—Is not the short-lived beauty of the Oriental women to be attributed to the influence of that sun

"Shining on, shining on, by no shadow made tender,"

which we well know, gives all the grandeur and beauty to the vegetable world of the East.

It will not be denied by any one, that the sun's rays have a quickening, an almost life-kindling, power. The fable of Prometheus, says Lavoisier, was the expression of a philosophic truth. To which then of those principles, which we have detected in the sunbeam, are we to ascribe this influence? Is it to Light, to Heat, or to ENERGIA, or whatever else we may call it, that we are to attribute all the great phenomena of creation which appear to be dependent on the solar emanations? The accumulated evidence would seem to show, that all those great changes, which we have been considering, are the results of this mysterious and most energetic power; that to it almost every phenomenon connected with the grôwth of plants is to be traced; that the animal kingdom is most powerfully influenced by it; and that all those chemical changes, which have been attributed to Light, are due to ENERGIA.

## PLATING.

MR. WOOLRICH has patented the following preparations:—

He boils twenty-eight pounds of pearl-ash in thirty pounds of water; to which, when cool and filtered, he adds fourteen pounds of distilled water, and than saturates the solution with sulphurous acid gas, producing thus sulphate of potash, which he terms the solvent. He now dissolves twelve ounces of crystallized nitrate of silver in three pounds of distilled water; and adds the solvent as long as a whitish precipitate falls: the precipitate is then washed, and re-dissolved in a sufficient quantity of the sulphate, to which is added one-sixth part more, so that the solvent may be in excess: this he calls the silvering liquor. For gilding, he dissolves four ounces of fine gold in eleven fluid ounces of nitric, thirteen of muriatic acid, and twelve of distilled water; the solution is evaporated, and the crystals are re-dissolved in one pound of distilled water. The gold is then precipitated by pure magnesia; the precipitate is first washed with distilled water, acidulated with nitric acid, and then with water alone. To the washed precipitate is added enough solvent to dissolve it, and one-fifth more. A coppering liquor is prepared by dissolving seven pounds of sulphate of copper in thirty pounds of distilled water, and adding solution of carbonate of potassa till precipitation ceases. The washed precipitate is dissolved is the solvent, with one-third more than enough.

## VARIETIES.

*Manumotive Carriage.*—Mr. Price, of Wardour street, is now registering a patent for a carriage, which is to be propelled by the hands, and which will travel at the rate of fifteen or twenty miles an hour, without fatigue or labour to the individual who works it.

*Niagara.*—In 'Silliman's Journal,' the following paragraph occurs:—The motive power of the cataract of Niagara exceeds by nearly forty-fold all the mechanical force of water and steam power, rendered available in Great Britain, for the purpose of imparting motion to the machinery that suffices to perform the manufacturing labours for a large portion of the inhabitants of the world, including also the power applied for transporting these products by steam-boats and steam-cars, and their steam-ships of war to the remotest seas. Indeed it appears probable that the law of gravity, as established by the Creator, puts forth in this single waterfall more intense and effective energy than is necessary to move all the artificial machinery of the habitable globe.

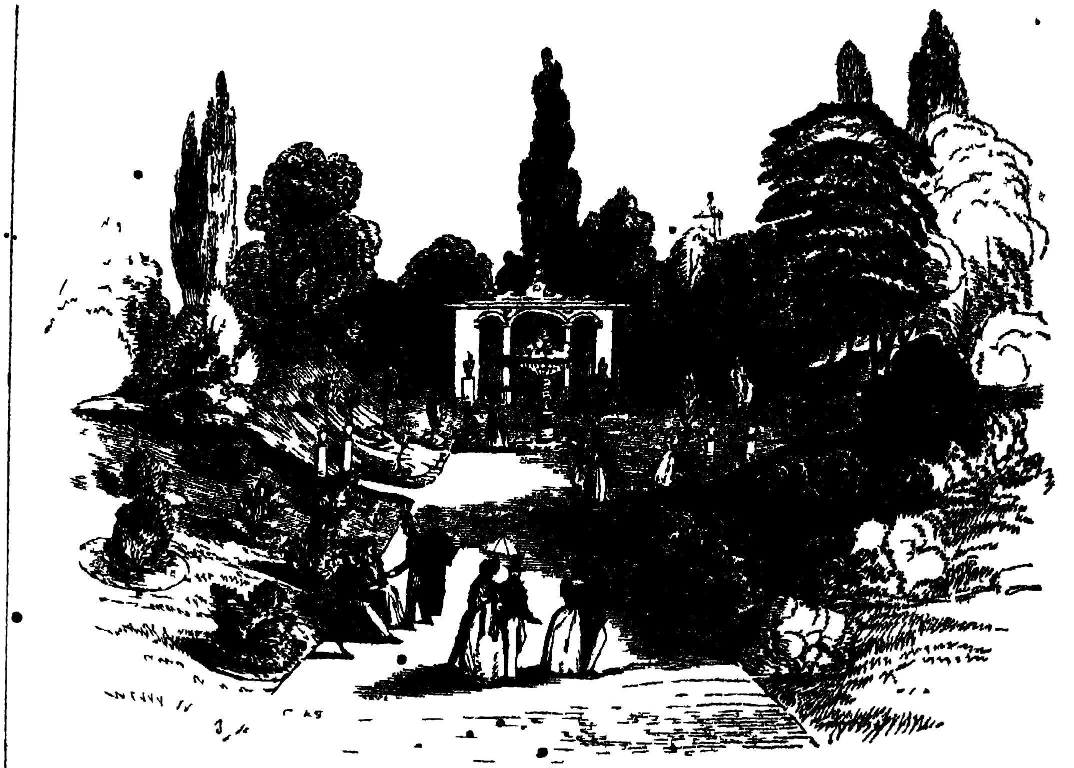
*Blasting by Electricity.*—Mr. R. W. Thomson, a Scotch engineer, is engaged in experiments for exploding gunpowder by Leyden discharges. He avoids hygrometric effects by enclosing his machine and [illegible] within an air-tight box, containing [illegible], so that he is now dependent on [illegible]ying conditions of the atmosphere.

[illegible]*ising.*—Mr. Snow Harris has commenced a [illegible] of papers in the 'Nautical Magazine,' which are to include an authentic list of some of the ships of H. M. navy, struck and damaged by lightning at various times, with brief notices of the attendant meteorological and other phenomena. In describing these cases the following arrangement has been adopted, with a view of facilitating scientific and statistical deductions from them. First, the place of the ship is given with the date. Secondly, the effects of the discharge. Thirdly, the meteorological phenomena. Lastly, such remarks as appeared necessary to complete the history of the case.

*American Bunting* is now made at Framingham, Mass. 600 yards daily, quite equal to the foreign article. This is the first manufactory of this article ever established in the United States. Heretofore all the bunting under which our navy has fought, and which has been displayed by our merchant vessels, has been the manufacture of foreign countries.—*American Paper.*

*A newly-invented Compass*, which has already attracted a great deal of attention among nautical men, has lately been shewn at the Hall of Commerce, to some of the leading London merchants. It is the invention of Mr. William Bush, the engineer, and is constructed for her Majesty's yacht the Victoria and Albert, being the counterpart of another, meant as a present to the King of the French, the patentee intending to proceed to Paris with a view of submitting it to his Majesty. The appearance of the compass is in some respects quite different from the common one, magnetic bars in a neat case being attached to the framework of what we believe is technically called the box. Upon the lurching of the vessel these remain perpendicular, and the compass itself is entirely unaffected by local attraction. This has been sufficiently proved by repeated trials in Woolwich Royal Dock-yards, where thousands of tons of iron are lying, and which nevertheless failed to disturb in any essential degree the patent compass, while that constructed on the ordinary principle was subjected to violent oscillations. There have also, as we understand, been several experiments on board iron steamers, so ill adapted to the right working of common compasses, and with the greatest success to the new one. Of course, if the *desideratum* of nonvariability of the needle shall be found to have been fully supplied (and we confess from all we have heard and seen, despite the fruitless efforts that have been made for more than a century, we believe it now is), this will have to be ranked among the great discoveries of the age.

*Water Cress.*—The grateful and salutary qualities of this vegetable are too well known to need description; but at certain periods of the year, when, perhaps, the cress is in its best state for the table, it is common for the under part of the leaves to have a white gelatinous substance adhering to them, which cannot be removed by washing; and small snails are also fixed on them. It may be useful to many to learn, that if the cresses are put into a strong brine, made with common salt and water, and suffered to remain there ten minutes or less, everything of the animal or insect kind will be detached from the leaves, and the cresses can afterwards be washed in pure water and sent to table. Small salads, cabbages, cauliflower, brocoli, celery, lettuces, and vegetables of all descriptions, by the same simple method, may be freed from slugs, worms, or insects. If a jar of brine is kept for the purpose, and strained after being used, it will last many weeks, and the expense, of course, be trifling.



THE ARBORETUM AT DERBY.

## THE ARBORETUM AT DERBY

As a specimen of Scientific Gardening, no place is, perhaps more worthy of being recorded in our pages than the Derby Arboretum, and amidst the benefactors of the human race, none stand more conspicuous than the late Joseph Strutt, Esq, who, with an effective liberality and determined kindness, was spared to commence, carry on, and complete this (emphatically speaking) garden of the poor, which occupies eleven acres of ground, and concerning which a correspondent of the Gardener's Chronicle thus writes —" I visited it on Sunday evening, the 21st of April last—the gardens being open only in the afternoon I observed a happy seriousness on the countenances of the visitors—a subdued enjoyment which spoke volumes in favour of the judgment of the noble-minded man who had thus provided the means of bringing the works of the Almighty under the eye of those who all the week are busily engaged in earning their daily bread. Parents, with their children of various ages, might be seen quietly sitting on the many substantial seats provided for them under the shade of trees, or strolling on the walks admiring the early flowers on the shrubs, all the shrubs have a name attached to them, very conspicuous, yet not so as to be offensive to the fastidious eye It was amusing to see the children of ten years trying to read, no doubt to them hard names, and puzzling their little heads to make them out. I remarked the good behaviour of those 'children of the poor,' as, amidst the many hundreds that were in the garden, I only observed one instance of rudeness, in two boys throwing stones at each other It was instantly checked by the elder people, and the boys slunk away ashamed of their conduct The garden was, as is generally known, laid out by the late Mr Loudon, and the execution of his task does credit even to him Broad substantial walks lead down the centre, branching off diagonally, and returning up each side in a serpentine form. They are hid from each other by raised mounds of various forms, sufficiently high to prevent persons seeing over The named specimens stand singly on the grass, at such a distance from each other as their various habits as to size and form will require when fully grown They are, consequently, conspicuous objects, and draw attention even from the most heedless In the ground, previously to its being laid out, there were some larger trees; these are judiciously preserved, and seats are placed under them. It is, I think, however, an oversight that these our common trees are not named That the people pay attention to the names, was evident from the fact, that the early flowering shrubs, such as ribes, prunus, &c., were crowded by even well-dressed elderly persons, who were reading the names, and, in some instances, copying them. I would just observe, *en passant*, that the labels contain the botanical name, English name, native country, and year of introduction. As a means of refining the manners, elevating the taste, and subduing evil propensities, giving the lower orders an innocent and rational amusement, and even instruction, the Derby Arboretum is much to be admired. I came away delighted at the good effects it had produced even already, although it is scarcely three years since the gardens were completed."

## HAMMERSMITH SUSPENSION BRIDGE.

The Thames at London is now embellished by no fewer than six magnificent bridges; but it is not quite a century ago since London bridge afforded the only passage from the one bank of the river to the other, and the only entrance into the town from the south, as it had been for eight centuries previous.

The Hammersmith bridge, the first of the kind thrown over the river Thames, is certainly superior in solidity and appearance to the Brighton pier, which is built upon the same principle. The architectural beauty of the masonry is a great improvement to the hitherto clumsy masses of stone introduced into other erections of a similar description, and the whole edifice forms a highly ornamental feature of the river Thames. The want of such a convenient communication had long been felt; the only previous connexion of the Surrey and great western and northern roads being Putney and Kew bridges; the deficiency is now, however, supplied, and a direct road established, whereby a considerable saving in time, distance, and expense is effected. The line of road on the Surrey side of the bridge leads directly to Barnes Common, whence roads branch off to all the south and south-western parts of the kingdom. The distance from London to Richmond, by Hyde-park corner, is also considerably shortened, and an easier communication is made to Kingston, through which lies the great road to Portsmouth. The first meeting respecting the building of this bridge took place in the month of February, 1824, when a plan of it was submitted by W. T. Clark, Esq., engineer to the West Middlesex Water Works Company, and at this meeting sixteen hundred shares at 50*l*. each were subscribed. In the month of July the committee of management made their report, in which it appeared that they had, with permission of the Dean and Chapter of St. Paul's, negotiated with Mr. Hoare, the proprietor of the Barn-Elms estate on the Surrey side, it being leasehold, and held under the Dean and Chapter, consisting of a mansion, grounds, and farms, the other property, belonging to Mr. Hoare, being copyhold and freehold, consisting of about fifty acres. The sum asked was 40,190*l*., exclusive of fixtures, and the house and the timber on the estate were required to be taken at a valuation. The sum given was 35,000*l*. for the estate, and the purchase of a copyhold meadow, containing six acres, three rods, for the sum of 700*l*., which, together with the amount of fixtures and timber, was paid in July, 1825. The Royal assent was given to the bill on the 9th of July, 1824, by the act £10,000 were required by the Corporation of London to be invested in three per cent. consols, in the name of the trustees appointed by the act; and the company were empowered to raise a further sum, not exceeding 20,000*l*., by subscription among themselves, or among new subscribers, or by mortgage, or by granting annuities, such annuitants not to be considered proprietors. On the 7th of May, 1825, the foundation stone of the north tower was laid by H.R.H. the Duke of Sussex, with masonic ceremony. The coffer-dam being fitted up as an amphitheatre, in which the stone was suspended, and the ceremony of laying the stone commenced after three cheers had been given to his Royal Highness.

The grand treasurer delivered to him a bottle containing the coins of the reigning sovereign, also a brass plate, to be placed over the cavity, with the following inscription:—This foundation stone of a bridge of suspension over the river Thames, from the hamlet of Hammersmith, in the county of Middlesex, to Barnes, in the county of Surrey, was laid with due masonic ceremony by his Royal Highness the Duke of Sussex, Most Worshipful Grand Master, on Saturday, May 7th, 1825. W. T. Clark, Esq., Engineer; George, William, and Stephen Bird, and Captain Brown, Royal Marines, Contractors. Mr. Robert Holl, Past Grand Secretary, Clerk, and Secretary. On the stone being lowered the Duke scattered the corn, and said, "As I have poured the corn, the oil, and the wine, emblems of wealth, plenty, and comfort, so may the bridge tend to communicate prosperity and wealth, from one end of the island to the other, God bless the King;" The procession then returned, and his Royal Highness dined with a numerous company at the coffee house.

The work proceeded rapidly, and after the masonry was finished to a certain height two massive chains were fixed from the hold-down piers, and attached to the buttress, which formed the supporting chain, and on which a platform of wood was erected for the workmen. On this platform the main chains were drawn up, and fixed together with bolts. The bridge was opened to the public on the 6th of October, 1827.

The suspension towers are of stone, and designed as archways, of the Tuscan order, the part below the roadway is boldly rusticated. The towers are forty-eight feet above the level of the roadway, twenty-two feet thick, and fourteen feet wide. The roadway is slightly curved upwards, and is about eighteen feet above high water mark. The width of the carriage-way is twenty feet, with foot-ways five feet wide, guarded by a light wooden fence. The chains which support the bridge are eight in number, composed of wrought-iron bars, five inches deep, and one inch thick, four of these have six bars in each chain, and four have only three bars in each, making a total of thirty-six bars, which make a disc or curvature in the centre of about twenty-nine feet; from the vertical rods is suspended the platform, which supports the roadway, formed of timber, and covered with chalk and flints. The chains pass over rollers, fixed in frames on the suspension-towers, and are secured to the hold-down piers on each side by bolts. The approaches on each side are provided with octagonal lodges, or toll-houses, with appropriate lamps, and parapet wall, terminated with stone pillars, surmounted with ornamented caps. A communication to the works of the hold-down piers is provided under the toll-houses on each shore, to facilitate the repairs of the iron work. The extreme length to the back of the piers on shore is eight hundred and twenty-two feet more than the Menai bridge, which is built on the same principle, over the Bangor ferry, in Wales. The dimensions are as follows:—The extent of water-way between the suspension towers, rising from the river, four hundred feet three inches; the distance between them and the river on shore is one hundred and forty-two feet eleven inches; the distance on the Surrey side is one hundred and forty-five feet six inches. The roadway on the Surrey side was formed from the soil brought from the excavation made for the St. Katharine docks. The weight of the iron used in this bridge is about three hundred and fifty tons, and was principally manufactured at Gospel Oak, near Birmingham. The actual cost was £45,341 10s. 9d. At the annual meeting of the shareholders, in June 1828, the engineer reported that no part of the chains or the bridge had been injured by the traffic which had gone over it.

## IMPORTANT NAVAL INVENTION.

In a well-digested article in a recent number of the Edinburgh Review, on the life of Lord St. Vincent, are the following remarks, shewing one advantage which steam has over sailing vessels.

"Alas for the mutability of human affairs and wonderful changes effected by human invention! A boiler of water, converted into steam, impels a ship through the sea with a greater and more constant velocity than the winds can do, and the ship so impelled requires but few or no seamen: she is navigated by engineers, gunners, blacksmiths, and coal-stokers who usurp the place of seamen. What, then, is to become of our brave sailors? and what is to become of our superiority of seamanship, of the glorious result of which we have just given so splendid an instance? It may be said, we, too, can steam equally with others. True; but the naval superiority of England, which has been asserted and maintained for the last three hundred years, admits not of equality. Let us but imagine what may well happen—one of three-deckers becalmed, and a steamer with those long guns which throw heavy shot or shells to a distance of three miles, taking up or shifting her position as best suits her, while the other thrice-powerful ship is compelled to remain immovable, and must submit to be 'pestered by a popinjay,' and stung, as it were, by a smoking musquito, which, like that animal, can neither be hit, nor caught, nor crushed. The only resource we have, and it is the imperative duty of the authorities to apply it, is to supply every ship and frigate of the line with as many of these long guns as each can conveniently be armed with."

Steam vessels would act principally during calms, and the power on which they would most depend would be, that of at pleasure raking the oppposing vessel, this gives them a fearful advantage; the broadside concentrated upon a small surface sweeps the whole range of the deck, and at the time she deals the most fearful execution, the steamer is herself receiving comparatively none. At the siege of Copenhagen, our vessels lay for some time becalmed, and very serious injury was received from gun boats, which, seizing this favourable time, attacked our largest vessels, in some instances completely disabling them by the constant firing kept up upon them, and to which they could make no return.

Each steam vessel may be regarded as a gun boat, with a power of destruction thirty times increased. It may appear easy to a person watching the sailing of our yachts or packet ships for a vessel to turn; but after the injuries sustained in an engagement this manœuvre becomes extremely difficult; and the idea of launching boats to pull her round while under the enemy's fire, which would be directed upon them, is evidently untenable; and in a rolling sea, after a storm, even if unmolested, boats could not live; sails are useless in a calm, and if much torn by the enemy's shot, with the rigging cut up, the manœuvre is difficult even with a stiff breeze. But, with the foremast lost, she is completely crippled. To meet this difficulty, it is proposed to apply an entirely new power. Our readers are aware that the motion of a steam vessel is due to the resistance offered by the water to the stroke of the paddle wheel; and whatever displaces the water in an equal degree will produce the same result. Air pumped rapidly a few feet below the surface of the water will afford a considerable power, if directed from the stern, to move onwards—bow to back, side to turn. The power is limited when thus obtained; but by chemical action an enormous quantity of gas can be generated, and under great pressure, for this, combustion affords the readiest mode; it is to this disengagement of gas alone that the terrific force of gunpowder is due, In gunpowder, by graining, &c., the action is rendered instantaneous; but by avoiding damp, and by close packing, affording the mechanical obstacle of cohesion, the action can be made manageable, and comparatively speaking, slow. The charge of powder for a thirty-two pound shot is ten pounds: any excess of weight is found to be lost, the shot leaving the gun before the powder is burnt, a large proportion of powder, however, escapes combustion. With this charge a shot can be thrown nearly three miles; this force applied gradually to the stern of a first-class vessel would move her onwards, in still water, twenty feet. A wrought-iron case, to hold fifteen pounds, filled with a composition of meal powder, sulphur, and charcoal, hollowed, to evolve freely the gas, is fired, when immersed deep in the water (this can be done by quick match or the voltaic battery), the gas is evolved with great rapidity, the water is observed to be most violently agitated, ploughed up as if a hundred paddles struck it; and a backward force, equivalent to that exerted on the water, is generated. One of these cases dropped from the stern, and another from the bow, would cause a first-class vessel of 2,800 tons to turn half a circle within four seconds. It would be therefore impossible for any steam frigate to rake a vessel provided with these cases, as she could turn faster even than the steamer during a calm; and while in action with one of her own class, this power of bringing her broadside to bear, without calling the men from the guns, could hardly fail to prove of incalculable value.

At present, notwithstanding her superiority in guns and men, she must strike without firing a shot; but, if fitted with these proposed cases, she could employ them, and bring her broadside to bear.

The Polytechnic Institution affords remarkable facilities to test the power; and we believe some satisfactory experiments have been made there. But as it is now before the Board of Admiralty, from whom the names of Sir George Cockburn and Sir William Gage are the guarantees, it will receive that attention its importance demands, we will defer our further remarks upon this interesting subject till the result is known. The power is undoubted, the necessity unquestioned; and one or two experimental trials, either on the Medway or at Portsmouth, under the charge of that excellent and careful officer, Sir T. Hastings, would, perhaps, simplify its application.

## EXTINGUISHING FIRES.

In a paper lately read before the Institution of Civil Engineers, Mr. Braidwood, Superintendent of the Fire Brigade, gave the results of his experience as to the best means of rendering large supplies of water available in cases of fire, and on the application of manual power to the working of fire-engines. The author stated that if water could be obtained at an elevation, pipes with plugs or firecocks on them would be preferable to any mode at present in use; and when this could not be obtained, and the premises were of value, it would be advisable to erect elevated tanks to be kept constantly charged. When water could be obtained, however, at not less than twelve feet below the level of the premises, if it were not thought prudent to erect elevated tanks, it might be conducted beneath the surface by cast-iron pipes, with openings for introducing the suction pipes. The system of covered tanks the author believed to be the least advantageous mode of supplying water, and in many cases where the supply proceeded from large reservoirs, he thought it would be better to place plugs or fire-cocks on the water-pipe. The results of a series of experiments were given, shewing that the idea of extinguishing fires by jets from water-mains, without the use of fire-engines, would not succeed. They also proved the necessity of placing the plugs on the mains, and not on the service-pipes, where that could be done. The details were then given of the mode of obtaining water from pipes or mains, and the advantages or disadvantages both of the plug and fire-cock were fully entered into. The author then stated that the best mode of using manual power was by applying the greatest aggregate amount of power to the lightest and smallest machine; that the reciprocating motion was to be preferred to the rotary; and that a fire-engine with two seven-inch cylinders and eight-inch stroke, weighing 17½ cwt., was the most advantageous size that could be adopted.

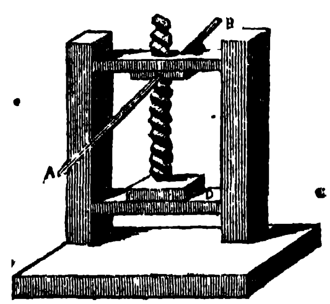
In the discussion which ensued, Mr. James Simpson approved of Mr. Braidwood's general views, but combated his ideas as to the disadvantages of sunk tanks, which he contended had been proved in certain situations to be essentially useful, and that they were provided in many public establishments. He stated that to the Dutch, who arrived with King William in 1688, we are indebted for the first organized system for extinguishing fires. Many parts of their system still remained; and in Cape Town, in 1817, he had been much struck with the completeness of their plans. He examined into the supplies of water for fires, and the modes of obtaining them, and thought that more water was wasted through the general excitement and want of presence of mind than was generally imagined. He recommended the use of screw-cocks rather than plug-cocks, as the latter were apt to become set and to be injured, as well as having in general too contracted a water-way. He also disapproved of the use of jets direct from the mains, stating them to be wasteful and not efficient, and that in almost every case they had failed, except under very peculiar circumstances.

## POWER OF THE SCREW.

The screw is a cord wound in a spiral direction round the periphery of a cylinder, and is therefore a species of inclined plane, whose length is to its height as the circumference of the cylinder is to the distance between two consecutive threads of the screw. It is one of the six mechanical powers used in pressing or squeezing bodies close, and is occasionally used in raising weights.

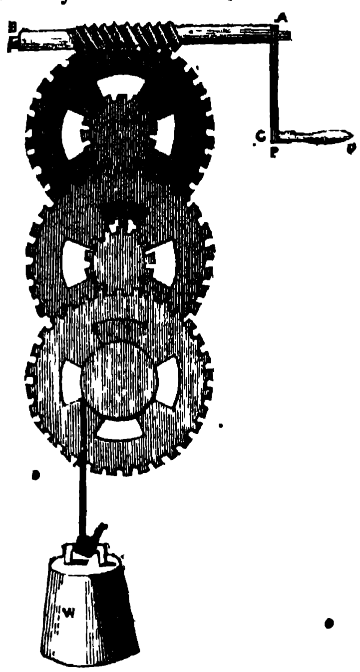
The screw, then, being an inclined plane or half wedge, the force of a power applied in turning it round is to the force with which it presses upwards or downwards, without estimating friction, as the distance between two threads is to the circumference where the power is applied. For considering it as an inclined plane whose height is the distance between two threads, and its base the circumference of the screw; the force in the horizontal direction being to that in the vertical one as the lines perpendicular to them, namely, as the height of the plane or distance between two threads, is to the base of the plane or circumference of the screw; the power, therefore, is to the pressure as the distance of two threads is to the circumference. But in the application of the screw a handle or lever is used, by means whereof the gain in power is increased in the proportion of the radius of the screw to the radius of the power, that is, the length of the handle, or as their circumferences. Consequently the power is to the pressure as the distance of the threads is to the circumference described by the power. The screw being put in motion, the power is then to the weight which would keep it in equilibrio as the velocity of the latter is to that of the former; and hence their momenta are equal, and produced by multiplying each weight or power by its own velocity. Thus it is a general property of all the mechanical powers, that the momentum of a power is equal to that of the weight which would keep it in equilibrio, or that each of them is proportional to its velocity.

From the foregoing observations, we may be easily led to compute the force exerted by any machine whose action is exerted through the means of the screw. In representing a press driven by a




screw whose threads are each one quarter of an inch apart, let it be turned by a handle or lever 4 feet long from A to B. Then supposing the natural force of a man, by which he can lift, pull, or draw, to be 150 pounds, and that it be required to ascertain with what force the screw will press on the board at D when the man turns with his whole force the handle at A and B; we have A B, the diameter of the power, 4 feet or 48 inches: its circumference, therefore, $48 \times 3{\cdot}1416$, or $150\frac{4}{5}$ nearly; and the distance of the threads being one quarter of an inch, the power is to the pressure as 1 to $603\frac{1}{5}$. But the power is equal to 150 pounds; therefore, as $1 : 603\frac{1}{5} :: 150 : 90480$, and the pressure therefore at D is equal to a weight of 90480 pounds, independent of friction.

In the endless screw A B, turned by a handle AC of 20 inches radius, the threads of the screw are at a distance of half an inch; and the screw turns a toothed wheel E whose pinion L acts in turning upon another wheel F, and the pinion M of this last wheel acts upon a third wheel G, to the pinion or barrel whereof is hung the weight W. If we would know what weight can be raised through the means of this combination by a man working the handle C, sup-




posing the diameters of the wheels to be 18 inches, and those of the pinions and barrel 2 inches, the teeth and pinions being all similar in size; we have $20 \times 3{\cdot}1416 \times 2 = 125{\cdot}664$, the circumference of the power; and 125·664 to $\frac{1}{2}$, or 251·328 to 1, is the force of the screw alone. Again, 18 : 2 or 9 : 1, being the proportion the wheels to the pinions, and there being three of them, $9^3 : 1$ or 729 : 1 is the power gained by the wheels. Consequently $251{\cdot}328 \times 729$ to 1, or $183218\frac{1}{9}$ to 1 nearly, is the ratio of the power to the weight arising from the joint advantage of the screw and the wheels. The power, however, is 150 pounds; therefore $150 \times 183218\frac{1}{9}$ or 27482716 pounds is the weight the man can sustain, equal to 12269 tons.

It must be observed, that the power has to overcome not only the weight, but at the same time the friction undergone by the screw, which in some cases is so great as to be equal to the weight itself, for it is sometimes sufficient to sustain the weight when the power is taken off.—*Gwilt's Architecture.*

## CHEMISTRY OF ANIMAL BODIES.

### *Of Digestion.*

THE food prepared by nature for many animals, when they first make their entrance into the world, is a fluid which, as is well known, consists of substances that are found in the animal nourishing them, either in the state in which they were originally introduced into the digestive apparatus, or in a slightly modified form. From a quantity of milk, therefore, it must be obvious to every one, that animals increase in size and in weight—or, in other words, they are formed from this fluid. The same observation applies to flour, which contains all those matters which are found in the animals which feed upon it—sometimes unchanged, and sometimes in a modified form. It hence becomes a most interesting inquiry to make ourselves acquainted with the nature of this fluid and this powder, upon which the existence of so much of animated nature is dependent. The following table affords a parallel view of the ingredients of the two bodies:—

| *Flour.* | *Milk.* |
|---|---|
| Fibrin, Albumen, Casein, Gluten | Curd or casein. |
| Oil | Butter. |
| Sugar, Gum | Sugar. |
| Water | Water. |
| Salts | Salts. |
| Starch. | |

The only ingredient in the flour for which there is not an exact parallel in the milk, is starch, which, however, differs from oil or fat merely in the quantity of oxygen contained in it; and hence the idea at present entertained by some chemists is, that the starch of flour, by undergoing in the animal system a deoxidating process, is converted into fat, which again acts an important part in the operation of breathing.

The fibrin, albumen, and casein, approach very near to each other in composition. The oil is a fatty body, which, however, has not been accurately examined; but as all oils and fats are similarly constituted, the transformation of one into another modified form, can easily be understood.

Fibrin is well characterized in the lean part of beef; albumen, in the white of the egg; and casein, in the curd of milk.

Such, then, are the main constituents of the food which nature has supplied for the purpose of supplying the waste which animated beings are continually undergoing. It has been a subject of much debate among metaphysicians, whether animals obtain a knowledge of the food proper for nourishing them by their experience, or by means of some mystical power which they term instinct. It is quite certain that experience alone is the guide of human beings; and it seems rather a stretch of reasoning, to attribute a *higher* power to *inferior* animals. Be this as it may, there is a law implanted in the animal economy which regularly, at intervals, brings to mind the necessity that there is for taking food. This law is commonly termed the sensations

### *Of Hunger and Thirst.*

These are the preliminary steps to digestion. They constitute a law of animal life, for the purpose of inducing living beings to take such nourishment as is required to supply the waste which they are continually undergoing. If the dictates of these sensations are rationally obeyed, satisfaction and healthy digestion are the result; but if, on the contrary, they are disobeyed, weakness and disease must necessarily ensue. A physician was consulted by a worthy missionary, previous to his departure for India, with regard to the propriety of fasting as a religious observance. The former told him, that he considered the sensation of appetite and hunger as a most important law in the animal economy, destined by the Creator for the purposes of existence. It was therefore a law of God, that it ought to be obeyed as a matter of duty; and that, if infringed, the consequences would necessarily be in a greater or less degree prejudicial; for it is no argument in favour of any such experiment upon human life, that life does not terminate upon its adoption, or that the symptoms of some frightful disease are not instantly ushered in. The seeds of future mischief may be sown in one experiment, and may only lie dormant until a second or succeeding infringement shall cause them to sprout forth into living activity. One instance of abstinence or of drunkenness may not produce death or immediate disease; but in one day of want or inebriety, the constitution may be irremediably ruined; and, at the very least, the subject who has been guilty of such deviations, must be pronounced as having attempted to thwart unchangeable and eternal laws. Similar reasoning is applicable to the poor who are unable to procure sufficient food to appease the important sensations when they occur. We have every reason to infer that disease will be engendered by these unwilling but necessitous fastings. How incumbent, therefore, is it on those who are in better circumstances, to prevent the occurrence of such disease, by contributing to the support of their fellow-beings!

Appetite, or, in its more advanced stage, *hunger*, teaches animals to seek for solid food; and *thirst* suggests the propriety of rendering the solid mass more pulpy and dilute, by the employment of drink. Experience and reason, we conceive, must distinguish the proper objects to be employed for such purposes.

### *Of Mastication or Chewing.*

When a solid portion of food is seized by the front teeth, it is conveyed into the cavity of the mouth, by the assistance of the lips, jaws and tongue, and the auxiliary muscles. By aid of the tongue, it is placed between the opposing jaws, where it is ground to a proper consistence. But the action of the jaws in grinding the morsel introduced between them, at the same time calls into play the compressing power of the muscles of the cheek upon the parotid gland, which is placed before the ear, and expels its secreted fluid, the saliva, into the mouth, to assist in comminuting the nutritive matter. Besides this mechanical agency, there is however, a nervous action called into operation; the masticated matter acts upon the tongue and adjacent parts, inducing a sympathy with the glands placed under the tongue, and causes them to pour out their copious contents. The object of mastication, or chewing is, therefore, to reduce the food to such a consistence as shall fit it for its reception and proper digestion in the stomach; this is well illustrated in the instance of animals which are not supplied with teeth. The common fowl, for example, has no teeth; but it has a muscular apparatus called the gizzard, which powerfully compresses the introduced food, and by means of pebbles and stone, which are a necessary article of food with the class of animals referred to, an artificial substitute for the teeth is provided. From attention to these facts, therefore, we are taught that the preparatory step of digestion consists of the comminution of solid food, by means of the apparatus set apart in the mouth for this purpose, and its mixture with a certain quantity of fluid to render it more dilute. Two questions arise from reflecting upon these circumstances. These are, what ought to be the nature of the solid food introduced, and of the liquid, which our sensations may require, in addition to that supplied by nature? The first question has been long ago solved by Dr. Prout, who directs us to nature herself for an answer to our question. Milk is the food provided at first for the use of man. The study of the composition of milk will throw light upon what ought to constitute the proper food of man. Milk contains four alimentary principles: *water*, *sugar*, *albumen*, and *oil*. Water, it has been asserted, affords no nutriment. And yet the human body consists of three-fourths of water; for without it, matter, in its solid state, appears incapable of vitality. One great antagonist to the organization of water, and therefore to vitality, is alcohol, which we find attracts the water, and causes the wretched mummy-like aspect, so distinctly observable in drunkards. Under *sugar* are included starch, and the other products resulting from chemical change in sugar: it comprises vegetable food. *Albumen* includes animal food, under its different modifications. The inferior nutritive food belongs to the class of oils, which are difficult of digestion, and in this country, comparatively rarely resorted to, with the exception of alcohol, which is most closely allied to the vegetable oils, the least nourishing of its class. The resolution of the second question, with respect to the nature of the liquid which ought to be introduced in contact with the solid food, directs us to the consideration of the saliva, which is the natural diluent to the food, and is supplied by the salivary glands. All the fluids of the human body present but an insignificant quantity of solid matter, in proportion to the fluid part; accordingly, we find that the saliva contains ninety-nine and one-third per cent. of water, the remainder being principally common salt and mucus. If we therefore follow the rules which nature laid down, it would appear that water is sufficiently stimulating for the purposes of diluting the masticated food, and preparing it for its digestion in the stomach.

The *saliva*, or spittle, is a frothy fluid, considerably heavier than water. During eating it is said to be alkaline; at other times acid. The saliva is supplied by a gland in front of the ear, termed the *parotid gland*, which is familiarly known in an inflamed state in the disease termed the mumps. Saliva is also poured into the mouth from various small glands placed under the tongue. The quantity emitted in twenty-four hours, from the various glands, is computed to amount to 1¾ lbs. troy. After being filtered, the saliva is clear and colourless. When evaporated, it leaves from 1·12 per cent. to 1·8 per cent. of residue. It consists of the following substances, according to two analyses:—

| | | |
|---|---|---|
| Water, . . . . | 98·878 | 99·29 |
| Animal matter, | 0·626 | 0·29 |
| Muriate of Lime, | 0·180 | 0·14 |
| Lactate of Potash, | 0·095 | |
| Lactate of Soda, | 0·024 | |
| Mucate of Soda, | 0·164 | |
| Phosphate of Lime | 0·017 | |
| Saliva, . . . | 0·015 | |
| Common Salt, . . . . . | | 0·17 |
| Soda, . . . . . . . . . | | 0·02 |

It has been thought that in the healthy state of the body the saliva should be neutral or alkaline, and that in persons who are troubled with indigestion, in which acid is developed in the stomach and in the upper part of the canal leading to it, we have an explanation of the rapid decay of the teeth in persons so affected. Certain it is, that in decayed teeth, the inorganic matter, consisting of phosphate of lime or bone, earth, and chalk, have been in a great measure removed, and the principal part of the residue consists of animal matter, or cartilage, which is insoluble in such acids as make their appearance in indigestion.—*Glasgow Mechanic.*

## ON THE MANUFACTURE OF SULPHURIC ACID, AND ITS MOST IMPORTANT COMPOUNDS.

In the manufacture on the large scale, the object is to provide, First, a large space in which the damp gases (sulphurous acid and nitrous acid) may unite to form the crystalline solid, and an extensive surface of water on which this may fall, and being decomposed, evolve the nitric oxide which sustains the continued action. This object is secured by means of a large chamber constructed of sheet lead, of two distinct portions: one a tray of about eight or ten inches deep, and the other, truly the chamber, which has no bottom, but the edges of the sides and ends dip into the water of the tray precisely as the edge of a bell glass for containing gases dips into the water of the pneumatic trough, or of a plate on which it may be placed. It is found that these very large chambers are not so beneficial as had been conceived. In fact, in them the materials have not merely room to mix, but also room to keep asunder, and it was necessary, to subdivide them by internal partitions, in order to throw the stream of gas into motion in various directions up and down in different parts of the chamber, by which the perfect diffusive mixture of the air, the sulphurous acid and the nitrous acid fumes may be secured. It is now, I believe, considered by the best informed manufacturers still better to have a series of small cubical chambers, which communicate by comparatively narrow tubes, than to form one or two very large chambers, even where the latter may be subdivided by partitions in their interior.

The sulphur in burning gives out heat enough to maintain combustion, and also to effect the decomposition of nitre. In the sulphur furnace, at such heights as to be just above the flames, are two crowbars, on which rests an iron pan, into which the nitre (nitrate of potash, or now more generally, nitrate of soda) is placed, with the equivalent quantity of strong oil of vitriol to liberate all the nitric acid, which is 49 parts to 86 of nitrate of soda, or to 102 of nitrate of potash. The heat produced by the burning of the sulphur underneath drives off all the nitric acid as vapour which enters the chamber with the sulphurous acid, and the residue in the pan, is either sulphate of soda, or sulphate of potash, which is removed and applied to its proper uses. In burning pyritis, a precisely similar arrangement is adopted.

The longer the water in the chamber is exposed to the action of the acid-forming vapours, the more highly impregnated with the sulphuric acid does it become, but it is found in practice most advantageous to remove it from the chamber when it has attained a specific gravity of 1400; the further increase of strength taking place so slowly as to produce great loss of time, and the acid above this strength acquiring the property of dissolving the white crystalline substance without decomposing it, in which case considerable loss results. The sulphuric acid is accordingly removed from the floor of the chamber, at the gravity of 1400, by means of a leaden syphon, and transferred to evaporating pans, constructed of lead without solder, and supported over the fire by means of a framework of iron. In these pans the acid is boiled down until it attains the specific gravity of about 1700. Beyond this it cannot well be brought in lead, as at the highest temperature necessary for its concentration, a stronger acid acts rapidly on lead, and would thus render itself impure, and destroy the boilers.

The final concentration was formerly effected in glass vessels, but from the suddenness and force with which the boiling of the acid occurs, breakages were so frequent; and produced such loss, as to have led to the universal introduction of platina vessels, which, notwithstanding the great outlay which occurs in the first instance, are very much more economical in the end. The platina boiler is made very thin, and is set in a cast-iron pot, which it exactly fits. Often a head (which may be of lead) is adapted to the boiler, converting it into a still, and the fumes of sulphurous and nitrous acid which accompany the last portions of water are conducted off from the head by a pipe which conveys them back to the chamber. When the sulphuric acid has been thus brought to its last degree of strength, it is removed from the boiler by a syphon, of a very ingenious kind, the longer legs being formed in the worm of a refrigeratory, and immersed in a vessel of cold water. The acid may thus be removed quite boiling from the platina vessel, but being cooled in the longer leg of the syphon, it runs out at a temperature sufficiently low to allow of its being placed in the carboys or large bottles in which it is sold.

The sulphuric acid, when thus finished, should be colourless, of a thick oily aspect. Its specific gravity is 1845, and it is truly a chemical compound of dry sulphuric acid with water, consisting of forty parts, or one equivalent of sulphuric acid united to nine parts, or one equivalent of water. Its boiling point is about 610°. It then distils unaltered. The acid of commerce usually contains some traces of sulphates of lead, of potash, or of soda, and when made from the iron pyrites, as was generally done whist the high duty existed on Sicilian sulphur, it contained a certain, though small quantity of arsenic derived from the arseniuret of iron of the mineral, which should be considered as sensibly affecting its properties when used as a medicine.

It has been already mentioned that the sulphuric acid derived its popular name of oil of vitriol from its thick liquidity, and from its being obtained by the distillation of green vitriol or green copperas, the sulphate of the protoxide of iron. The oil of vitriol, obtained in this way, is much stronger than that produced by the combustion of sulphur in chambers, and possesses in some of the arts such advantages as to make it bring a much higher price; it is, however, not prepared in any great quantity in England, but in the north of Germany it is extensively manufactured, and is often called German vitriol, or fuming acid of hordhausen, from the white fumes which it exhales on exposure to air, particularly if hot. These white fumes are very remarkable, being produced by the evaporation of sulphuric acid absolutely free from water. The mode of producing this acid involving the prior preparation of copperas, I shall briefly notice this latter first.

Although sulphur and iron exist in nature, combined in various proportions, it is only the bisulphuret, consisting of two atoms of sulphur (32), united to one atom of iron (28), that is found sufficiently abundant to assume manufacturing importance. This mineral derives its name of iron pyrites from a Greek word signifying fire, which it may have obtained, either by its striking fire with steel, or that it frequently, on exposure to the air, becomes decomposed with such rapidity and evolves so much heat as to take fire. It affords one of the most remarkable examples known to chemists of the same substance existing in two totally distinct crystalline forms, and possessing in each totally different properties; thus its usual form belongs to the regular system of crystals, being a cube or a dodecahedron. In this state it is quite permanent in the air, is not acted on by any acid but nitric acid, and is indeed only capable of yielding any of its products after having been strongly heated. The second crystalline form under which it is, is that of a rhombic dodecahedron. In this state the pyrites has a remarkable affinity for oxygen, and absorbing it rapidly on exposure to the air the sulphur becomes converted into sulphuric acid, and the iron into protoxide of iron. These unite to form protosulphate of iron, copperas, or green vitriol.

In the districts where this easily-oxydized pyrites is met with, the mineral is disposed in heaps, on a floor, formed of well-beaten clay, with such inclination as may convey the saline liquor that drains down from the heap to a reservoir, in which it is collected, either by the rain, or by occasional washing with water. The sulphate of iron is dissolved out according as it forms, and washed into the reservoirs, in which some additional treatment becomes necessary.

It has been noticed that the pyrites is truly a bisulphuret of iron, that is, for each atom of iron it contains two atoms of sulphur. Now to form copperas, each atom of iron requires but one atom of sulphur, and the second atom, also attracting oxygen and forming sulphuric acid, renders the liquor intensely acid. This would interfere with the subsequent crystallization if not removed, and this is best done by economising the excess of acid in the formation of another quantity of copperas. Hence there is placed in the reservoir into which the copperas liquors drain, abundance of old scraps of iron, on which the excess of acid acts, and by dissolving them becomes neutralized, forming as much more sulphate of iron as the mineral alone should have yielded. This addition of the iron is beneficial even in another way. The solution of copperas exposed to the air absorbs oxygen, the protoxide of iron passing to the state of peroxide, and the liquor then loses the power of crystallizing, whilst a kind of yellow ochrey material rapidly forms, by which much sulphuric acid might be lost. Now the metallic iron, in dissolving in the excess of acid, evolves hydrogen gas, from the decomposition of the water, by which the oxygen is obtained for the iron. Whilst this disengagement of hydrogen is going on, no peroxide of iron can form, and there is ultimately obtained a liquor almost quite neutral, and containing protosulphate of iron nearly pure. This liquor is evaporated down, in iron or leaden pans, until it attains a specific gravity of about 1,350, and is then run off into crystallizing vats of wood lined with lead, where it is allowed to cool slowly; it sometimes requires ten or fourteen days for the perfect formation of the crop of crystal. Small branches of trees are occasionally immersed in the liquor to give points of attachment to the crystals, and when the deposition is not too crowded, these when taken out, present a beautiful aspect, realizing in appearance the jewelled branches of Aladdin's cave, from the graceful geometrical form, the brilliancy of lustre, and soft bluish and green tints of the multitude of crystals they sustain.

(*To be continued.*)

## VARIETIES.

*Death from Prussic Acid.*—Death caused by prussic acid, says a German paper, is only apparent; life is immediately restored by pouring acetate of potash and common salt, dissolved in water, on the head and spine. Some time since, Mr. Rogerson, a chemist, instituted a series of experiments on animals for the purpose of observing the effects of prussic acid, and of discovering the means to be pursued in case of poisoning by that fluid. He then, if we mistake not, invited the attention of the medical profession to the fact, that rabbits poisoned with prussic acid could be at once recovered from apparent death by merely pouring cold water over the head and spine.

*Wasps.*—It is not generally known that the large wasps, which are seen flying about in the months of April and May, are *Queen* wasps, and that, therefore, the destruction of them is the prevention of the birth of myriads of wasps. These powerful enemies of the honey bees are eagerly sought after at this season by apiarians, by whom they are mercilessly destroyed. Earl Fitzwilliam gives a shilling for each wasp brought to him, "dead or alive," in the months of April and May; his lordship pays more than five or six pounds a year in this way, which he considers a very profitable expenditure as regards the protection of his fruit and honey bees.

*Frankincense.*—Frankincense, which was also used in the worship of the true God, and on the altars of the heathen temples, was obtained from trees which grew in Arabia Felix. The incense trees grew only in that part of Arabia inhabited by the Sabæns, and so strict were their laws respecting them, that persons were not permitted even to see the trees, except those appointed to take care of them. The valley where they grew was surrounded by mountains, and was situated eight days' journey from Sabota (now Sanaa), the capital, whither the incense was conveyed on camels; and it was forbidden, on pain of death, to enter the city with this drug except at one particular gate, where the priests took a tenth part for their god Sabis, and no person could either buy or sell it till this duty was discharged. The Gebanites were the only people allowed to carry it out of the country. They also paid a toll to their sovereign. It was taxed again at Gaza, and by the time the kings, the priests, the secretaries, the wardens of the temples, and the various officers had levied their contributions on this drug, but little was left to pay the great charge of bringing it to the coast. At the time the frankincense was taken to Alexandria to be tried, refined, and made up for sale, the workmen were attired only in short trousers, which were sewed up and sealed, to prevent the possibility of their concealing any portion of this valuable drug. Their heads were fixed in a mask or caul, lest they should secrete the smallest portion in their mouths or ears. They were not suffered to depart after all these precautions without a strict examination.

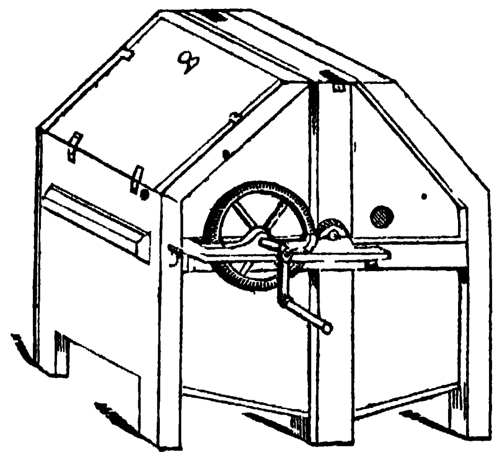


Fig. 1.

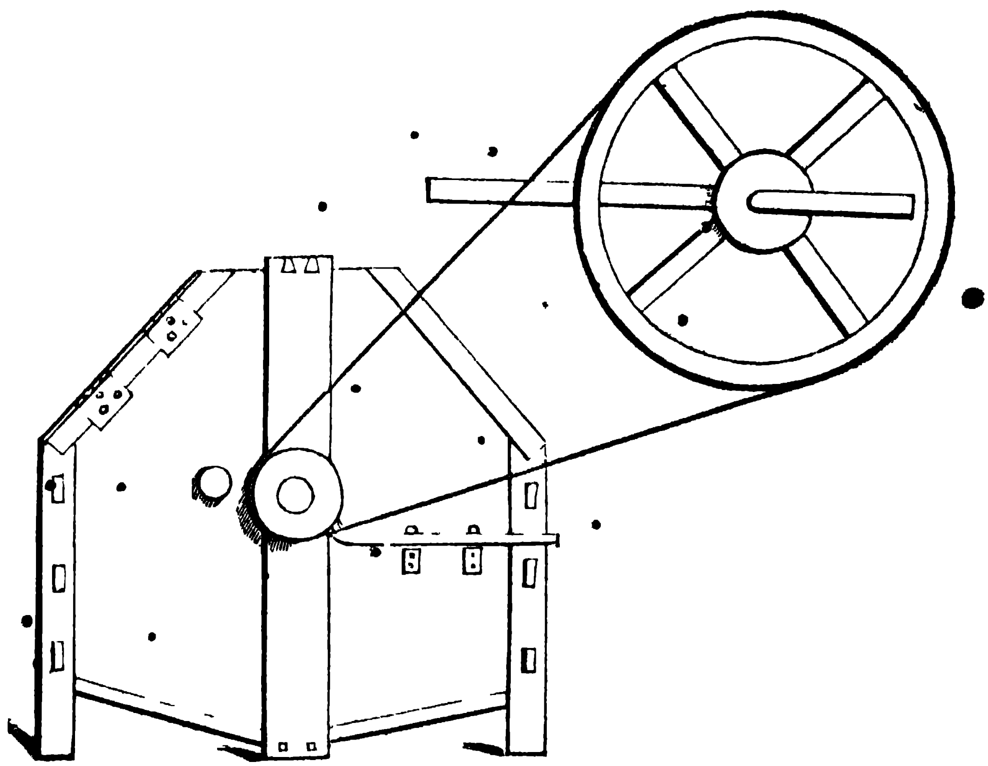


Fig. 2

ROBINSON'S PATENT DRYING MACHINE.

## ROBINSON'S PATENT DRYING MACHINE.

An ingenious and at the same time simple and valuable Machine has lately been patented by Mr. Robinson of London, for the purpose of Drying articles of wearing Apparel, Bedding, &c., which entirely supersedes the destructive process of wringing. The articles are taken quite wet from the tub, and placed in the Machine, which contains two boxes revolving on an axis, which boxes by means of a handle, (as shewn in the engraving,) are made to revolve at a most rapid rate, and thus a current of atmospheric air is produced, sufficient to discharge all the water from every part in a very few minutes. This novel contrivance is already patronized by a large number of the nobility, and in several Public Establishments, to which it more particularly recommends itself by the great facility it offers for drying heavy wet clothes in the most unfavourable seasons of the year, and by obviating the labour that is necessarily required in wringing, as well as the injury which this operation entails upon the linen.

Fig. 1, is the machine as used by hand.

Fig. 2, a back view of the same shewing how steam power may be applied.

## SAGO AT SINGAPORE.

The following information from Singapore on an article of importance, will be read with interest:

With the view of expatiating on the rise and progress of this commodity, which about forty years ago was almost entirely unknown in an European market except medicinally, being recommended as a restorative in pythisis and emaciations: we shall commence by describing the nature of the soil and situation which is favourable to it, the progress of vegetation, and the expenses of bringing it to market in its crude state; and subsequently enter into a detail of the process of refinement as practised at Singapore, remarking on the cost of labour and profit of manufacture attending its refinement from the first stage to what is called pearl sago, with statements of the import of the farinaceous pith or medulla, and export of the refined pearl sago, with the various uses to which it is applied, and such general remarks as present themselves for consideration.

Growing in an almost wild state in many places in the vicinity of Singapore, it claims particular attention, in the first place, as an article of considerable export, and secondly, to use Dr. Johnson's definition of it, as "a kind of eatable grain," increasing in demand; improving in quality and in the manufacture of which Singapore, within the last year, has not only surpassed in quality but exceeded in quantity that of any other place.

In his 'Indian Archipelago,' Crawfurd says "Sago is an article of exportation to Europe, to India (principally Bengal), and to China. It is in its granulated form alone that it is ever sent abroad. The best sago is the produce of Siak, on the north coast of Sumatra. This is of a light brown colour, the grains large and not easily broken. The sago of Borneo is the next in value; it is whiter, but more friable. The produce of the Moluccas, the greatest in quantity, is of the smallest estimation. The cost of granulated sago, from the hand of the grower or producer, is about twice the price of rice in Java, or a dollar per picul. In the market of Malacca, the sago of Siak may be had at from two to three dollars per picul. The sago of Borneo has been sold to the European merchant, in Java, as low as one dollar and three-quarters per picul. The foreign exporter will be able to ship the former at from three and a half to four and a half dollars per picul. It may here be worth mentioning, that, within the last few years, the Chinese of Malacca have invented a process by which they refine sago so as to give it a fine pearly lustre. Not above four or five hundred piculs of this are manufactured. It is thought that it may be obtained at about six dollars per picul, when the supply is more equal to the demand. A small quantity of it exposed for sale in the London market, in 1810, sold for about thrice the price of ordinary sago."—Vol iii, p. 348. And he describes the sago-palm (*Metroxylon sago*) as a native of that portion of the Archipelago in which the easterly monsoon is the boisterous and rainy one—as the eastern portion of Celebes, and Borneo, to the north of Mindanao, to the south of Timur, and to the east of New Guinea; and says that the great island of Ceram is, of all others, most distinguished for its production. He doubts it being indigenous in the western parts of the Archipelago, and draws some curious and interesting interferences from the various designations under which the sago-palm is distinguished in the different languages of the islanders, tending to prove that in the western parts it is an exotic. He gives a sketch of the sago harvest, and the modes of preparing the farina for consumption; with the various economical uses to which the different portions of the sago palm are applied, at some length, and winds up with the rough estimate of an English acre yielding 8,000 lbs. of raw meal a year.—See vol i, pp. 383 to 393.

We do not pride ourselves on our skill in botany, and submit quietly to be led, in the term *Metroxylon sago* given to the palm tree called *Rumbiya* by the Malays of this part of the world, which produces the pith, afterwards manufactured into sago, though we are not obliged to confess that we are led blindly, inasmuch as the latest work we have had it in our power to consult calls sago the production of the *Cycas revoluta*, and the 'Encyclopædia Britannica' has it the *Cycas circinalis*, a genus of plants, however, classed by Linnæus first amongst the palms, and afterwards amongst the ferns; so far we may be allowed to admit, that which we cannot confute: this knotty point settled, we may proceed to business, and for the sake of perspicuity will divide the subjects into two parts, and speak first of the crude, and then the refined state.

### ITS CRUDE STATE.

Low marshy situations, shut out, but at no great distance from the sea, and well-watered by fresh water, seem most productive. The soil in such situations to the depth of several feet is generally a flaccid mould, composed chiefly of decayed vegetable matter, and extremely pervious to water; below the above depth a stratum of marine formation generally exists. According to 'Raffles on Java,' this tree is found only in a few low and marshy situations, and the preparation of sago "from the pith is not known to the inhabitants." Marsden says that sago is but little used by the Sumatrans; and Crawfurd, as we have before stated, presumes that in this, or the western part of the Archipelago, the sago-palm is an exotic. Our inquiries have been unavailing in the attempt to discover it as indigenous in our neighbourhood, and we feel confident that it does not exist in the native wild state to the eastward of Borneo.

The best sago produced in our vicinity is from the islands of Appong and Panjang, which form the east bank of Brewer's Straits, or properly Salat Panjang; and next in quality is that from the rivers Mandha, Kâtuman, Goung, Egal, Plandok, and Anak Sirka, lying between the Campar and Indragiri rivers, on Sumatra, or Pulo Percha, as it is called by the Malays. Of least value is the produce of the islands of Buru, Ungah, and Cundor, in the Straits of Dryon, or Salat Duri. The sago-palm is found in several other places, in small quantities, but seldom cut down by the lazy possessors of it, to whom it probably descended through a long line of equally sluggish ancestors from some *Inchi* of *zamen daulu*, who had better notions when he planted it. The nature of the soil in the places we have mentioned is very similar, all of them deep bogs, next to impassable to one unaccustomed to such walking.

Cutting down and burning the jungle is all the preparation required previous to planting the palm, which is best done from the seed, a small black nut, about the size of a pullet's egg, at about five fathoms apart.

Plantations have been tried from the suckers, but the injury sustained by their roots in the separation from the parent stem has invariably retarded their growth above a year.

From seven to ten years is the time it takes for the tree to bear fruit, when planted from the seed in the first instance; cutting down for their pith commences generally at about the age of six or seven years; after this period, the pith gradually loses its moisture, and is no longer fit for the purpose when the tree comes into bearing.

Sago is cultivated in large patches—divided into lots, the property of individuals, and as much as one man, his wife, and family choose to look after—I say choose, because it is not as much as they could if they would attend. One man as above can manage one hundred fathoms square; upon this he plants four hundred seeds, and subsists himself for the first six or seven years on his means, not unfrequently leaving the trees to take care of themselves until he can commence cutting. From that day the supply is constant. Each tree throws out from ten to twenty suckers, which increase so rapidly that the owner is obliged to thin them constantly. A good tree yields from forty to fifty tampins, and the worst ever cut down about twenty-five. this is on Appong. The tampin of Appong is to that of Mandha as four is to five, and is a rough measure made of the leaves of the sago tree, of a conical form, twenty to thirty inches long, with a base of about eight inches diameter. Both ends of this are stuffed with the refuse pith to prevent the escape of the *farina*, and the tampin of Appong holds on an average nineteen pounds avoirdupois; thus seven tampin very nearly equals a picul of this place, or $133\frac{1}{3}$ lbs. avoirdupois.

It will be needless to speak of the sago of each place, differing but a little in quality, and in the measures they are sold by, as the acuteness of the Chinese brings them all to their true level on arrival here. One remark on the stupidity of the cultivators may be noticed, viz.,—one hundred tampins of Appong may always be purchased on the spot, cheap or dear at other places it matters not, for 61·4 reals, or Sp. Drs. 5, 12, as a Sp. Dr. or a real, is the same thing with them, and both go alike for 246 doits or 62 cents. of a Sp. Dr. of Singapore; if the person in quest of sago takes doits, they must be of the small kind, but thick: at Mandha, on the same principle, the same number of tampins may be had Sp. dol. 9. 61. Now the Appong measure yields fourteen piculs twenty-nine catties, and the Mandha seventeen piculs eighty-six catties, a difference against Appong of Sp. dol. 2·51, and all because they say it has been the *adat*, or custom, to sell it so.

One person is sufficient to clear the underwood away, as it grows up in every lot of one hundred fathoms square. The whole family are, however, fully required when at times they cut down, for manufacture — which is always done on the spot where the tree is felled—they prepare the number of tampins or measures required for the reception of the sago, in the first instance, and put them out to dry; they then fell the tree, and split it in halves, by means of wedges; build a temporary house over it, and dig out the pith with hoes made from the rind of the tree; this they carry up into the house, the floor of which is latticed so close as just to allow the finer parts of the Medulla to pass through on being wetted with water and trodden by the feet; into this house the produce of the trees is brought two or three at a time, and all the finer parts are carried down by the water into the trunks of the trees, three or four feet in diameter, which are cleanly hollowed out and left below to receive it; in order that no wastage may take place, they lead a mat, made also leaves of the palm, from the floor of the workshop down into the shells of the trees, and this carries the water, without spilling any; they trample it, until the water passes through clear of the farina, and then throw away the refuse, keeping sufficient merely to stuff the ends of the tampin. By the next day the medulla has settled in the trunks of the trees, leaving the water at the top; this is drawn off, and the sago flour thrown, in its wet state, into the tampin, already prepared, and left to strain itself; some refuse pith is then put on the end before left open, the base of the cone, and the work is done. The shell of the tree is then cut up for fire wood, or in slips, and thrown into the marsh, to prevent the poor devils going quite overhead in carrying down the sago to boats waiting for it. This is always their duty, for if the Malays, who come to purchase, could not get this included in their agreement, the chances are, they would go elsewhere in search of the sago. Sago, once made, is obliged to be kept wet, or would spoil in a few days; again, kept constantly wet, the tampin leaves soon rot; cultivators cannot, therefore, keep a stock ready, but at a greater risk than these savages choose to undergo. They have a method of frying the meal over the fire, called then sagu randang, which sells for a real, or 82 cents of a Sp. dol., for 16 of their gantongs are equal to 20 of Singapore, or one picul. This, however, will not keep long, as damp throws it all into a glutinous mass, and in a short times spoils it, and it may easily be supposed that their situations are not very dry and airy! At Appong, the sago is made by Orang Utan, or people of the woods, who speak a jargon of Malayan, are not Mahometans, and eat the hogs, deer, &c., with which their island abounds and the maritime Malays, who visit them for sago, are obliged to be always upon their guard, and not unfrequently wait two months for a cargo of a few hundred tampin; if they take money to purchase they get it much quicker, but require additional caution in making advances. There are said to be about 350 souls, and that the produce might be put down at 3,000 piculs a year. The most of these people are dependants of Siak, and Campar, the chiefs of the former place exercising a system of extortion and rapine, enough to induce any other class of people less accustomed, to desert the place. The cultivators in the other places are Malays, and much superior, though their exports are severally less, and trafficing with them is not so dangerous or uncertain.

Appong has 350 souls employed, and could produce 3,000 piculs—this would afford, under all the disadvantages at which they sell it, Sp. dol. 1,024 per annum, a sum quite adequate to the demands for foreign luxuries of people who do not eat rice, and live upon the produce of their woods. The people of Siak were the chief importers of sago into Malacca, whence erroneously it got the name of Siak sago—described as the best by Crawfurd. Siak itself exports no sago.

Malays all agree that the cultivation of sago is the most profitable of agricultural pursuits, not yielding to even the cultivation of rice by Sawars, for once in bearing the trees are *ad infinitnm* equally profitable, and require little or no labour.

The miserable state of barbarism in which the cultivators of sago exist, puts all calculation at defiance, but we do not hesitate in saying that if any person would commence here, and there are many places peculiarly favourable to it, and of considerable extent, that the profits of an English acre when the trees were once fit to cut would amount on a low estimate to fifty pounds sterling per annum, after paying all expenses.

## WINDOW GARDENING.

There is nothing more important in a metropolis like that of London than the management of plants in pots, for at present nothing is more certain in a general way than the speedy death of the very best that comes into the market, yet nothing so ornamental to a good house, as good plants in the window. The plants which come to the London market, are, it is true, usually at their best; they have been carefully grown according to rule, their watering has been regular, the soil properly adapted to their habits, the pots in which they have been grown are of suitable size, and the heat, and air, and light have been as well regulated as skill could suggest. The transition from all this regularity to the tender mercies of the purchaser is felt the first twenty-four hours, and the effect is often seen in that short period; drowning or starving is no uncommon fate, they are taken home, put into plates or tea saucers, deluged with wet and left standing in it; or, they are put in some conspicuous place and left to their fate without any notice at all. In the former case the leaves turn yellow and fall, the blooms drop, and in the course of a very short time the naked stumps with little tufts of green at the top or ends of them are all that can be seen of the plants, which, comparatively, a few hours before were in perfection; in the latter case the plants droop and die with all the leaves and bloom upon them. Nearly all the evils attending plants in London may be traced to these two causes; but there is a good deal to be said as to the state of the plants when purchased. Some plants are in their nature short lived, they are grown and blown only to sell, and with all the care in the world they could not be saved long. For instance, thousands of pots of tulips are sold in the London market full blown, if these were at home in their nursery they could not last long, a very few days would see them fade even in the hothouse or other place where they bloom, these are a kind of plant which might be grown in the darkest street in London, so also might hyacinths, crocuses, and many other bulbs; these then ought to be so grown because they are interesting in all their stages of growth, and those who only buy them when in flower, lose nine-tenths of their value. Even the first portion of bloom, the very first flower that shows its colour has a charm about it, and therefore should be possessed from the first. The great supply, however, of flowers, consists of stocks, mignionette, wall-flowers, cinnerarias, camellia japonicas, roses, polyanthuses, auriculas and geraniums; these are for the most part more or less forced, and the very change of temperature, from the heat of a forcing house to the cold of the common atmosphere is enough to destroy their beauty. Stocks and mignionette are generally kept through the winter in frames, and tens of thousands are treated alike till they are fitted for market. Now both of these are hardy in the open ground when they are not forced, but when brought forward for the spring market, they are naturally tender. It happens in most cases that when they are bought they want water, but it is easily seen whether the soil is wet or dry; when, therefore, they are first brought home, they should be refreshed with water, and every dram that runs through the pot should be thrown away, the saucer ought not in fact to be even damp, the plants may then be placed at the window, which in mild weather should be open, but shut if the wind be very cold; while the soil in the pot is moist no more water should be given, and when it is dry enough it should be supplied as at first, and the refuse water thrown away. In this manner they should be attended to from the time they are purchased; never to be allowed to get thoroughly dry, nor to stand in water, nor be wet long together. But the plants which suffer most, are the heaths, which require more air than any other, camellias which drop all their blooms on any sudden change of temperature, and hard-wooded plants such as epacris. It is far better that they risk a trifling frost or cold wind than that they be shut up close in a room, and more especially if there be a fire in it. It may be taken, however, as a general rule, that no plants like too much water, and if they stand in a wet saucer they have too much, unless they are in the patent pots which have feet on purpose to keep them above the wet, or are placed in patent saucers which sustain them above the water which runs through. The following may be adopted as very general rules, and although more absolutely necessary to some plants than to others, very good to all.

1. Never to water them while the earth is moist under any circumstances, but only when they are getting dry on the surface generally, this is not above twice a week in winter, every other day in spring and fall, and every day in the height of summer.

2. To give them plenty every time they are watered and allow it to run quite away from them, so that the bottom of the pot shall never stand in the water, nor even on the wet bottom of the saucer; but that whatever they stand in shall be dry.

3. To use river water where it can be had, and if

it be necessarily spring water, to let it stand in the air a day before using.

4. To give air every possible opportunity either by putting them outside the window or out in a balcony in mild weather, and if in the burning sun to recollect that the pots must be shaded if the plants are not, as the heat of the sun on the sides of the pot would dry the fibres and greatly injure the plant.

5. To recollect that plants actually in bloom would be greatly hastened out of bloom by exposing the flowers to the sun, as is the case even with plants in the open ground.

6. To keep plants as far from the fire as possible if there must be a fire in the room, and as near the window as possible, unless the frost is severe, when they are better near the middle of the room.

7. To keep the rooms where plants are as nearly of an even temperature as possible.

8. To water them all over the foilage frequently in the summer time, but only at the times when they require watering in other respects.

9. To examine them occasionally to see if the pots are full of roots, and if so to either get some soil of the nurserymen you buy of, and put them in pots a size larger, or to be more watchful that they are never too dry, and let them take their chance of living which is doubtful, though many flowers are not worth the cost of a new pot, nor the trouble of getting the mould that is proper.

In buying plants there is a good deal in a good choice. For however gratifying it may be to have those which look best, it is most pleasing to have those which last longest in perfection. Geraniums last a long time in perfection, so do the hydrangia, mimilus, myrtle, cinneraria, heartease, fuchsia, corraa, verbena, petunia, and many others whose blooms come all the summer, or at least come as fast as the plants grow. Camellia japonica may be selected with a number of buds in different stages of forwardness so as to last a reasonable time, but many of the plants brought to market are kept in the nursery till they are in perfection, and then from the moment they are bought they get worse every day, and would even in the gardens where they are raised. All such plants, therefore, ought to be bought before they are in bloom, before they have opened fairly, and to do this you must perhaps go to the nurseries instead of the market, for they are better worth twice the money they cost at market when well selected at the nursery if it be only for remaining in perfection more than twice as long. Those plants whose blossoms are coming the whole season, may be found quite good enough at the market. Upon the whole if the good people in close rooms could but give their plants more air, less water, and that more regularly, they would prolong their beauty always and their existence very often.—*The Gardener.*

## GAS LIGHT SUPERSEDED BY ELECTRICITY.

THE following is an interesting account from Paris of the first public trial of an experiment which has been more than four years in preparation, for fixing at a public point the electric light, and making it applicable to the purpose of lighting the streets and private houses:—On one of the bases of statues called the Pavilion de Lille, on the Place de la Concorde, a glass globe, of apparently twelve or thirteen inches diameter, with a moveable reflector, was connected with a voltaic battery, and at a little before nine o'clock, the electric light was developed in it by proper conducting arrangements. At this time all the gas-lights of the Place about 100 in number, were burning. As soon as the electric light appeared, the nearest gas-lights had the same dull, thick, and heavy appearance, as oil-lamps have, by the side of gas. Soon afterwards the gas-lights were extinguished, and the electric light shone forth in all its brilliancy. Within 100 yards of the light it was easy to read the smallest print; it was in fact as light as day. The astonishment of the assembled multitude was very great, and their delight as strong as their astonishment. The estimate made by scientific persons who were present, was, that the electric light was equal to twenty of the gas lamps, and consequently, that five of these lights would suffice to light the whole Place most brilliantly. As regards the expense of production, nothing positive has transpired: but I think I may safely assume, that it would be considerably less than that of the generation of gas, whilst the first outlay for machinery and conductors would not amount to a twentieth part of that required for gas-works. There would also be another great advantage in the electric light. It gives out no bad smell; it emits none of those elements which, in the burning of gas, are so injurious to health; and explosion would be impossible. The only danger that could arise, would be at the battery itself, but that would be under the control of competent persons; and even in this respect there would be no danger, even to unskilful persons, with an apparatus of moderate size. Internal lightning would be as practicable as external lightning; for by conductors the fluid would be conveyed to every part of the house. The experiment performed was with a voltaic battery of two hundred pairs, composed as follows:—1st, an outer cylinder, of glass; 2nd, in this cylinder a cylinder of charcoal, open at both ends, and plunged in nitric acid contained in the outer cylinder; thirdly in the cylinder of charcoal a porous porclain tube, containing water acidulated with sulphuric acid, and within the porcelain tube a cylinder of amalgamated zinc plunged into the acidulated water. The pile was on the Pavilion de Lille; the two copper conductors from the two poles terminated in charcoal points, within the globe, from which the air had been exhausted. The electricity produced a soft, but most intense light. I understand that the experiment was considered highly successful by the authorities who were present, and that it is to be repeated on a larger scale. Should the thing work as well in a general way as it did on the first trial, and the cost be less than that of gas, which it must be, there will be a dreadful revolution in gas-works. I have heard it asserted by persons who are acquainted with M. Achereau, the gentleman who performed the experiment, that a company for the supply of the electric light would realise a handsome profit on charging only a sixth of what is now paid for gas. The strength of the electric light did not appear to exceed that of the hydro-oxygen; but it is much more simple in the apparatus required; and much less costly in the expense of production. The hydro-oxygen light requires double and most expensive apparatus, and is only applicable to a few localities; the electric light may be applied externally and internally in any place.

## PROFESSOR FARADAY ON HEAT.

*A course of four Lectures delivered at the Royal Institute.*

### Lecture I.

The Professor commenced his lecture by remarking that he did not know which was the more delightful occupation, to receive and apply the laws of science as divulged by others, or by well-devised and carefully executed investigations to assist in searching out those immutable laws by which the universe is governed. It was the object of the present short course of lectures to consider the principal phenomena and general nature of that power commonly called heat; and although there has been but little that is new brought forward on this subject within the last year or two, yet it would not be without interest to pass again over the well-beaten path and familiarly to reflect upon some of its most important truths, as met with in every day life. It will matter little in what order the subject is taken, so that by the end its most important points have been touched upon. It will be of no advantage to follow any particular pedantic arrangement, or rigid scientific order, as we do not find such in nature. The present lecture he proposed to devote to the consideration of the sources of heat.

By the sources of heat is merely meant those circumstances which cause the feeling of warmth to the hand, which communicate the same to other bodies, or ignite combustible substances. The common source of artificial heat is what is termed combustion, that is, heat generated by bodies at the moment they are combining by chemical affinity. As one instance of what is meant, a piece of phosphorus may be burned in a portion of air confined in a glass jar, and will continue to burn so long as the air within contains any oxygen for it to combine with, but when that is consumed it will go out. Just so is it with any other combustible, as a common fire; cut off air from it and it is extinguished. In these instances the heat is accompanied with light, which is the case in all ordinary combustions. The heat and light are momentary but the effects are permament. Certain substances are produced, in the case of phosphorus, a solid, in that of the fire, a gas, but in either case nothing is lost; no such thing as annihilation of either matter or force ever takes place; it may be transferred from one place to another, but in most cases it can be followed, and its presence proved. But this action can only once produce these phenomena, and therefore it is necessary in fires to keep up a continuous supply. The substance that we now use as fuel, namely coal, is perhaps of all others the best adapted for our wants. Wood is seldom now, at least in this country, thought of as fuel. A piece of charcoal and a bottle of hydrogen gas may be taken as representing the composition of all ordinary combustibles; whether coal, wood, oil, wax, or gas, it is for their carbon and hydrogen alone that they are valued. A piece of coal lighted and put in a jar of oxygen gas, will represent the ordinary circumstances of a coal fire, acting with more rapidity, certainly, but in every other circumstance the same. The minature fire swells with heat, sends out gas, which burns with flame, causing heat enough to expel more gas, and leaving a red hot cinder, which if there be gas enough, will burn entirely away, leaving a little ash. And now in the jar instead of oxygen is found carbonic acid gas and water, as the whole of the process consists merely in the carbon and hydrogen of the fuel combining with the oxygen to produce carbonic acid and water. The amount of heat produced is perfectly definite. From a given weight of combustible the same quantity of heat is evolved, whether it be burned slowly or quickly, whether under one circumstance or another. The amount of light produced must not be considered as at all indicating the amount of combustion or heat, as it is produced from a somewhat different cause. The flame of hydrogen is very faint, but produces great heat; the flame of hydrogen, to which has previously been added half of its bulk of oxygen, is scarcely perceptible, but its heat, with one exception, is the most intense that can be obtained. But bring into this non-luminous flame some solid substance, and it instantly becomes luminous. Not that the substance need consume, for lime, which is unaltered by heat, gives out a light so bright that the eye can scarcely bear it. Light in these cases, then, appears merely to arise from solid substances becoming intensely heated. Coal gas may be burned, and that to any amount, and in the most perfect manner, and yet very little light be evolved. By placing a piece of fine wire gauze on the top of the glass chimney, and lighting the gas after it has passed the gauze, the air is so intimately mixed with the gas that the carbon of the gas is consumed before it has been highly heated, and therefore little light is caused.

All things are combustible; every thing around will burn; and yet they are all waiting till commanded, so obedient is nature to man's wishes. Why does the candle wait till lighted—why does gunpowder in the cannon wait? It is because they all want some little necessary condition to set them off: like a spring wound up to full tension, waiting but a touch. Sometimes the condition wanted is a little moisture, or electricity, or heat. A wax taper immersed in oxygen does not burn, though its wax is all ready to consume, and has ever been so, whether taken from the mummy or the Bee of last year.—*Architects' Journal.*

## ON THE MANUFACTURE OF SULPHURIC ACID, AND ITS MOST IMPORTANT COMPOUNDS.

*(Continued from page 120.)*

Such are the general characters of the formation of a copper bed, as it is termed, and the manufacture of the salt from it. If the pyrites to be employed be in the more common or cubical form, it must be deprived of all that portion of its sulphur which can be driven off by a full red heat. This is from the pure mineral, as has been mentioned in the last article, one-third, or eighteen per cent., and the iron then remains combined with two-thirds of the sulphur, forming what is termed magnetic pyrites. This substance is rapidly oxidized on exposure to the air, and hence the residual pyrites from which sulphur has been distilled, or that has been partially burned in manufacturing sulphuric acid, is formed into a copperas bed, and the same subsequent treatment followed out as has been already described. In this case, however, the quantity of free sulphuric acid that is formed is by no means so great as when the native rhombic pyrites are employed.

The copperas thus manufactured serves for a vast number of applications in the arts. It is the foundation of nearly all black dyes. Thus for ordinary black ink, for staining leather black, for various processes of dyeing or printing on calico and linen, black, or when mixed with an aluminous mordant, as such bodies are termed, for various shades of purple and brown. For such purposes, however, some other salts of iron answer even better than the sulphate, and for our present object, the preparation from it of the fuming sulphuric acid is of the most interest.

The crystallized copperas contains nearly half its weight of water (forty-five per cent.) This may be perfectly removed by the application of a heat below redness, but if we push the heat further, the salt is itself decomposed, the acid and the oxide of iron separating. At that high temperature, however, the acid is itself decomposed by the protoxide of iron, the latter is converted into peroxide, taking oxygen from the sulphuric acid, and this last being thus reduced to the state of sulphurous acid, passes off as gas. Even that portion of acid which escapes the action of the protoxide of iron, is itself resolved by the high temperature, into sulphurous acid and oxygen. Thus, if we take copperas perfectly dried, we shall altogether fail in obtaining sulphuric acid by its distillation, and accordingly, in practice, some water is left united to the salt. The crystals contain seven atoms of water; they are dried until they form a perfectly white powder, by which they lose six atoms but retain the seventh, which, from the high degree of affinity by which it is retained, has been termed, by Professor Graham, the constitutional water of the salt. This white powder is placed in earthern retorts, holding each about a gallon, with a short neck passing into the mouth of an earthenware receiver, which is kept very carefully cooled. The retorts are placed in two rows in a long furnace, the fire being supported on a grate extending betweeen the lines of retorts, and the flame spreading round each so as to raise its temperature to full ignition. This great heat being applied before all water is driven off, a great portion of the sulphuric acid is preserved from decomposition by being mixed with its vapour, in union with which it distils over, and there then collects in the receiver a dense thick liquid, the proper oil of vitriol. It is distinguished from the common sulphuric acid by its higher gravity, often rising to 1,900, and by the circumstance that in place of having, like the other, a very high boiling point, it gives off, even at ordinary temperature, copious white fumes, and at 120 degrees Fahrenheit it boils. But it does not distil unaltered; it is in reality not a true chemical compound of sulphuric acidated water, but a mere solution in hydrated sulphuric acid of ordinary strength, of the true anhydrous sulphuric acid, and this latter being exceedingly volatile, is converted into vapour, passes off, and produces the ebullition. If the vapours thus formed be conducted into a vessel surrounded by ice, they condense in beautiful silky-looking fibres of a brilliant white colour; this is the true sulphuric acid, quite free from water, solid, exceedingly like fine amianthus in aspect. Its fibrous crystals are flexible and peculiarly tough; exposed to the air they evaporate rapidly, and, uniting with the watery vapour which the atmosphere always contains, produce dense white clouds of oil of vitriol vapour. In this form the sulphuric acid is too costly, and too difficult to preserve, to be other than an object of scientific curiosity, but the dense oil of vitriol, produced as described, by the distillation of copperas, is of great importance to blue dyers for dissolving indigo, which does not unite either in such quantity, nor with at all so good a colour, with the sulphuric acid of gravity 1,845, prepared in chambers.

The residual product of the copperas may deserve a word of notice; it has been mentioned that it is peroxide of iron, the additional quantity of oxygen being derived from the decomposition of a part of the sulphuric acid. This oxide of iron, under the names of *colcothar* and *rouge*, is employed very much for polishing plate-glass and plate. The people of those trades have various minute receipts for preparing it, by which its grain becomes more or less fine and its colour more or less deep, suited to its intended use; but in all cases, the principle of the process is the same as that above described.

Associated with the manufacture of copperas is that of the other vitriols or sulphates of copper and of zinc, which are carried on when necessary, absolutely in the same mode as that of the protosulphate of iron. But as these products are not by any means of such extensive use in the arts, their manufacture is not on so large a scale, and they are frequently obtained as secondary products in other operations. Thus, when the native sulphuret of zinc (*blende*, as it is termed by mineralogists, and *black Jack* by miners) is being prepared for smelting, the roasting to which it is subjected in order to burn out the sulphur, converts a large quantity of the sulphur into sulphuric acid, which uniting with the oxide of zinc, cannot be expelled by any subsequent heat. The roasted mass is, therefore, exposed for a little time to the air and washed, by which so much sulphate of zinc is dissolved out, as to fully satisfy the demands which exist for it in commerce. The liquor is evaporated until it is strong enough to crystallize in a nearly solid mass, and is then run into deep pans, where it is allowed to cool.

Sulphate of copper might be prepared in the same way, but that it would interfere with other processes to which the ore is subjected. and that the sulphuret of copper is capable, by good management, of having its sulphur so fully burned out that the small residue is not injurious in the smelting. The source of sulphate of copper may also be the waters that drain from copper mines, in which, by the spontaneous oxidation of the sulphuret of copper, blue vitriol is formed. As these waters are very dilute, however, the cost of evaporating them, to the degree at which the salt should crystallize, is generally too great for use, and it is preferred to allow this drainage to collect in tanks in which iron is placed, when, in consequence of the more powerful affinity for oxygen and sulphuric acid which this metal possesses, it dissolves, and the copper is deposited as a metallic, partly crystalline powder. The copper thus obtained is very pure, and is called cementation copper. It is said that the copper mines of the Oroca district, in Wicklow (Ireland), were first discovered in this way by a peasant, who, having forgotten overnight his iron shovel, in a pool at the foot of the hills, found it in the morning to be, as he thought, changed into copper. Much of the faith given by the alchemists to the possible transmutation of the baser into the precious metals had its origin doubtless in the observation of such facts, whose true nature the existing state of science did not allow them to ascertain.

At present the principal portion of the sulphate of copper used in the arts is prepared quite artificially, but by a simple process. Copper is remarkable for its affinity for sulphur. If some sulphur be placed in a glass flask, and made to boil so as to fill the flask with its vapour, and that then a little bundle of fine copper wire be introduced, the wire will take fire and will burn brilliantly with a deep red light in the vapour; sulphur being thus, though combustible as regards air, a supporter of combustion as regards copper. Now this is done on the large scale nearly in the same way. Sheets of copper are placed in a reverberatory furnace and heated to dull redness, sulphur is then thrown on them, ignition occurs, and the whole is converted into sulphuret of copper. The mass should as much as possible be prevented from melting, as thereby the next process would be impeded. This consists in roasting in a current of air with a moderate heat the sulphuret until the sulphur is changed into sulphuric acid, and the copper into oxide, by absorption of oxygen: the mass is then exposed to the air and lixiviated with water, in which the sulphate of copper dissolves the concentration of the liquor, and the crystallization being carried on in precisely the same way as that described for copperas, except that the vessels employed must not be of lead or iron, by both of which metals the copper should be precipitated in the metallic state.

We have thus endeavoured to exemplify the various products of manufacture, of which sulphur may be considered as the root. There still remains one, by no means the least important, that of alum. For its description we shall have hereafter another opportunity, and will devote the next article to an account of one of the most important uses of sulphuric acid, the manufacture of carbonate of soda, and in conjunction with it that of common salt, from which all our supplies of soda are derived.

---

## VARIETIES.

*Electro-Plating and Gilding.*—Mr. E. Tuck has taken out a patent for plating. He employs either the sesqui-carbonate or the bi-carbonate of ammonia as one of the ingredients in the solution. He varies the salt of silver according to the nature of the metal or alloy to be plated; for the German silver he uses the sulphate of silver; for the superior kind and for copper, he uses the cyanide of silver. He prepares a solution of seventy parts by weight of bi carbonate of ammonia; and to this he adds one hundred and fifty-six parts by weight of sulphate of silver, or else one hundred and thirty-four parts of cyanide of silver, these being equivalents; and he boils the liquor till the salt of silver is entirely dissolved. He varies the strength of the solution according to circumstances; the strongest he has used contained half an ounce of bi-carbonate of ammonia with one hundred and seven grains of sulphate of silver to a pint of water.

*Public Garden at Frankfort.*—Frankfort is surrounded, except on the side bounded by the Maine, with a pleasure ground at least two miles in length, and occupying the breadth of the former ditch and ramparts. It is laid out in the English style, and great variety of shady walks, and picturesque scenery, with the great advantage of being accessible from every part of the city in a few minutes. One peculiar feature of this pleasure ground is, that it is not confined to trees and shrubs, but contains a profusion of the choicest roses, georginas, chrysanthemums, &c., together with most of the showy annuals, and even pelargoniums, and Tigridia Pavonia, planted in large masses of each, intermixed with vas beds of mignionette, super clumps of Brugmansia suaviolens, Salvia coccinea, &c. Though merely separated from the high road by a low hedge, though at all times accessible (there being no doors or gates of any kind at the entrances), to every individual of a population of fifty thousand souls, and constantly frequented by servants and children of all descriptions, not a flower, nor a leaf of any of the plants, from the earliest and most showy, to the humblest, seems ever touched. Even the beds of mignionette look as untrodden and unplucked as in an English private garden. It is needless to say how utterly impossible it would be to have near any large English town a similar garden thus open to the public, and thus scrupulously kept from injury, and yet there are apparently no persons to guard it; and instead of threats of heavy penalties, a printed paper is affixed to a board at each entrance, expressing that the public authorities having originally formed, and annually keeping up the garden for the citizens, its trees, shrubs, and flowers are committed to the safeguard of their individual protection. This simple appeal is quite sufficient. This garden was planted and laid out by M. Sebastian Rison, nurseryman and garden artist at Frankfort, and reflects on him the highest credit.

*Canal of the Pyrenees.*—A project has been brought forward by Mr. Buck, the civil engineer, for cutting a "canal of the Pyrenees" to connect the Mediterranean with the Atlantic, and avoid the circuitous route by the coast of Spain. The plan, as it at present stands, was first matured by M. Galabert, member of the French Chamber of Deputies. The French legislature granted to a company that was to carry it into execution the property in perpetuity in the canal, with several other advantages, but required a deposit of 3,000,000 fr. until the act was passed. The subscriptions were completed, and the company was in active operation. In consequence of this deposit not having been made, the grant has remained subject to forfeiture, but nevertheless the scheme has not been abandoned, and the notion exists of raising capital in England.

*Saddles and Harness.*—Edward Banton, Walsall, Staffordshire, saddlers'-ironmonger; has patented an improvement in saddles and horse harness. The patentee makes seven distinct claims in this specification The main feature of his improvement in saddles is the construction of the saddle tree in such a manner that the pummel may be removed, as it is fixed on by a pin and a spring, instead of being nailed on, as in the usual manner. The improvements in harness refer principally to the bit, which is so contrived that the mouth-piece may be detached from the cheeks, and fixed by screws in any position that may be required. There is a contrivance also for bringing down the nose-piece when the reins are pulled, and thus shutting the horse's mouth, and preventing the animal from running away. Another part of the invention refers to a plan for lengthening or shortening harness without buckles, by employing what the inventor terms a 'metal trough,'' with holes pierced in it, into which holes studs are fixed to the other parts of the harness drop, and are there kept firm. The patentee also claims a plan for enamelling both the leather and the metallic parts of harness for their preservation; but he does not very clearly state what part of the process is new, for the plan of enamelling, he admits, has been previously adopted.

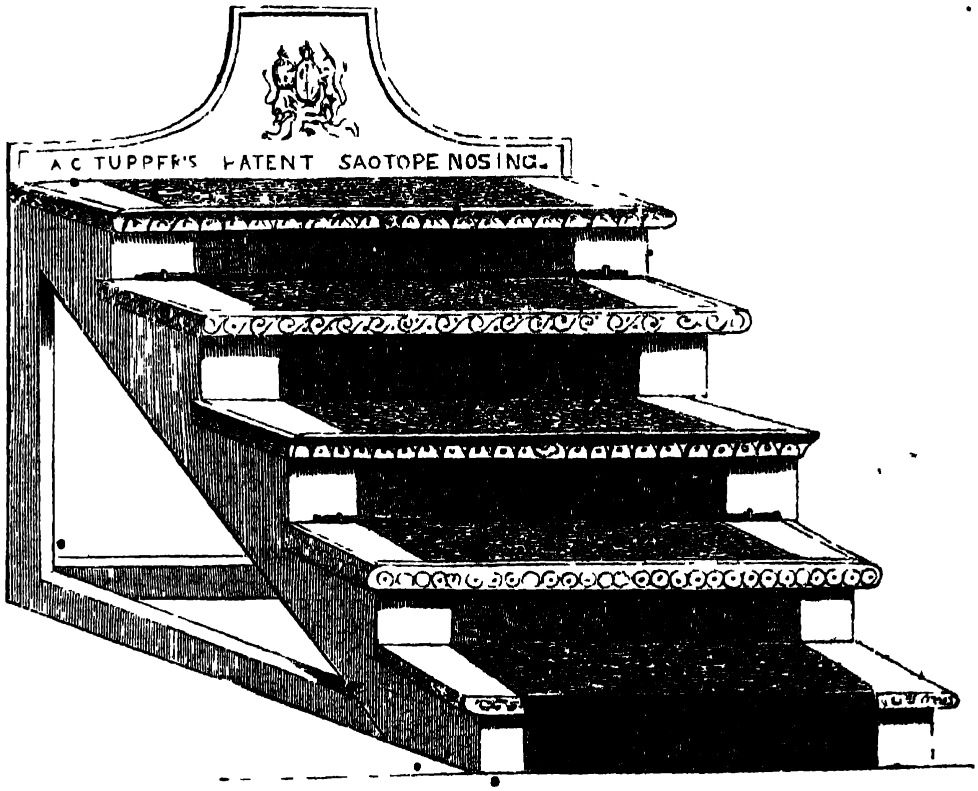



Fig. 1.

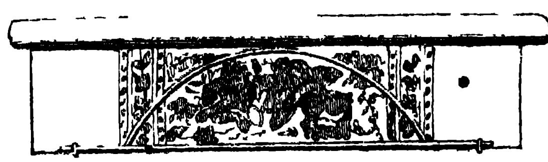


Fig. 2.

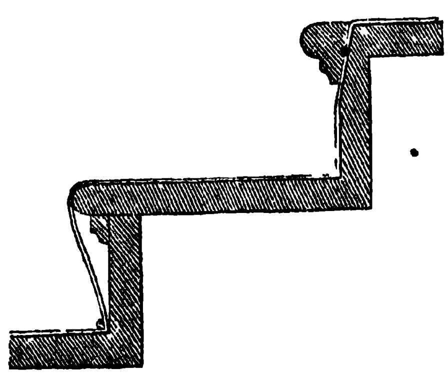


Fig. 3.

TUPPER'S PATENT SAOTAPE NOSING.

## TUPPER'S PATENT SAOTAPE NOSING.

The accompanying wood cut Fig. 1, is drawn from the model at present deposited at the Polytechnic Institution, and will enable our readers to judge of the appearance of this novel invention, and we beg to state that an inspection of the model will be much better understood than any written description; the arrangement being so simple in practice.

The improvements in laying down carpets and other materials upon stairs and steps, and in the construction of stairs and steps, and for which Mr. Tupper has obtained a patent, may be arranged under two heads, *The Nosing*, and *Stair Rod*.

In staircases in present use, and where landlords will not go to the expense of new nosings, the inventor proposes cutting through the step obliquely, close to the nosing as shewn in Fig. 3, which represents a section of two stairs, one with the carpet applied in the old manner, and the other on the improved method, in the slit so made the carpet is passed through. To insure support the stair rod can be made of an arch-like form, as represented in Fig. 2, with the apex placed under the nosing itself; it will be the means also of preventing the carpet from becoming loose, and will also keep the stair-rod from bulging and getting out of the *eyes*; these rods can be made of various patterns.

The separate nosings are made of wood, as oak, walnut, deal, mahogany, and also of metal, and they can be applied to stone and wooden steps. Mr. Tupper prefers using a wrought iron stud and plate for fixing the nosings, but they can also be attached by screws, hinges, grooves, &c., so that the carpet can either be placed and the nosing applied over it, or the nosing moving upon a hinge can lift up, and the carpet be placed as usual. The nosing so placed not only prevents the material wearing out, but also takes up less of the fabric put down, as there is a saving of about two inches upon every step. In the moveable nosings two or more pieces of metal can be attached and fastened in such a manner, as when the nosing is fixed in its place, the carpet is firmly clamped by these *stays*, doing away in this case both with stair rods and eyes.

We may as well mention that the meaning of the word *Saotape* is carpet-guard, and a better protector we think could not have been discovered.

## OF COMMON SALT, AND THE MANUFACTURE OF SODA FROM IT.

Common salt, or chloride of sodium, is diffused almost universally in nature. It exists in the blood of animals, to whom, therefore, its supply with their food is an imperious necessity. It is found in the juices of most vegetables, to provide for which it requires often to be supplied by the agriculturist by a manure, but it is peculiarly in the mineral kingdom that its presence is remarkable in amount and situation.

The vast ocean which surrounds us may be considered as a great salt mine. If we evaporate to dryness one hundred parts of sea water, taken from any locality where it has not been reduced in strength by the reception of the fresh waters of any large river, it will leave behind about three parts of saline matter, of which two and a half will be common salt. This mode of extracting the salt is actually followed, as shall be shortly described. In many instances the waters of inland lakes are salty; thus the waters of the Caspian Sea and of the Dead Sea. Some are even more salty than common sea water in many instances; thus, one hundred parts of the water of the Dead Sea give twenty-five parts of saline matter; whilst the Caspian and Aral seas are not so, is easily seen to arise from the vast quantities of fresh water thrown into them by the Volga, and other great rivers, by which they are supplied.

The common salt is found also imbedded in the earth in vast quantities in many countries, forming salt mines, situated almost exclusively in the more recent or secondary rocks. Its principal localities are in the north-west of England, particularly Cheshire; at Wielieska, near Cracow; at Salzburg, in the Tyrol. In all of these places the rock salt, as it is termed, is quarried absolutely as any other rock might be. The mines of Wielieska are the most extensive, but the produce of the Cheshire mines is, I believe, purer than that of any other. It is frequently used just as taken out of the mine, but more usually the rough product is dissolved in cold water, so as to produce a saturated solution for which generally three parts of water take up one of salt. This is then evaporated in large iron pans. It is a peculiarity of common salt to be almost exactly of equal solubility in boiling and in cold water, so that when the liquor boils down, the salt separates in crystals, the circumstances of which determine the quality and value of the refined salt. For as the evaporation of the water takes place only at the surface of the liquor, so does the separation of the salt occur there also, and the peculiar form of its crystals has then its origin. This form is a cube, but when a minute crystal has been produced at the surface, and that new ones tend to form round it, the central particle sinks a little, and the newer are deposited on a higher level; the crystal, then, although formed by an aggregation of minute cubes, assumes the form of a hollow four-sided pyramid, with its apex downwards, and continues to increase until by its own weight it breaks the continuity of the surface of the liquor, and falls to the bottom: or that, if the salt be required fine, the workman, by agitation interrupts the process, and the salt is deposited in the minute crystalline grains as they at first form. In either case the deposit is removed by perforated ladles, according as it accumulates, and is placed in conical packets to drain. When completely dry it is sent into commerce.

There are many localities where the salt exists, not solid, constituting rock, but dispersed through the rocky strata, from which it is dissolved out by the drainage water of the district, which then arriving at the surface, constitutes brine springs, and may be obtained by digging wells in suitable situations, which are recognized generally by the vegetation of the immediate neighbourhood, presenting the botanical character that properly belongs to the sea shore, and the plants being found to contain in their ashes, soda, and not potash, the alkali that properly belongs to inland vegetables. Of such brine springs there are many in the salt districts of England, and a great part of the salt employed in Germany and Russia is derived from such. In England the preparation of the salt is carried on by boiling down the water absolutely, as has been described, for the brine made with rock salt, but, on the continent, where the high price of fuel renders every economy of it important, a very peculiar arrangement is made use of for concentrating the brine until it becomes strong enough to render the use of heat advantageous. A strong framework of wood is erected, in some cases so much as two thousand yards long and from ten to twelve yards high. On the top are, at intervals, cisterns, into which the brine is thrown by force pumps, in connexion with the pits. The interior of the frame-work supports a series of walls of hurdles, formed of twigs, over which the brine, issuing from apertures in the cisterns above is made to trickle, and thus, presenting an immense surface to the air, evaporates with great rapidity. As it runs down it is received in a cistern, from which it is again pumped up, the process being carried on until the brine has attained the highest degree of concentration that the condition of the atmosphere as to heat and moisture will admit of. The direction of the prevalent wind must be carefully attended to in this erection, so that a current of air may, as much as possible, sweep along the surfaces of the hurdles, and remove the watery vapour as it forms.

It has been mentioned that often salt is obtained directly from the sea water. This process is confined to the sea coasts of southern countries, as the evaporation can only be carried on with economy by means of the heat of the sun. Near the sea a number of pits are dug, covering collectively a very large surface, and situated so as to be exposed to the prevailing winds. They communicate one with another, so as to form a series, of which the first is nearest to the sea, on which it opens by a sluice; it is made deeper than the others. In spring the sea water is allowed to enter in, and after it has deposited all sediment and become quite clear, it is run successively from one to the other pits at intervals. Under the summer sun it evaporates, and as soon as it is ready to deposit salt by further concentration, it is removed to the evaporating pans, where the process is completed in the usual way by fire. After the common salt of sea water, or spring brine, has been separated from it, there remains a liquor termed mother water or bittern, which contains so much magnesia as to be used in the preparation of Epsom salts, and contains also the remarkable element, bromine, which was, indeed, thus first discovered by Balard. The water of the Dead Sea, it may be mentioned, contains more bromine and more magnesia, in relation to its other constituents, than water from any other known source.

The properties of common salt need not be noticed, as they are familiar to all. Its uses are multifarious, but we shall only describe those which, in a chemical point of view, are most interesting. Common salt is, in fact, almost our only source of chlorine, an elementary body of the highest importance in many arts; of muriatic acid; and of alkali soda, the production of which from common salt is probably the most extensive chemical manufacture now carried on. Common salt was formerly considered to be composed of muriatic acid and soda; but we now know that the salt, when dry, contains neither hydrogen, which should be in the former, nor oxygen, necessary to the existence of the latter. The salt consists only of the element chlorine and the metal sodium, and it is only when the salt is decomposed, in contact with water, that the hydrogen of this unites with the chlorine on the one hand, and its oxygen with the sodium, on the other, and thus the alkali soda and the muriatic acid are produced. This decomposition of the salt is generally effected by means of sulphuric acid, which, in oil of vitriol, is always associated with an equivalent of water. Under the influence of the intense affinity of the sulphuric acid, the water and the salt are decomposed, soda and muriatic acid being formed, of which the former rest in union with the sulphuric acid, as sulphate of soda (Glauber's salt), whilst the latter is given off as a gas, which, dissolved in water, constitutes the liquid muriatic acid, or spirit of salt of commerce. This action constitutes the first step in the ordinary process for obtaining the alkali soda from common salt, the invention of which affords an example of the immediate dependence, not always recognized by statemen, of national prosperity on the condition of scientific knowledge.

It has been mentioned that the ashes of plants growing on the sea shore, or in salt marshes, are found to contain soda, of which, though in part united with muriatic and sulphuric acids, so much was free, or combined only with carbonic acid, as to render such ashes available in the arts as the source of alkali. Thus, on the Scottish islands and coasts, and on the northern and west coast of Ireland, vast quantities of sea weeds (fuci) were burned in rude kilns, and the half-melted mass of ashes that resulted constituted the kelp of commerce. On the Mediterranean and Atlantic coasts of Spain various plants, still rich in alkali, were similarly treated, to furnish the barilla, of which Alicante furnished the best; and from this locality France was almost universally supplied. On the breaking out of the revolutionary war all commercial intercourse with the Peninsular was at a end, and the various arts, to which soda is indispensable, would have ceased to exist in France, had not the energies of the scientific chemists of that country been directed to supply the want. In a very short time many processes for obtaining the soda from common salt had been invented, but that proposed by MM. Leblanc and Dizé has obtained the preference, not merely in France, but has been adopted up to the present time by the soda manufacturers of all countries. Of this process, the first step is, as has been mentioned above, to convert the common salt into sulphate of soda, and as this is in itself an important manufacture we shall notice its practical conditions a little more in detail.

*(To be continued.)*

---

## PROFESSOR FARADAY ON HEAT.

*A course of four Lectures delivered at the Royal Institute.*

### Lecture I.

*(Continued from page 126.)*

But the taper when lighted and put into oxygen falls, in a stream of liquid fire. These are all cases of communication; the taper is lighted from the candle, and then can communicate to any number of combustibles. All combustions are similar; they are all successive; no such thing as instantaneous combustion is known. In a mass of gunpowder, which seems to give but one flash, the combustion travels from particle to particle, no one particle becoming ignited but by the flame of its neighbour; even in each grain the combustion is progressive, travelling from the outside to the inside. In a mixture of two gases, where the particles must be in intimate contact, there is the nearest approach to instantaneousness. Still, here, there is progression of flame. If a mixture of hydrogen and oxygen be fired, the explosion sounds instantaneous. So also does it if they be divided into bubbles by being made to pass through a solution of soap, though here it is evident the flame from one bubble must light the other. In a long narrow tube full of the same gases, the flame is seen to run from end to end, and scarcely any noise is produced. Still, in all this variety of circumstance, the amount of heat produced by the same amount of combustible is always the same. The ignition of the mixture of some other gases takes place more slowly; with olefiant gas and chlorine, the flame is seen to travel slowly along, marking its progress by a dense deposit of soot.

Many other substances are known, besides those commonly used, which burn in the air, A certain preparation of lead, for instance, becomes red-hot on exposure to air, and is called a pyrophorous. But a comparison of this with a piece of charcoal will show the beautiful fitness of common fuel for the purpose of heating. The charcoal continues to glow as long as it has air, and at length leaves nothing but a very little light ash; a mass of the pyrophorous, on the contrary, requires constant stirring to expose it to the air, and more ash remains than fuel used. This would be a serious inconvenience, for before the pot could boil, the grate would be full of ashes, preventing entirely the use of such powerful machines as steam engines.

But there are other sources of heat besides the chemical one of combustion, and none more astonishing than the heat caused by friction; there is nothing more puzzling to the philosopher, and he is obliged to acknowledge that it is entirely beyond his power of explanation. In other cases there is a limit to its extent, a cause for its production; but the heat from friction seems inexhaustible, its origin inexplicable. Here there is no case of affinity, nothing consumed. The Indian takes advantage of this source of heat, for he obtains a light to kindle his fire, by means of rubbing together two pieces of dry wood; and the school boy burns his fellow's hand by a button which he has rubbed on the form on which they sit. In nature, the chafing together of two branches of a tree frequently sets fire to a forest. Count Rumford kept water boiling for hours together by the heat arising from friction. The lecturer saw an ingenious carpenter melt a small portion of glue by placing it in the hollow of a gouge and rubbing it a few times backwards and forwards. The same may be done with a piece of jelly in a a silver spoon. The fire from a flint and steel is a case of both friction and combustion; for the friction of the blow of the flint causes a piece of iron to fly off at such a heat that it burns in the air; and although the hand can bear it with impunity, it has heat enough to fire gunpowder, as is seen in the flint-lock of a gun. The miner, frequently surrounded by an atmosphere of gaseous gunpowder ready to blow him to pieces, cannot use a common flame; and before Davy's invention of the safety-lamp, a shower of sparks from a steel-mill, turned by a boy, was the only light by which he dare work. A dexterous smith avails himself of the heat of friction to light a match, for by a few blows of his hammer on a nail, turning it at the same time on the anvil, he will make the point of it red hot. This heat arises from the friction of the particles of iron against each other, and has nothing to do with any alteration of its capacity for heat. Lead becomes heated in the same manner.

From heat electricity can be obtained, and from electricity heat; and the heat from the latter source can be considered as heat from friction, for bodies evolve heat by the passage of electricity, just in proportion as they resist its progress, or are bad conductors. A powerful current of electricity from a galvanic battery may be made to develope great heat and light, by sending it through various substances. Between charcoal points they are most intense. Passed through wires the phenomena are different, according as they are good or bad conductors. In a chain, the links of which are alternately silver and platinum, the platinum becomes red hot, whilst the silver is not so; and here, as in other cases of friction, there is no consumption of any thing to produce this heat, neither the electricity is lost nor the platinum consumed.

Evolution of heat takes place in animals to a very great extent. They are always giving heat off to the air from their bodies, losing it by evaporation of moisture from their surface, and giving it off by their breath, and yet, in the most frigid climate, the same temperature is maintained in their bodies, which in most animals is far above that of the air. And what, it may be asked, is the source of this heat. The answer is, combustion; for the burning of charcoal in the animal frame is supposed to be continually going on, giving out, in this case also, as much heat, though diffused over a longer time, as when it is burning more rapidly in a grate. No less than eight ounces of carbon, taken into the system in the food, is supposed to be consumed daily by a man, for the purpose of maintaining a proper temperature in his body, by being brought into contact with the oxygen of the air he breathes. He ought, consequently, to produce carbonic acid largely in his system, and he does so, throwing it off by breathing.

The Professor then brought forward two pieces of apparatus, to compare the effect produced on the air by breathing with that produced by burning charcoal; by means of one of which he passed the air from his lungs through lime water, and by the other, the air which had passed over a piece of burning charcoal, in both cases the lime water was rendered turbid by a formation of carbonate of lime, proving in both a like formation of carbonic acid gas.

*(To be continued.)*

## THE INFLUENCE OF EMPLOYMENT ON HEALTH.

Dr. Guy lately read a paper before the Statistical Society, on the Influence of Employment upon Health.—By his communication it appears from the Reports of the Registrar-General that the deaths from pulmonary consumption in England and Wales may be estimated in round numbers at 36,000 annually, or rather less than 1-9th of the mortality from all causes, at all ages, though as much as 1 in less than 6 of all the deaths occurring in persons above 15 years of age, which may, for the most part, be taken as the earliest period of life at which consumption is liable to occur. To the published statements of the Registrar-General, Dr. Guy add his experience derived from attendance on the out-patients of King's College Hospital; and he classes the patients who are the victims of consumption under the three heads of gentry, tradespeople, and artizans. Results of Dr. Guy's researches are,—that taking the whole period of life, the deaths from consumption in this country are as 1 to 5, in the tradespeople as 1 to 2·6, and in the artizans as 1 to 2·3 nearly. The proportion of persons dying of consumption under the ages of 30 and 40 years is greater in the second named than in the other classes; but in other respects the mortality of the tradespeople entitles them to hold an intermediate place between the other two classes. Thus, while the proportion of deaths under 30 is among the gentry 9 per cent., and among the artizans 19·8 per cent., among the middle class it stands at 16 per cent.; deaths under 40,—gentry 20 per cent., tradespeople 32·5 per cent., artizans 37·5 per cent.; deaths *above* 80,—gentry 10 per cent., tradespeople 3·4 per cent., artizans 2·4 per cent. The proportional longevity of the upper classes is of course due, for the most part, to the various advantages they possess; and by the same rule the more rapid mortality of the poor from the physical discomforts by which they are surrounded, —as the narrow streets, confined and ill-ventilated houses and workshops, a paucity of water, little salutary exercise, a want of public baths, bad habits, and prolonged hours of labour. The good effect of pure air and exercise in prolonging life is rendered evident by the enormous preponderance of the deaths from consumption in persons employed in sedentary occupations. Thus, while the deaths among sedentary artizans under 30 years of age are as much as 44 per cent., among those employed in doors in occupations demanding great exertion is only 31½ per cent., and among those exercised out of doors less than 24·8 per cent.: of deaths under 40 years of age those among sedentary artizans amounted to 66·4 per cent., among those employed in doors, with great exertion, 54·8 per cent., and those occupied without doors 53·4 per cent.

## SUGGESTIONS ON THE CHEMICAL CHARACTERS OF CONTAGION.

BY MR. A BOOTH, PROFESSOR OF CHEMISTRY.

THAN drainage, sewerage, and ventilation, and the accumulated evils which arise from their neglect, there is no subject of greater importance in the whole range of *hygiene*. It is a matter of remark that in this country, and, in fact, many others, diseases have become greatly modified in their character; in many, from improved systems of diet, but in other instances, from more attention being paid to insure the purity of the atmosphere. The Pontine Marshes, near Rome, are allowed to remain untouched, productive of the most fatal malaria, and epidemical diseases of the most inveterate form, whilst in our own country, nearly every marsh has been drained, and ague is almost extinct. Sierra Leone owes its title of the Grave of Europeans to the marshy lands on which the luxurious vegetation of the tropical regions, with the numerous forms of animal life, putrefy and decay; and were we once to get rid of the cause, the effects would cease, and, in all probability, the country would be as healthy as our own. Chemical fumigating or disinfectant agents were tried, but without effect, to neutralize the poisonous miasms on the late lamentable Niger expedition, by the use of chlorine gas. Next in importance to drainage, come sewerage, to take off the decaying matters from our houses, and remove them from the spot where their decomposition would produce the most noxious results. Ventilation is of no less consequence in the removal of air already vitiated by respiration, or impregnated with the products of combustion, or the exhalations from decaying, decayed, or diseased bodies.

It is scarcely possible to say to what an extent a neglect of these important matters is the cause of disease in close and confined districts, where not a breeze of air comes in to disturb the still of the polluted atmosphere. The annals of medicine and the bills of mortality pourtray it too strongly to need any particular proofs; and when any old disease is revived, or new one introduced, it is sure to meet here with its first, and always its most numerous victims. Notwithstanding some of the remarkable and anomalous careers of the distribution of these diseases, and the peculiar range that they take, it is always certain that these suffer most from epidemics. Many courts, alleys, and narrow streets in the metropolis (and doubtless in other towns), are, it is well known, never free from typhus fever, and the squalid appearance of the wretched inhabitants shews the very unhealthy character of the localities. Here we still find no sewerage; drains and gutters running down the middle of the streets; accumulated heaps of filth, and puddles saturated with all manners of decaying garbage, from which emanate gaseous compounds of the most noxious and subtile forms. Thus the pure atmosphere inhaled by the country peasant, which gives him the bloom of health, becomes saturated with poisonous matters of the most noxious kinds; nor are the effects confined to the districts in which the poor generally reside; for the incipient seeds of disease and death, wafted by the winds to considerable distances, reach the abodes of the heedless rich, who, insensate to their wants and sufferings, reside in more airy abodes and better ventilated districts. And when we look at the abodes of the poor, how much is there not to excite our sympathy and demand our exertion? Their houses have bad ventilation—their narrow courts want drainage—they have not water sufficient scarcely for domestic use, and still less for purposes of cleanliness. When the gardener wants to bleach a plant, he secludes it from the light; and here, almost immured in darkness, a most baneful influence is exerted on their health. One solitary room, with no convenience, is the only place in which all their processes of cooking and domestic economy are performed;—it is at once their sleeping-room, their kitchen, their workshop, and their constant abode. They cannot ventilate the room by opening the window, fearful of the descending smuts from an adjoining chimney. The luxury of white-washing their walls, by which adherent matters and incipient disease might be destroyed, and their deficiency of the light of heaven in some measure compensated for in its reflection, is denied them. The keeping of pigs, donkeys, and domestic animals, adds but to the accumulated evils; and, apart from the moral associations engendered, what a fearful share have not the condition and abodes of the poor in the contamination of the atmosphere. and the consequent propagation of disease!

These observations may lead us more successfully to the consideration of miasms,—those unseen and subtile causes of disease, the existence of which we reason by analogy, and of which much has been said, although little is known. We know that decomposing animal and vegetable matters produce carburetted, sulphuretted, and phosphuretted hydrogen gases, with ammonia and its compounds;—we may collect and submit these gases to experimental observation, though it is probable that others still exist, although in a state too recondite for investigation by our present resources. The last few years have added to our list of gaseous products *cyanogen*, a compound of *nitrogen* and *carbon*, which is the basis of Prussic acid, the most suddenly fatal and destructive of all poisons, which gas is also highly poisonous even in a very dilute form. The effect of unseen exhalations, but of the existence of which we are assured by reference to other senses, is very different on the human constitution. Amongst these we recognize odours; which as every organic compound is defined in its nature and composition, we may also consider to be chemical compounds, guided by the same laws as characterize substances which we can see, feel, taste or handle. So convinced were the ancients of this, that they applied them as medicinal agents; and now some attribute to the odour of a cow-house, or the exhalation of newly-ploughed earth, a curative influence in consumptive cases. From inhaling the odour of beef the butcher's wife obtains her obesity; and that most disgusting of all trades, cat-gut manufacture, is amongst the most healthy of employments. So there are exhalations which have a noxtious effect, and which we equally assume to be chemical compounds, not only affecting the body itself by its immediate influence, but acting upon a large body of an impure atmosphere, which it either changes by virtue of a certain chemical action, or this merely acts as a diluent for the more extensive propagation and diffusion of the poison. The situations in our towns where *epidemics* and *contagious* diseases mostly prevail are notoriously those which are most filthy and dirty; and the individuals chiefly attacked, those who, being most careless in their habits, may be supposed to carry around them an atmosphere most easily susceptible of impregnation. This view of the constitution of miasms is supported by reference to those substances, or chemical re-agents, which have attained reputation as dis-infectants. Amongst these are chlorine and nitric acid, two most powerful chemical agents. Vinegar and camphor have long held repute as prophylactics; and, however ridiculous it may appear, we should not discard at once and without injury what has been the belief of ages, handed down to us probably as those were, the long experience of past times. Now vinegar is a powerful chemical solvent, and camphor assists in the solution of many substances which are with difficulty soluble. Charcoal in a minute state of division has a strong absorbing power for colouring matter and gaseous substances, so that if some be introduced into a jar of gas it will disappear. We have it in this minute state of division in the smoke of the burning brown paper, the popular purifier of the sick room. Heat is used in the fumigation of the clothes of persons infected with the plague, and if it destroys the *fomites*, it is by the separation of those elements which form the poisonous compound of contagion. If these substances are effectual, it is from their chemical action, and that energy can only be exerted upon chemical substances. The great improvements which have taken place in the public health have been chiefly owing to the means which have been adopted to preserve the atmosphere from contamination with these compounds of known and presumed existence. Three or four centuries back, houses were built in as close and narrow a space as possible, and land was economized as much as possible in their erection—no means were afforded for cleanliness or ventilation—drainage was not thought of, and hence the plague, sweating-sickness, and other fatal disorders and epidemics incidental to those periods were treated but as matters of course. Modern chemistry, however, teaches us the composition of air, and how to respect its purity; that pure air is essential to all the functions of life, and that whatever affects its purity must possess an injurious effect upon the constitution. We learn from it that stagnating ditches, stinking cess-pools, open drains and crowded bedrooms, cannot long remain without producing disease—that they elaborate noxious gases, the formation of which must be prevented before we can secure immunity to health. We find that houses cannot be near each other, nor rooms over-tenanted, without a palpably injurious effect—that mistakes still exist which require rectification; but we cannot hope to obtain a remedy until the public are become more alive to the evils from which they suffer. Committees of the House of Commons have unequivocally condemned "interment in towns," and the "nuisance from smoke in the chimneys of furnaces," and yet no legislative enactments have been directed to remedy or remove these noxious evils, prejudicial to a great extent in the local contamination of the atmosphere. Whilst on this subject, we may refer to the desirableness of promoting by every means the provision of pure air, particularly for the poorer classes, a subject recently taken up with effect in the promotion of public walks and parks. The squares and parks of London have been emphatically called its lungs, and in order that the overgrown metropolis may breathe more freely, it is necessary that the surface of these lungs should be increased to keep pace with its growing dimensions. By so doing, not only do we supply pure air to the inhabitants, but we invite their attention to exercise, to moral improvement, and to the bettering of their social condition.

The free currents of air which are necessarily in constant circulation from their proximity to the majestic Thames, and the storms which destroy the equilibrium of the atmosphere by putting in motion its elements, have been considered (and not improperly) as a great cause of the salubrity of the metropolis. Amongst other conservative agents in its purification, there is no doubt but that of watering the streets is one, from the quantities of water distributed throughout the atmosphere in its evaporation. This as it ascends will carry up with it into the atmosphere, and above the reach of mischief, the various decomposing and decomposed organic matters floating about, and which otherwise allowed to remain, would be productive of contagious miasms. We recognize the additional purity or freshness of the atmosphere by following a watering-cart as we do after a shower of rain, and the same effect is recognized in a newly-cleansed or scoured room. Here, independent of the influence of the brush in removing substances, the decomposition of which would fill the atmosphere with impurities, the evaporation of the water would produce the same effects in watering the streets, as in cleansing the air of the room. This shews the necessity of an adequate supply of water being provided for purposes of cleanliness, a deficiency too palpable in the crowded courts and habitations of the poorer classes. In watering the streets, we may observe the obnoxious practice which has been pursued in some districts in the use of the water accumulated in the sewers, which must be highly objectionable in the diffusion of noxious malaria.

The general use of wood paving may justify an inquiry into the circumstances as to how far its adoption may not be injurious to the public health. No doubt can be entertained of the prejudicial effects resulting from the accumulation of decayed and decaying organic matters in the streets, giving rise as they do to various gaseous and volatile compounds, and the removal of which is most desirable; nor of the injury to property, from the dust given off by the abrasure of granite or stones. When the blocks are taken up for repair, they will be seen to be impregnated for some inches below with black matters absorbed from the surface, consisting of decomposing organic matters. The wood is likewise susceptible of absorbing water, which it may retain in its pores, or in the interstices, and when dry weather supervenes, this will necessarily evaporate, carrying with it in solution into the atmosphere the volatile matters given off from these organic compounds. In this view I am supported by Dr. Copland, who, at a recent meeting of the Westminster Medical Society, gave it as his opinion that the general use of wood pavement would have a tendency to maintain and propagate that low form of typhoid fever which has recently been so prevalent in the metropolis, and almost defied the treatment of medical men.—*From the Builder*.

## ON THE STRUCTURE OF ROCKS.

PROFESSOR DAUBENY gave a lecture before the Royal Institution on the 31st of May, "On the Provisions for the Subsistence of Living Beings evinced in the Structure of the older Rocks, and in the phenomena which they exhibit."—He began by observing, that as the attention of philosophers was that evening directed to the moon by the eclipse, he, thought it might not be inappropriate to illustrate the line of his argument by reference to the supposed structure and condition of that satellite. Supposing then a human being to be transported to the surface of the moon, and to contemplate her in that condition in which astronomers represent her to us as existing—namely, as destitute both of seas and of an atmosphere, with vast cup-shaped mountains, the craters of volcanos, vomiting forth steam and smoke, and emitting volumes of noxious gases, would he not conceive the globe in question abandoned to those destructive agencies which he saw in such intense activity, rather than that it was in a state of preparation for the abode of beings constituted like himself? Yet what the moon now is, geology leads us to infer that the earth has formerly been; and from the phenomena now presented to us by it, we may infer a train of events to have occurred which, whilst they must have been at the time utterly destructive to all kinds of life, nevertheless prepared the earth for the reception of living beings, and rendered it a more agreeable abode to those which, like man, possessed a feeling of the sublime and beautiful. The Professor then proceeded to point out the provisions for the future existence of living beings which were made in those earlier stages of the history of our globe, when it appears to have been in a condition as chaotic as that of the moon at present. Those ingredients of the crust of the earth which seem designed more especially for the purposes of living beings may be distinguished into such as minister to some object of utility for man in particular, and such as are essential to animals and vegetables in general. The former class, being commonly more or less poisonous, occurs in veins for the most part existing in the older rocks, being stored, as it were, out of the way, before living beings were created. Such are copper, tin, lead, mercury, and other of the metals. The latter, on the contrary, are more generally diffused through the strata of the globe, although, for the most part, in comparatively minute proportions. Amongst the latter are the fixed alkalies, which are present in all felspathic and other rocks of igneous origin, from which they are slowly disengaged by the action of air and water, in proportion as they are required for the necessities of living beings; whereas if they had been present in a readily soluble form in the earth, they would have been washed into the sea before they could have been made available for such purposes. Another essential ingredient in the structure of animals is phosphoric acid, which appears peculiarly suited for entering into the organization of a living body, by the readiness with which it undergoes changes in its properties, by the character of its crystallization, and, (in the case of the bone-earth phosphate) by the associations of the *bibasic* with the *tribasic* salt, in equal proportions, which causes each to counteract the tendency to crystallize in the other, and thus renders it more capable of accommodating itself to the delicate texture of the animal fibre. The question then is, whence do animals and vegetables obtain this necessary ingredient? Professor Daubeny and others have detected minute proportions of it in many of the secondary rocks, but as these are derived from more ancient ones, it ought to be present likewise in them. Now we know at least of one instance in which this material occurs in considerable abundance in a rock which, so far as our observations at present extend, seems to have been formed antecedently to animal life. This is the slate rock of Estremadura, in Spain, where, near the village of Logrosan, it had been pointed out as existing many years ago. Exaggerated reports had, however, been spread as to its extent, for Professor Daubeny, in a visit he paid last year to the locality, found that it formed only one solitary vein, generally about ten feet wide, and extending along the surface for about two miles. It also contains a considerable per-centage of fluate of lime, and as this ingredient appears, from recent experiments of the author of this paper, to be present generally in bones both recent and fossil, it would seem that it was treasured up by nature as one of the requisite materials for the bony skeletons of animals. Provision seems to have been also made for supplying living beings with their volatilizable, as well as with their fixed ingredients. The attraction of all porous and pulverulent bodies for gases may explain the manner in which the latter are brought into contact with the secreting surfaces of plants: but it must be remembered, that of the four elements which together constitute these parts of a living body which are dissipated by heat, oxygen alone can be directly absorbed. Of the three remaining, hydrogen must be presented in the form of water, nitrogen in that of ammonia, and carbon in that of carbonic acid. Now volcanoes appear to have been the appointed means of providing both of the two latter in quantities sufficient for the food of living beings, for both ammonia and carbonic acid are evolved in immense quantities from all volcanos, as the Professor shewed by appealing to the case of Vesuvius and its neighbourhood, as well as to that of other volcanic vents. The production of ammonia in the interior of the earth might, he contended, be readily explained upon the principles of that theory of volcanos which he had for many years adopted, and which was founded on the great discovery of the metallic bases of the earths and alkalies, which we owe to the genius of Sir Humphrey Davy. Once admit that those substances which we see brought up to the surface, in the shape of lavas and of ejected masses, exist in the interior of the globe, wholly or partially, in an unoxidized condition, and that first sea-water, and afterwards atmospheric air, gradually find access to them through certain crevices; and all the phenomena of a volcanic eruption may be shewn to follow; namely, the intense heat, the escape of muriatic acid, the copious deposits of sulphur, the volumes of carbonic acid, and, lastly, the salts containing ammonia; for if nascent hydrogen, disengaged from water decomposed by meeting with the alkaline metals, were brought in contact with nitrogen under a high pressure, there is every reason to believe that ammonia would be the result. Thus, the very agents of destruction, which seem at first sight to be antagonist forces to every kind of creative energy, have been, in fact, the appointed means of supplying the materials out of which all organized beings are fashioned. But though the materials for our subsistence are thus provided, it does not follow that man is not to exert himself in order to obtain larger supplies than are naturally placed before him. On the contrary, his business is to husband his resources, and to apply them to the best account. Alluding to a late work of Professor Liebig's, he contended that this eminent chemist could not have meant to discourage the preservation of the volatile ingredients of our manure-heaps, whilst insisting on the paramount importance of supplying those which are fixed. It is true that nothing is lost, for the excrementitious matters which are washed into the sea increase the luxuriance of the marine vegetation, which affords food for a larger number of fishes, which again encourage a greater amount of sea-fowl, which finally deposit, what had been originally derived from the depths of the sea, on the islands of the Pacific, as guano. Thus England contrives, by means of her navies, to bring back from the opposite extremity of the globe, the very material which she originally wasted by the defective arrangements of her large towns. This, however, is a very circuitous mode of proceeding, and the true secret of all agricultural improvement is, to apply the means at our disposal, so as to produce a return for the toil expended in the shortest possible space of time.

## VARIETIES.

*The Telephone.*—Capt. Tayler recently exhibited at the Admiralty before the Lords Commissioners, a model of his new Telephone. The chief object of this powerful wind instrument is to convey signals during foggy weather, when no other means presents itself, by sounds produced by means of compressed air forced through trumpets, which can be heard at the distance of six miles. This important instrument will tend to prevent collision at sea and on railways, and will lessen the horrors of shipwreck and capture, and give notice of fire. Vessels in the offing will be by it directed into harbour, and the time to enter tide-harbours made known from the pier-head. The four notes are played by opening the valve of the recipient, and the intensity of sound is proportioned to the compression of the internal air. The small-sized telephone instrument which is portable, was tried on the river, and the signal notes were distinctly heard four miles off.

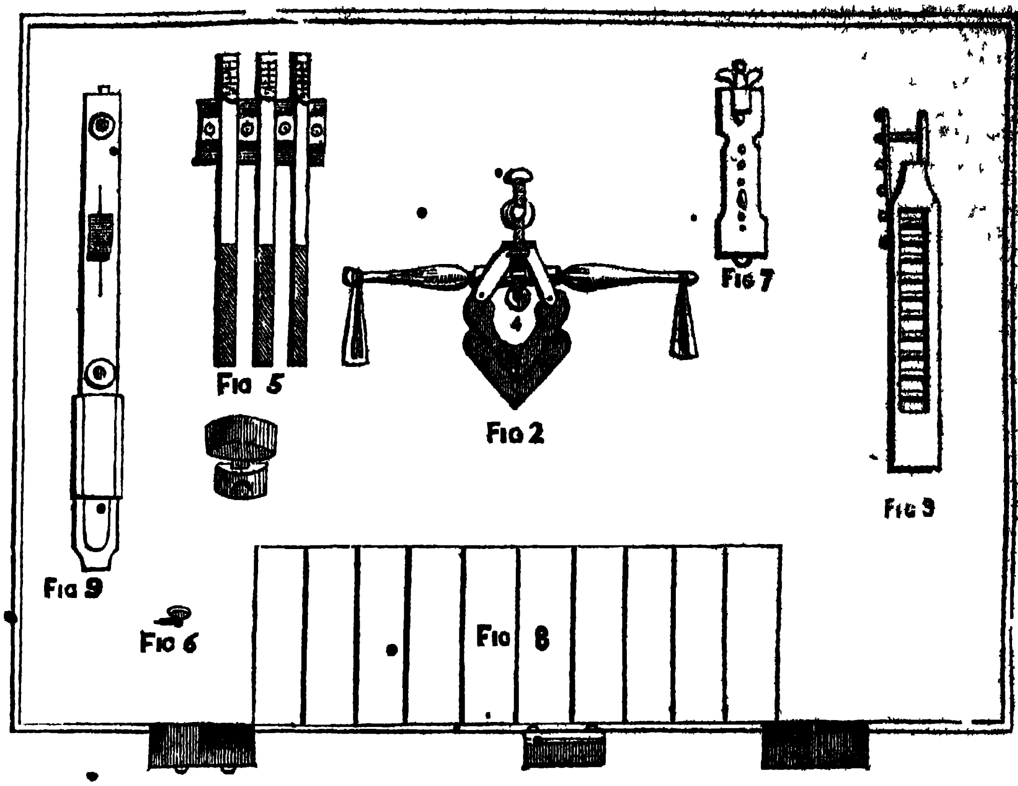
*To preserve Animal Food without Salting.*—The meat should be cut into slices of from four to eight ounces each, then immerse them for five minutes in a vessel of boiling water, and dry them on network, at a regular temperature of from 120° to 125° Fahr. Next, evaporate the soup formed by washing the meat, to the consistence of a thick varnish, adding a little spice to flavour it; into this fluid immerse the perfectly dry pieces of flesh, and again expose them to the proper drying temperature. Repeat the operation of dipping and drying a second, and even a third time. For use, the meat must be cooked in the usual way for boiling, &c. In this manner, meat may be preserved without salt, for from fifteen to twenty months.

*Good Bread.*—Flour, 1 sack.
Salt, 4 pounds,
Water, sufficient quantity,
Yeast, 4 pints;

Dissolve the salt in three gallons of the water (warm); then add a little of the flour and the whole of the yeast: keep it in a warm place until it rises, then add more flour and warm water, and after three or four hours the remainder of the flour and sufficient water to bring the dough to a proper consistence. When the whole mass of dough is in a proper state, it is to be cut into loaves and baked. The bakers employ alum in making their bread, as it not only makes the dough more retentive of moisture, but improves the colour of the bread. The proportion is usually eight to fourteen ounces of alum per sack, or even more. By this process a sack of flour will produce from 345 to 350 pounds of *well*-baked bread, or if less baked, from 370 to 385 pounds.

*Brazil Wood Lake.*—A beautiful lake may be prepared from Brazil wood, by boiling three pounds of it for an hour in a solution of three pounds of common salt in three gallons of water, and filtering the hot fluid through paper; add to this a solution of five pounds of alum in three gallons of water. Dissolve three pounds of the best pearlashes in a gallon and a half of water, and purify it by filtering; put this gradually to the other, till the whole of the colour appears to be precipitated, and the fluid be left clear and colourless. But if any appearance of purple be seen, add a fresh quantity of the solution of alum by degrees, till a scarlet hue be produced. Then boil again, strain, and add a solution of pearlash (strained) as long as it occasions a precipitate. If half a pound of seedlac be added to the solution of pearlashes, and dissolved in it before its purification by the filter, and two pounds of the wood and a proportional quantity of common salt and water be used in the coloured solution, a lake will be produced that will stand well in oil or water, but it is not so transparent in oil as without the seed lac. The lake with Brazil wood may be also made by adding half an ounce of annatto to each pound of the wood; but the annatto must be dissolved in the solution of pearlashes. After the operation, the dryers of plaster, or the bricks, which have extracted the moisture from the precipitate, are exposed to the sun, that they may be fitted for another operation.

*Poisoning by Lead.*—MM. Flauden and Danger, in a Memoir read before the Academy of Sciences, state that although there exists no lead in a normal state in the human body, yet from poisoning it is formed as surely as arsenic, antimony, and copper. It should be particularly sought for in the digestive canal, liver, spleen, renal apparatus, and the lungs, but cannot be detected in the blood, the heart, the brain, the muscles, nor the bones, but contrary to copper it is eliminated by the renal secretion. In cases of medico-legal investigations, certain organs must exclusively be operated on, and the liver should be selected in preference. In ordinary cases the tenth part of this organ (about 500 grammes) is sufficient.




THE CHIROGYMNAST, OR FINGER EXERCISE.

## THE CHIROGYMNAST, OR FINGER EXERCISE.

For several years past, Gymnastic Exercises, of every sort, have been acquiring and increasing in celebrity. Experience has fully confirmed their utility in every department, notwithstanding which, the analytical improvement of the hand, that member so useful, is left unattended to. No essay, either serious, logical, or scientific, has been attempted to triumph over the obstacles with which nature has confined its actions, obstacles which many have, nevertheless, often lamented.

The object of this invention is to facilitate the action of the fingers, to give them more independence and equality, and to obtain, at the same time, by the use of gradual exercises, distinct individuality (if we may be allowed the expression) for each finger, with more *agility*, *extension*, and *force*.

The only thing in use, up to the present time, to subdue the physical resistance resulting from the formation of the hand, has been musical compositions, called studies, no doubt excellent in their way, but requiring a very determined mind, seldom found in pupils, and exacting, above all, a great deal of time. To replace these two conditions, time and will, or at least, to render the difficulty of overcoming them less painful, the use of gymnastic exercises has appeared useful to us. It is well understood, that it does not exclude the piano-*forte* studies, written by our celebrated composers: it is only meant to facilitate and accelerate the execution of them.

The instrument which has been invented for this purpose, and which is called the *Chirogymnast*, or Finger Exercises, ought incontestably to cause the different parts of the hand to acquire a dexterity, the happy influence of which will be felt in all exercises which it is called upon to perform.

The *Chirogymnast* is so made, as to be adaptable to any sized hand.

Another advantage is, that the *Chirogymnast* does not fatigue the ear by any sound, as the piano does, upon which the reiterated repetition of the same exercise, which is mostly performed on five notes, causes melodious and harmonious combinations, very unpleasingly monotonous to the pupil and his hearers.

The constant repetition of the same exercises, has moreover the double disadvantage of unequally wearing out the piano and of destroying, by this means, the equality of sound; whilst one of the evident advantages of this absence of sound is, that the *Chiro-gymnast* can be practised upon, without causing any interruption, even in the midst of an assembly. It may not be unneccessary to add, that this instrument is elegant, light, and portable, and can be placed on a cheffoniere or table.

We shall in a future number revert to the several parts shown in the engraving, referring our readers to the exercises adapted to each particular finger.

## OF COMMON SALT, AND THE MANUFACTURE OF SODA FROM IT.

*(Continued from Page 131.)*

Formerly, the decomposition of the common salt was carried on for the sake of the muriatic acid, and the residual sulphate of soda counted for little, or, at best, being dissolved in warm water, and crystallized, by cooling the solution, it was obtained in the usual form of Glauber's salt, and employed in medicine. Its history, in this point of view, is indeed so remarkable, as to deserve notice. The older chemists, or rather alchemists, had an idea that in man way typified the constitution of all mundane things, and that hence every substance contained a kind of spirit or soul, on which its active properties depended, united to an inert earthly matter, which being as the dead body after the departure of the living soul, they termed the caput mortuum. In fact, by distillation, with or without various additions, they obtained from most subtances volatile and active bodies—thus from wine, spirit of wine; from saltpetre, spirit of nitre (nitric acid); and from salt, spirit of salt; from the bones or hornes of deer, spirit of hartshorn (carbonate of ammonia in solution). The residue was thrown away as dead and useless, until Glauber conceived, for the first time, the idea to try whether anything could be got out of a caput mortuum. He dissolved, in boiling water, the residue from making spirit of salt; on cooling, it shot out in beautifully transparent and large prisms, endowed with a cooling, not very disagreeable saline taste, and possessed of a medicinal activity, calculated to render it highly useful. It was a perfect resurrection, he termed it sal mirabile (wonderful salt). It became the fashionable medicine, and the catalogue of evils which it was reported by the best physicians of the day to be competent to remove, might challenge comparison with the catalogues of modern charlatanerie. Popular favour has, however, recently departed from this salt, and its use is now almost totally restricted to veterinary medicine.

When the object of the manufacturer is to prepare the muriatic acid the process is carried on in iron cylinders, which are set in brick work horizontally; the ends being exposed, are closed by iron disks, which are kept applied by means of a screw, or wedge. The salt is placed inside; and through a small aperture in the front plate the necessary quantity of oil of vitriol is introduced by means of a bent funnel of lead. To an aperture in the plate closing the back of the cylinder is attached an earthenware pipe, which conducts the muriatic gas to the first of a series of stoneware bottles, about half full of water. The water absorbs the gas, and as each bottle is provided with two necks, the gas which escapes the action of the water in the first, passes into the second, and so on until it is completely issolved. When the water has dissolved its full proportion of gas, which is nearly 500 times its volume, it has a specific gravity of 1,200, water being 1,000, and possesses all the properties of a strong acid. To finish the decomposition the cylinders require to be heated to dull redness, and as soon as all gas has been expelled, the fire is withdrawn, and the ends of the cylinders being taken off, the dry sulphate of soda is taken out of the cylinders in large lumps, in which form it bears the name of salt cake.

When, however, the formation of sulphate of soda became a part of the alkali process, the quantity of muriatic gas produced was so great that no employment could be found for it, and the decomposition of the salt in iron cylinders was far too expensive. The salt cake furnace of the soda works is a common reverberatory furnace, such as is used for roasting metallic ores. It has a floor about ten feet long, by four or five wide, formed of such bricks as best resist the action of acids. At one end is a large fireplace, the flame from which may sweep over the entire floor, and at the other the current of hot air and vapour is carried off to a lofty chimney. The roof is formed by a very flat arch, by which the heat and flame from the fire being reflected down on the materials spread on the floor, gives it its peculiar character of a reverberatory furnace. The quantity of salt proper for a charge of such a furnace being spread upon the floor, the sulphuric acid, which, for economy, is in this case generally used at a specific gravity of 1,600, is poured in through a small aperture which is preserved in the vaulted roof, and may be covered by a flag. Decomposition occurs, and the muriatic acid gas evolved is carried off into the chimney, and thrown out into the atmosphere at its summit. The vast quantities of acid gas thus emitted from extensive works has occasionally done much injury to the neighbourhood, and caused the erection of those gigantic chimneys which, in the case of those recently erected by Mr. Muspratt near Liverpool, and Mr. Tennant at Glasgow, are amongst the highest edifices in the world. That this great height is really necessary is easily seen when it is considered not unusual to decompose twenty tons of salt in a day. To throw into the atmosphere, consequently, twelve tons of muriatic acid gas, occupying a space of 9,000 cubic yards, and that an atmosphere containing one part in 2,000 of this gas, is very markedly injurious both to vegetable and animal life. In smaller works various plans of condensation of the gas are employed, and even on the great scale, condensations by streams or jets of water is now so far brought into play with success, as to render the quantity of gas that actually escapes from the chimney so small as to be quite innoxious.

The sulphate of soda (or salt cake) having been obtained by any of the plans just described, the next step is to convert it into carbonate of soda. This is accomplished by roasting in a reverberatory furnace, at a very high temperature, a mixture of salt cake, limestone, and small coal. The proportions found most perfect are two parts of salt cake, two of limestone, and and one of small coal (slack). The decomposition which occurs is very remarkable, and the explanation of it may be rendered more intelligible by giving the equivalent numbers of the respective ingredients as employed with their composition.

There are taken 144 parts or two equivalents of sulphate of soda, consisting of

| | |
|---|---|
| 2 equivalents of sulphuric acid . . | 80 |
| 2 equivalents of soda . . . . . | 64 |

Also, three equivalents of limestone, consisting of

3 equivalents of lime . . . . . 84
3 equivalents of carbonic acid . . . 66

and 8 equivalents of carbon (coal) 48.

Now when these materials are fluxed together, the sulphate of soda is first of all decomposed by the carbon of the coal. The oxygen of the sulphuric acid, and, and also of the soda, combines with the carbon and passes off as carbonic oxide gas, and sulphuret of sodium remains.

The 80 parts of sulphuric acid contain 32 parts of sulphur, and 48 parts of oxygen. The 64 parts of soda contain 48 parts of sodium, and 16 parts of oxygen. Now the 32 sulphur (2 equivalents) unite with the 48 of sodium (2 equivalents) to form 80 parts of sulphuret of sodium, whilst the 64 parts (8 equivalents) of oxygen unite with 48 parts (8 equivalents) of carbon to form carbonic oxide.

When this has occurred the limestone begins to dissolve in the melted mass, and the sulphuret of sodium is decomposed by the carbonate of lime. To see how this occurs, let us consider for the moment but two equivalents of limestone out of the three that are used. The lime consists of the metal calcium, combined with oxygen When melted with the sulphuret of sodium, the oxygen unites with the soda, whilst the calcium unites with the sulphur, and there is

From 100 carbonate of lime, consisting of

40 calcium,
16 oxygen,
44 carbonic acid,

acting on 80 sulpheret of sodium consisting of

32 sulphur,
48 sodium,

there are produced

72 sulphuret of calcium

and 64 of soda (oxide of sodium), with which the 44 of carbonic acid unites to form 108 parts of carbonate of soda.

Now the carbonate of soda is formed; but the most remarkable peculiarity of the process is this, that although the change just described occurs in the furnace, the elements would all go back to their original state, when dissolved. if only the two equivalents of lime had been used. For the sulphuret of calcium being soluble, would be instantly decomposed by the carbonate of soda, and sulphuret of sodium and carbonate of lime regenerated. This is prevented by the third equivalent of lime, which the practical proportions include. Of this the carbonic acid is expelled by the heat; and the lime unites to the sulphuret of calcium, forming an oxy-sulphuret, which is not acted on by cold water. But hot water dare not be used in treating the mass, for then the third equivalent of lime would separate, and all would be destroyed again.

The party man, as drawn from the furnace and cooled in iron boxes, is greyish-yellow, or often black from an excess of coal, whence its common name of black ash. A great deal of the soda it contains is caustic, the carbonic acid having been burned out of the lime before the decomposition became complete. It is finely powdered, and placed in a series of tanks, arranged in tiers, so that fresh water being delivered in a small but constant stream to the highest range, it percolates from one to the other, until it issues from the lowest nearly saturated. This liquor is then boiled down nearly to dryness, in iron pans, and finished in reverberatory furnaces. The final product thus obtained is a white powder, known as white ash, or soda ash. It contains generally about 45 or 50 parts of pure alkali in the 100, and of this about one-third is caustic, and two-thirds carbonated. The insoluble residue is known as soda waste; it is the oxy-sulphuret of calcium. In theory its composition should be expressed by the formula 2. Ca S + Ca O, but in practice it is generally Ca S + Ca O, about a fourth of the sulphur having been roasted off in the process.

This white ash being dissolved in boiling water, and the deficiencies in the carbonic acid being supplied, usually by the addition of some bicarbonate of soda, the liquor, on cooling, deposits crystals of carbonate of soda, which in this somewhat impure form constitutes the common washing soda, or soda crystals of commerce. By a second crystallization they are obtained almost absolutely pure, in flat oblique rhomboids, many inches across.

The rapid extension of this manufacture since its introduction from France, and the consequent remarkable fall in the price of its products, and of the various substances in forming which they are employed, constitute one of the most interesting practical results of modern chemistry.

## PROFESSOR FARADAY ON HEAT.

*A course of four Lectures delivered at the Royal Institute.*

### Lecture II.

*(Continued from page 132.)*

The power of heat to expand bodies, to make them occupy a larger space than they did when cold, is most enormous, in solids, indeed, is almost irresistible. But it varies in degrees according to the substance. If two pieces of different metals be soldered together and heated, they will curve into a bow, that metal which expands the most, forming the outer or convex side. Bad conducting substances act in a similar manner, and are frequently broken by heat. A thick piece of glass, as the bottom of a test glass, if heated suddenly, is broken, owing to unequal expansion in its various parts, as occurs, also, when boiling water is poured into a tumbler, especially in cold weather. Hence great care is requisite in the laboratory when applying heat to glass vessels. Owing to this it is that a thick glass rod which will bear hundreds of pounds weight of even pressure, is easily broken by heat. A piece of sulphur which is strong enough to bear a great deal of even pressure, flies asunder by the heat of the hand. By alternate expansions and contractions rocks are broken up, so as to form the soil for the plant to grow in. Solid metal inserted into pillars, frequently becomes the means of weakening instead of strengthening buildings, as may be seen at the Bank, Somerset House, the Custom House, and other public buildings. The linear expansion of some of the metals from the freezing to the boiling point of water, is given in the following table:—

Linear expansion of metals from 32° to 212°.

| | | | | |
|---|---|---|---|---|
| Zinc 1 part in | . 322 | Gold 1 part in | | . 682 |
| Platinum | . 351 | Bismuth | ,, | . 719 |
| Tin, pure | . 403 | Iron | ,, | . 812 |
| Tin, impure | . 500 | Antimony | ,, | . 923 |
| Silver | . 524 | Palladium | ,, | . 1000 |
| Copper | . 581 | Platinum | ,, | . 1100 |
| Brass ,, | . 584 | Flint glass | ,, | . 1248 |

In fluid bodies the expansion is greater than in solid, as may be seen by heating water in a tube having a piston touching its surface. The rise of the piston shows the difference between the expansion of the glass and the water. When a solid is heated irregularly, it breaks, but not so with a liquid, because its particles are free to move. But other effects take place, such as the formation of a series of beautiful currents circulating through the mass of the fluid. These currents can be easily traced by placing at the bottom of the water some light particles of a coloured substance, which on the application of the heat from a lamp under the flask, are instantly set in motion, rising in the hottet part and descending in coolest. The particles, becoming hot, increase in the size; because they are large they are light, and because they are light they rise to the top, till becoming cool again, they fall to the bottom, If hot water be carefully poured on to the top of a similar arrangement, so that the two liquids do not mix, it forms a strata into which the heated particles cannot rise until they have received the same temperature, and the lamp may be kept underneath for a considerable time, the two fluids remaining quite separate, the hotter colourless liquid floating on the top of the colder blue liquid. This shows the reason why it is not proper to heat liquids at the top. An arrangement such as the following shows the current in a very striking manner. Place a glass vessel full of water up high, and into the top and bottom of it fasten the ends of a long metallic pipe, in the upper part of which is a small chamber filled with a coloured fluid; heat the lower part of that side of the pipe where the small chamber is, and as soon as the water becomes a little warm, a current is established, which passing through the coloured fluid carries it with it, and pours into the water of the glass vessel a beautiful stream of coloured water. This arrangement will serve to illustrate one of the latest methods of warming buildings, by means of one long length of iron pipe filled with water carried through the various rooms of a building, the bottom part of the pipe being made to lie in a coil in a furnace. Thermometers, also, owe their utility to this property of expansion, the heat they indicate being calculated by the height to which the fluid in the tube has risen. All liquids expand by heat and contract on its withdrawal; but for a wise purpose water has been made to depart, in one portion of its course, from this general rule. When water cools down it contracts until it has arrived at a temperature of 40°, but on continuing to cool, it begins to expand till it arrives at a temperature of 32°, when it is solidified or freezes. Beginning at the temperature of 40°, therefore, water is expanded by either heat or cold. This is the case with no other known body, and the reason of it is obvious. If water, when near its freezing point, continued to contract and become heavier, as other liquids do, the colder parts, sinking through the warmer, would soon reduce the whole mass into a solid block of ice, which all the following summer's heat would not be sufficient to melt; the world would become ice-bound, and its inhabitants would perish; but owing to this benevolent exception to the general rule, when it has arrived at a temperature below 40°, it becomes lighter owing to the expansion which then begins, and the surface alone becomes frozen, protecting the water below from further effects of cold.

With gases and vapours, expansion takes place to much greater extent than with fluids. Immerse the beak of a retort in water, and apply heat; air will be expelled in large bubbles, which may be collected, and will serve as a measure of the expansion that has taken place, which is also shown by the quantity of water which flows in when all is cool again. The glass of the retort does not expand so much as the air within does, their comparative expansion being seen by reference to the following table, where is shown the increase of volume of solid, liquid, and gaseous bodies, from 32° to 212°.

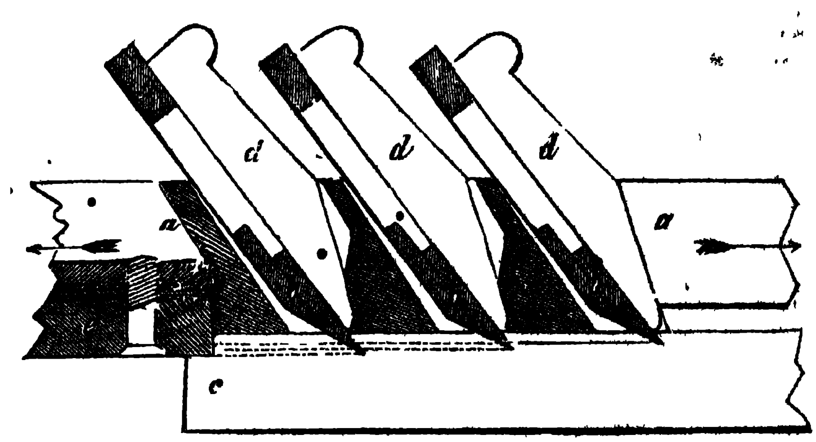
| At 32° | | | At 212° |
|---|---|---|---|
| 1000 volumes of | Air | become | 1375 volumes. |
| ,, | Alcohol | ,, | 1110 |
| ,, | Ether | ,, | 1070 |
| ,, | Water | ,, | 1044 |
| ,, | Mercury | ,, | 1020 |
| ,, | Glass | ,, | 1002 |

The expansion of gases, though small in force, is great in bulk; but that it has force may be proved by heating a small portion of air contained in a bladder, when it will acquire power enough to burst the membrane with a considerable report. There are a great many airs and vapours, all differing from each other in their properties, but it has been found that the rate of expansion is the same with them all. A volume of hydrogen gas which weighs one ounce, the same volume of air which weighs 14 ounces, or of the vapour of iodine which weighs 125 ounces, all expand to the same extent by the same quantity of heat; they are all expanded about $\frac{1}{8}$ of their bulk, by an increase of heat from 32° to 212°. Water, when converted into steam loses the law of expansion of liquids, and acquires that of gases. When air is expanded by heat, it of course becomes lighter, and rises through the atmosphere, in a similar manner to water, though much more rapidly. Air enclosed in a light body and heated, would consequently carry it up with it, and hence the principle of the Montgolfier or fire balloon. In a crowded assembly, the air becoming heated by gas and otherwise, is continually becoming lighter, and exerting a pressure against the roof of the building. If from any cause it were suddenly heated from 32° to 212°, every 1000lb weight of air would exert a force of 380° trying to lift off the roof; and there are some cases known where, from sudden changes of temperature, it is doubtful whether roofs have not yielded to this pressure. It is this expansion, this rising through the air of the heated particles, which causes bad air to be disseminated and carried to those places where it will be purified, thus preventing the accumulation of tainted air; by this means the air which we respire, and which our systems have just deprived of its oxygen, rises through the atmosphere and becomes dispersed. That the breath when expelled from the mouth rises in the air may be shown by suspending a bell glass filled with muriatic acid vapours over the head, placing a small vessel with the ammonia in it in the mouth, and breathing under the jar; the breath carries with it the vapours of ammonia, which, rising into the glass vessel, combines with the acid, and a white cloud of sal-ammoniac is the result. Without this provision vitiated air would be breathed over and over again, and suffocation would frequently be the result.

## SCALEBOARD.

A PATENT for a new Machine has lately been obtained by Messrs. Parson and Esdaile, for cutting leaves of Wood, commonly called Scaleboards.

The improvement consists in the multiplication of the knife or cutter of the machine, and also in supplying the place of the additional quantity of wood




removed from the block by the application of an adjusting bar. The machine for cutting scale boards or leaves of wood consists of a frame supporting a horizontal table, which is caused by certain mechanical arrangements to move backward and forward from one end of the frame to the other; to this frame is attached a cutter, which at every stroke of the machine, removes or cuts from a block of wood supported above the table, a scale board or leaf of wood. The improvement is an application of two or more cutters, which may be so regulated as to cut any thickness of scale board, and also in the application of an adjusting or support bar, which may be understood by referring to the annexed drawing, where *a*, *a*, shows a portion of the table or bed plate, which is caused by certain mechanical arrangements to move backwards and forwards in the direction indicated by the arrows; *b*. *b*, *b*, are three knives or cutters, which may be set at any height from the bed plate, depending upon the thickness of boards to be cut from the block of wood; *c*, *c*, that is to say, the first knife if required may be set at $\frac{1}{16}$ of an inch, above the table, the second $\frac{2}{16}$, and the third $\frac{3}{16}$ of an inch, the knives being secured at their ends by means of wedges *d*, *d*, *d*; *e* shows a portion of an adjusting bar which can be raised or lowered by means of adjusting screws according to the thickness of scale board intended to be cut. There are three of these bars extending in a direction of the length of the table, the object of which is to support the end of the block of wood as the wood is removed therefrom, and also to prevent the other end of the block from rising up.

The patentee claims the multiplication of knives or cutters, and application of an adjusting or support bar or bars as described.

## SUB-MARINE FOUNDATIONS FOR BREAKWATERS, LIGHTHOUSES, BATTERIES, &c.

A PRIVATE lecture on this subject was delivered on Saturday in the theatre of the Polytechnic Institution, by Dr. Ryan of that establishment. This gentleman conducted several experiments illustrative of the method intended to be pursued, and which were accompanied by a success that might indicate the efficiency of the apparatus on a larger scale, acting under similar conditions. The leading character of Dr. Pott's invention consists in atmospheric pressure being allowed to exert itself upon a surface, under which a partial vacuum is being created. He proposes to accomplish this by making his piles hollow, and, in some cases, covering them at the top with an air-tight cap. The pile, whether of iron or wood, is in this state placed upon the soil in the direction in which it is to be driven. A reservoir is placed at low water-mark, and communicates, by means of a large hose or metallic pipe, with the head of the pile about to be driven. This reservoir is in communication with apparatus for the exhaustion of air, consisting either of air-pumps or steam condensers. Water is supplied to the soil immediately under the pile by the same engine. The effect produced by this contrivance is to keep the subsoil in a state of agitation and hold it mechanically suspended. When the air in the pile becomes a little rarefied by the action of the exhausting machine this mixture will rise, and ultimately pass through the pile-head into the receiver. This vessel being filled, a cock or valve at the bottom is turned, and its contents are discharged, the operation may be resumed any number of times, by alternately closing the valve, pumping the soil into the receiver and discharging it. The soil thus pumped up does not come from the outside of the pile. When any portion of it is raised, atmospheric pressure and the weight of the pile, act instantaneously with joint forces, thus shutting out the adjacent soil by the sinking of the pile. All that comes up is brought from below the interior of the pile, which will therefore continue to descend till lateral pressure overcomes that of the atmosphere, added to the effect of gravitation. In some soils the inventor, when sinking a large pile, does not use the cap, but sends down a man with a flexible tube in connexion with the exhauster. This tube being directed to various parts of the base of the pile, its foundation is undermined by the removal of the soil, and the pile will sink till it be necessary to resort to more extensive exhaustion. In all these cases the estimate of the weight which the piles could sustain is afforded by the known pressure of the atmosphere. This is fifteen pounds on a square inch, at an average height of the barometer, but it will be considerably diminished from the imperfect rarefaction capable of being attained by even good machinery. It may be said that 1,000 lbs. will be about the extent of atmospheric pressure thus brought into play, and it is true in the case of ordinarily-sized piles. With this force, however, small as it is, the effect would be produced—for the principal resistance is removed by the pumping out of the sand. Dr. Potts applies these means to the sinking of caissons, for the purpose of constructing an isolated rock, on which a lighthouse might be built. The caisson is made of the proper size, and the annulus, or hollow ring, divided into several compartments, or air-chambers. It may then be floated to its place, and sunk by the admission of water into its chambers. The means we have described may then be employed till an enormous pressure would be requisite to sink it further. Piles, &c., having been sunk by these means to their proper depth an actual rocky structure is to be formed about them, by the application of cements described in the patent. These were not minutely entered into by Dr. Ryan for want of time, but Roman cement, and Medway mud burnt up with lime, are of the number. The bottoms of the piles are inclined, and the horizontal reaction thus obtained forces them more closely together. The experiments were performed upon sand and Thames ballast, to which water had been added. In these the apparatus pumped up the soil with great force, and the piles sunk with tolerable swiftness and regularity. Where a great and sudden force is required a large air chamber can be exhausted, and produces an instantaneous effect where communication is made with the pile. We cannot say how far the process would succeed in argillaceous and chalky strata, but the ingenious patentee of these contrivances has not, doubtless, left these cases unprovided for. There are a few properties of sand well worthy the attentive consideration of those who are engaged in these pursuits. A grain of sand will not roll off a smooth surface, till the surface be inclined to the horizon in an angle of between 30 and 40 degrees. This angle is the inclination of the slant side of the cone, into which sand forms itself when shot upon any surface. On this principle depends the hour-glass, the sand in which runs out as quickly at the last moment as it did at the first, for as it is arranged in similar cones which cover one another as they rise, the reaction of the sides sustain the weight of the particles, acting in the slant direction we have described. This can be beautifully shown by loosely placing a piece of paper at the lower end of a glass tube. Sand being poured in at the top, the paper, though not fixed, will sustain any height of it. Large blocks of stone are raised in quarries by inserting a piece of wood into a hollow of the stone, and filling it round with sand. When the lifting force acts, the peculiar action of the sand jams the wood, and the stone is raised. Other instances of this oblique force are seen in sawdust and congealing water. We have alluded to them to shew that they are capable of adding to the stability of these kinds of foundations. Dr. Potts turned his attention to this process from careful inspection of the coral structures of the zoophytic insects. They consist of vertical tubes braced together by horizontal bands, and the idea was thus supplied to him. The nautilus pompilius suggested the plan of sinking the caisson, by the manner in which it can sink or swim at pleasure, in common with most kinds of fishes. He has been examined by a specially appointed commission of Harbours of Refuge between the Thames and Portsmouth. These gentlemen, and many others of high scientific acquirements, have approved the

## ART AND SCIENCE,

BY JOHN BRYNE, PROFESSOR OF MATHEMATICS

Art and science are, indeed, words of familiar use and great significance, yet their difference is but little understood. In the present age, notwithstanding its improvements in knowledge, exists the popular prejudice of terming almost every thing a science. It is true, if we consult our best dictionaries for an explanation, we find nothing but an abstract definition, in which one obscure notion is substituted for another, that rather casts obscurity than light on the subject. I have therefore attempted to draw a more visible parallel between art and science. To *science* belong such things as men may discover by the use of sense and reasoning, such as the laws of nature, the affections of bodies, the rules and criterions of right and wrong, truth and error, the properties of lines and numbers, &c. To *art*, on the other hand, belong such things as mere reason would not have attained, things which lie out of the direct path of deduction, and which require a peculiar cast, or turn of mind, to see or arrive at. Or a *science* is a series of deductions or conclusions which every person endued with sound faculties may, with a proper degree of attention, see and draw; and a formed science is no more than a system of such conclusions, relating to some one subject, orderly and carefully laid down in words, comprehending the doctrine, reason, and theory of the thing, without any immediate application thereof to the offices of life. Thus, natural philosophy, ethics, logic, pure mathematics, statics, &c., are sciences. An *art* is not founded on self-evident principles or demonstrations, but is a system or collection of rules, precepts inventions or experiments, which being duly observed, make the things a man undertakes succeed, and render them advantageous and agreeable. Thus, grammar, painting, poetry, sculpture, music anatomy, dancing &c., are arts. The difference between the two may be illustrated by that between wit and humour: the former is a general faculty of exciting agreeable and suprising pictures in the imagination, and the latter a particular one: the former is pure and absolute in its kind, the latter tinged with something foreign and complexional. In this sense an art and a science only seem to differ as less and more pure; and my parallel becomes more like that species of mathematical lines, which continue to draw nearer and nearer to each other, *ad infinitum*, yet never meet. But a *science* is a system of deductions, made by reason alone, undertermined by any thing foreign or extrinsic to itself. An *art*, on the contrary, requires a number of data and postulata to be furnished from without; and never goes any length, without, at every turn, needing new ones. Nevertheless, an art appears to be a portion of science or general knowledge; considered, not in itself, as a science, but with relation to its circumstances or appendages. In a science, the mind looks directly backwards and forwards to the premises and conclusions: in an art we look laterally to the concomitant circumstances. A science, in fact, is to an art, what a stream running in a direct channel, without regard to any thing but its own progress, is to the same stream turned out of its proper course, and disposed into cascades, jets, cisterns, ponds, &c., in which case the progress of the stream is not considered in regard to itself, but only as it concerns the works, every one of which modifies the course of the stream and leads it out of its way. It is easy to trace the course of the former from its rise to its issue, as it flows consequently; but a man, ever so well acquainted with this, will not be able to discover that of the latter, as it depends on the genius, humour, and caprice of the engineer who laid the design.

The arts which relate to the sight and hearing, Bacon observes, "are reputed liberal beyond those which regard the other senses, which are chiefly employed in matters of luxury." The mechanical arts are generally practised by means of a machine, and require more the assistance of the hand and body than the mind. However, there is no truth more undeniable than this, that if a man were not really and truly a free agent, there would be no such thing as an art, at least in the sense here understood: but art would only be a name given to that system or series of effects to which man is made by nature, and in her hands, subservient; and might, with equal reason, be attributed to such effects as any other natural production is subservient to. But we must not forget those enigmatical theories, visionary speculations, and chimerical inventions, which are never matured into either an art or a science; their novelties often please, but with novelty they pass away, and new ones succeed, "like leaves of trees," though not by a similar order of nature, but because things that become useless soon become contemptible.

Among the *scientific* vagaries of the present time, we have phrenology, phrenomagnetism, mesmerism, clairvoyance, the homœopathic system, and some others. to say the least of them, they are more adapted to catch and entangle the mind, than to instruct and inform the understanding; and, perhaps, without saying the most of them, the words formerly applied to *alchymy* would define any one of them. "It is an art without sense, the beginning of which is deceit, its middle labour, and its end beggary." But when error has obtained the mastery of our minds, during our tender age, we are seldom at pains to shake off its yoke, but rather strive to subject ourselves more to it.

Again, when we hear of a young person knowing a great many sciences and and arts, we suspect him of understanding them very imperfectly, or of knowing only the elements at most, which is in fact knowing nothing at all. Some, it is true, have a passion for universal knowledge, and this universal knowledge consists in knowing by memory a few words upon every subject, which convey no kind of ideas. To those that would form a new science, or extend the boundaries of the old, we would suggest the following rules, which are strictly observed by mathematicians.—

1. To offer nothing but what is couched in clear express terms; and to that end, to begin with definitions.

2. To build only on evident and clear principles: hence it is necessary to proceed only from axioms or maxims.

3. To prove demonstratively all the conclusions that are drawn hence; and for this purpose, to make use of no arguments or proofs, but definitions already laid down, axioms already granted, and propositions already proved; which serve as principles to things that follow.

## PROFESSOR JOHNSTON'S LECTURES ON GUANO.

*(Delivered at the British Institution.)*

THE Professor commenced his lecture by observing that the word guano was an old term, and one which had been imported into this country from South America.

It was now, and had been long, given by the Peruvians to the dung of sea-fowl, which from the remotest era, had been gathered on certain islands on their coast, and was still represented by the deposits collected on the rocky promontories of South America. They were well aware that many of the islands upon the Scottish coasts were frequented by innumerable clusters of sea-fowl; but their droppings did not remain there. The frequent rains which remained in our variable climate was the obstacle to the accumulation of this kind of manure, for by this means the valuable particles were soon washed away and disappeared. But for 500 or 600 miles on the coast of Peru and Bolivia scarcely any rain fell, and the droppings of millions on millions of these sea-fowls had been allowed to accumulate there in deposits of sixty, seventy, and eighty feet deep, wherever the birds had permanently settled. The value of this substance was well understood by the ancient Peruvians, and so highly was it estimated, that the various islands along the coast, such as Chincha and others, were each allocated to a separate tract of country, the inhabitants of which drew the guano to grow their crops from a certain island, and no district of country was allowed to obtain the manure from any part but that specially allotted to it.

Persons were regularly appointed to look after the birds, and it was an offence punished with loss of life for any person to kill one of them—so satisfied were the Peruvian rulers of the necessity and importance of preserving and husbanding this means of raising their corn. At the present day this substance was not only extensively employed upon the coast, but it was carried on the backs of mules to vast distances along the ridge of the Cordilleras, for the purpose of fertilising the inland soils. Though the guano might well be supposed to exist on our own coast, it was not found there, from reasons which he had already mentioned. Still, a reasonable hope was entertained that it might be found on other coasts, which were similar to Peru, viz. where no rain fell; but it was not until less than two years ago that deposits had been found in other parts of the world—deposits from the effects of which he augured the most beneficial effects to the Agriculture of this country. It was of great consequence that guano should be found in large quantities on the coast of Africa, for the voyage to it was comparatively short, and they might thus entertain the expectation that in the course of a year or two the price would be reasonably reduced, and thus a greater extent of soil brought under its beneficial operation. After this explanation, he would proceed to inquire into what formed the component parts of guano; and as the quality of different kinds varied, he would show to them the result of the analysis of several samples. The first two columns on the subjoined Table contained the result of two different samples brought from Africa by the "Levenside." The next two columns contained samples which had been sent to him from the "Star of the West," which had come into Plymouth—the one sample being taken from the hold of the ship, and the other from a quantity which had been brought in bags. The next sample was the guano which had been imported into Glasgow from Ichaboe by Mr. Downie; and the last was a sample from Bolivia, which, in many respects, it would be seen, differed from the others. The

Table to which he called their attention was as follows :—

| | Levenside. | | Star of the West. | | Ichaboe | Bolivian. |
|---|---|---|---|---|---|---|
| Water | 13·75 | 22·85 | 13·30 | 27.66 | 17·41 | 8.34 |
| Organic Matter and Ammoniacal Salts | 58·09 | 52·66 | 32.31 | 32·34 | 55.33 | 65.60 |
| | — | — | 33.50 | 9.80 | — | — |
| Sulphate of Soda and Common Salt | 6·94 | 6·51 | — | — | 4·92 | 0.78 |
| | — | — | 1·58 | 2.02 | — | — |
| Carbonate of Lime and Magnesia | 3·32 | 2·77 | 5.81 | 4.12 | 3.54 | 1·12 |
| Earthy Matter | 2·83 | 3·11 | 1.30 | 3.88 | 0·57 | 4.46 |
| Phosphate of Lime | 15·07 | 12·10 | 12.00 | 20.18 | 18.23 | 19·80 |
| | 100 | 100 | 100 | 100 | 100 | 100 |

Now, did these substances contain all that was necessary for a perfect manure? They had, in the first place, organic matter and ammoniacal salts, capable of imparting the great essential of nitrogen to the plant. It generally bore a large proportion in the manure. Then they had sulphate of soda and common salt, which was highly necessary to the healthy growth of a crop. Then they had carbonate of lime and magnesia, on the merits and importance of which he need not enlarge. Next, they had earthy matter, which should have been placed last on the list, for the less sand they had in their guano the better—the more valuable it would be. They had also the phosphate of lime, so necessary for the inorganic structure of plants. They all contained water to a greater or less extent; but here, also, the less the better; for in proportion to the quantity contained, one kind of guano might be 10s. per ton superior to another. In the samples before them they would see how much the quantities varied. Even the two different samples of the "Levenside" varied from each other by 13 to 22—the one sample in this respect being 9 per cent. better than the other. In the "Star of the West" it varied from 13 to 27—the one sample being 14 per cent. better than the other.

(*To be continued.*)

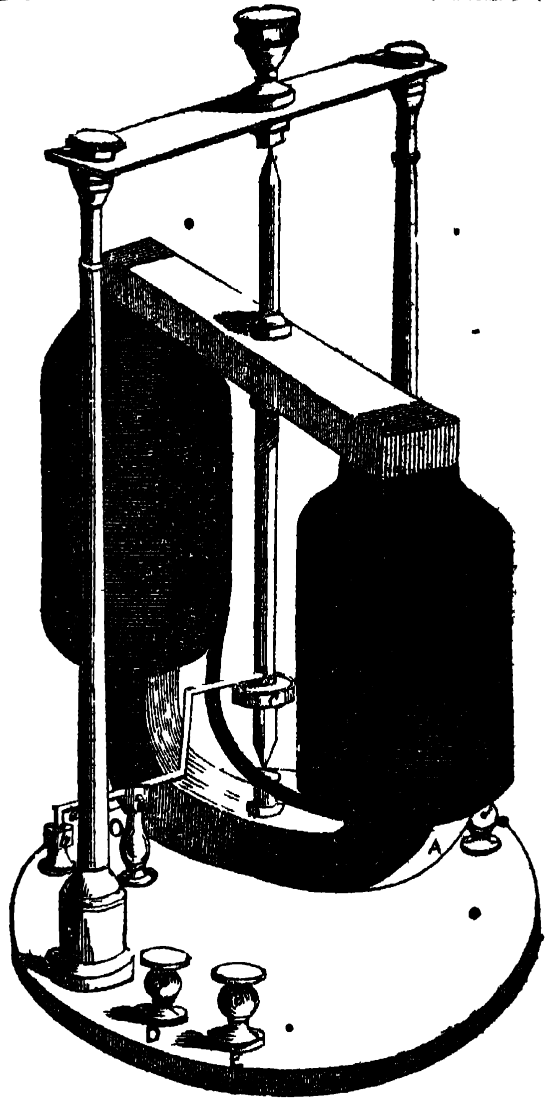
## VARIETIES.

*Artificial Marble.*—We learn from an American paper that a method of manufacturing marble has been discovered, which is pronounced superior to any other artificial stone or marble in use; it will supersede the use of lime mortar in the varied processes of plastering; and will be extensively used in stucco work, mosaic statuary, mantel-pieces, table-slabs, atmospheric and hydraulic cement, roofing of houses, paving of streets, &c. It will set or harden in six hours when applied to plastering houses. It will resist the action of atmospheric heat, damp, frost, &c., is susceptible of a high polish, and can be manufactured at a cost little exceeding ordinary lime mortar.

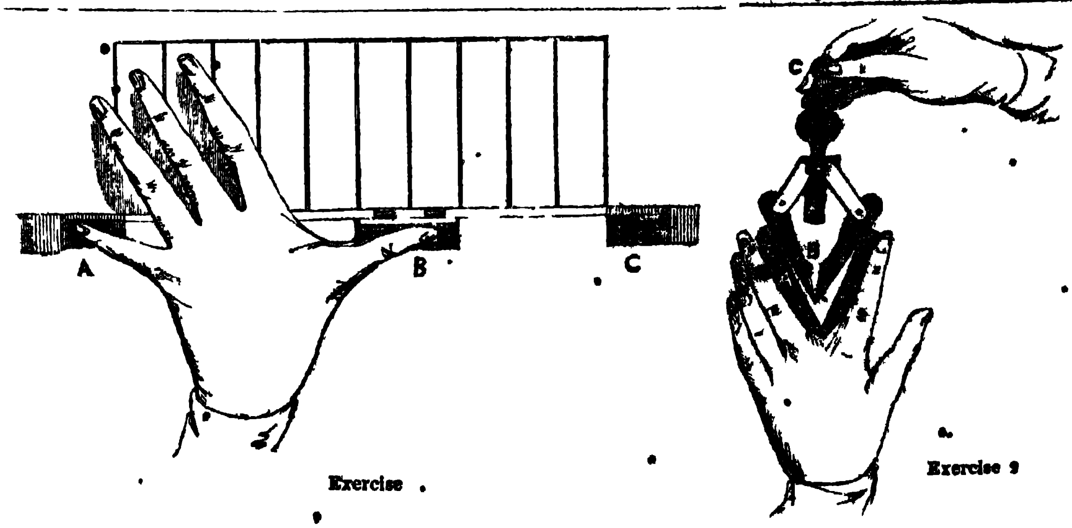
*French Embalming.*—Dr. Broc has just superintended the embaling of the body of Marshal D'Erlon by the injection of the carotid artery. He dissolved 500 grammes of corrosive sublimate in 2·000 grammes (about 2 quarts) of alcohol. There were also 25 grammes of arsenious acid dissolved in half a pint of warm water; and a third solution was made of 4 grammes of essence of cloves, 15 grammes of essence of lavender, and 5 grammes of essence of orange in 2 quarts of alcohol. At the moment of injection these solutions were mixed. Three-fourths of this mixture were injected into the interior end of the left carotid artery, and the remaining fourth distributed, after previous punctures, into the pleura and the peritoneum. The body was afterwards wrapped in linen bands.

*New Process for preparing Cyanogen.*—On mixing together cyanide of potassium and bichloride of mercury, both in powder, and leaving them for a few days, Mr. Kemp observed that the mixture became of a greenish colour, which at first led him to suspect the presence of iron in the bichloride of mercury; but as he failed in detecting it, he next proceeded to make a few experiments with the substances, the result of which was, that cyanogen might be more easily and economically obtained by the following method than by any of the usual processes:—Take six parts perfectly dry ferrocyanide of potassium, and nine parts of bichloride of mercury, both in fine powder, and mix them intimately together, then apply heat to the mixture, in a glass retort, when cyanogen gas will be disengaged; mercury at the same time distils over, and a dark-coloured matter is left to the retort, being a mixture of chloride of potassium and cyanide of iron.

*Blue Colour of Lapis Lazuli.*—Elsner has made some experiments on the blue colour of the lapis lazuli, and has ascertained that it is caused by a silicate of alumina and soda, which may be replaced by lime, combined with a double sulphuret of sodium and iron, in which the amount of iron is very small, but is essential for the production of the colour. The colouring matter in artificial ultra-marines is partly of a fine blue, and partly of a fine green tint. The latter, by continued heating in an open vessel, passes into the former; which, Elsner says, takes place, because the blue colour requires the combination of a larger quantity of sulphur with the sodium. This is effected when a portion of the sulphur is converted into sulphuric acid, which removes soda from the sulphuret, by which means the latter becomes comparatively richer in sulphur. On this account the natural as well as the artificial ultra-marine always contains sulphuric acid.



THE ELECTRO MAGNETIC COIL MACHINE.




THE CHIROGYMNAST, OR FINGER EXERCISE.

## THE ELECTRO-MAGNETIC COIL MACHINE.

The accompanying engraving represents a very powerful arrangement of the electro-magnetic coil-machine, made by Mr. W. T. Henley, we are indebted to Mr. Noad's recently published and most interesting Lectures on Electricity for the following description.

A, a series of U-shaped bars of soft iron, bolted down to a base board, and wound with four coils of No. 14 covered copper wire to within an inch from either extremity; over this is wound a thousand yards of No. 34 covered wire in one continuous length. B, the revolving armature which rotates between the poles of the magnet fixed on an axis, the lower end resting on a hard steel cap, the upper kept in its position by a screw passing through a flat piece of metal mounted on two brass columns. O, the apparatus for breaking contact, consisting of a small lever *a*, suspended on a pillar, one end dipping into a mercury cup, *b*, and the other end provided with a friction roller, running on an undulating wheel *c*, the prominent part of which, raising the end of the lever, dips the other end into the mercury, a spring *d* raising it out when the roller falls on the lower parts of the wheel. A break-piece formed of ivory and brass may be substituted for this, but the oxide of the metal formed by the spark is such an imperfect conductor, that three cells have no more effect than one with the mercury. D E are the binding screws for forming connexion with the battery; the opposite ones are the ends of the secondary coil. On the same side of the base with the last (not seen in the wood-cut), is an ivory knob, which being turned, connects the ends of the secondary coil, either to diminish the primary spark, as the armature will then rotate for hours without burning the mercury, or to prevent the operator from receiving an unpleasant shock while adjusting the instrument. The ends of the thick wire are passed through the base, those from one pole soldered to E, the other to the mercury cup; the pillar C, and binding screw D, are connected together. This machine works very well with one or two cells of Smee's battery; and with an intensity series of eight, the secondary current is exceedingly powerful, the spark passing ¼ of an inch through air; with a battery of ten of Sturgeon's cast iron pots, the spark from the secondary coil passes ½ of an inch through air, and brilliantly deflagrates gold and silver leaf; the shock would be far too powerful to be taken through the body, for when only two fingers are included in the circuit, it is sufficiently intense to be felt at the shoulders. With such a battery power the sparks from the primary coil are brilliant in the extreme; and from the ease with which the ends of the secondary coil are united and disunited, viz., by merely turning the ivory knob, the instrument is admirably adapted for demonstrating at the lecture table the induction and reaction of electrical currents; when the ends of the secondary are disunited, the sparks from the primary are large and brilliant; when united, they are small and faint.

## THE CHIROGYMNAST, OR FINGER EXERCISE.

We resume our notice of this most useful invention, the Chirogymnast, and it will be seen by referring to our sketch, page 137, that it consists of nine different parts, to each of which a separate and distinct exercise is applied, in order to prepare the hand for the study of all sorts of musical instruments, but particularly the pianoforte. These are arranged on a board nineteen inches long by twelve and half broad, and one in thickness, and are made of either mahogany or satin wood, whilst in some cases the notes are made to appear like a pianoforte, mounted with ivory and black ebony, the whole weight of the apparatus is not more than six pounds, thus the size and lightness of it renders it easily portable, and the construction of the exercises is such that they may be used with equal facility by the juvenile performer, or the adult.

It has been the study of the inventor to apply these gymnastic exercises in such a way as to give strength and freedom of action to all the fingers alike, and more particularly to the third finger, which as is well known to all scientific performers, is naturally weaker than either of the others, and moves with greater difficulty when required to be used separate from the rest, and having studied the anatomical movements of the hand, and the different reasons which opposed the free action of the fingers, has succeeded in constructing the machine before us, we will proceed to explain the different exercises, as promised in our last number.

1. The first exercise is to facilitate the striking of the octave, or even the ninth or tenth note, by gradually exercising and extending the thumb and little finger, and continually spanning as far as the hand will reach; this exercise is attached to the notes at Fig. 8, so that it may be perceived how far the hand will extend, the parts A and C are fixed, whilst the thumb rests on the slide at B which is moveable, taking care to keep the little finger upon the rest, at A.

2. The second exercise has for its object, the facilitating the extension of the second, third, and fourth fingers, and by its use serves to extend the fingers sideways, by elongating the ligaments which are between the fingers on the back of the hand, this exercise by means of the screw at C, makes the angle at B, more or less obscure; according as the hand is able to practice it. The part A consists of two little pieces of wood united together by a hinge of leather, this part which is detached, is placed between the fingers, and forced at the angle at B, continuing the exercise until the fingers move easily and separately.

It is required that each finger should be kept level on the board during the exercise.

The exercises 3, 4, 5, 6, and 7, being intended to develope the strength of the third finger, we shall leave those parts for explanation in our next number.

## CUVIER'S SYSTEM.

Professor Ansted has given the following concise analysis of the celebrated Cuvier's system in his new work on Geology.

There are certain great divisions of natural objects, so decidedly marked by nature, and offering such broad distinctive characters, that no great amount of observation is required to discover them. Such, for instance, are the divisions into the Animal, Vegetable, and Mineral kingdom of all the vast multitude of natural objects of which we have any knowledge; and such also is the division of the animal kingdom into vertebrated and invertebrated animals; under the former name, including those provided with an internal frame-work, or skeleton, attached to a vertebral column, or backbone, through which the spinal marrow passes from the brain; while, on the other hand, the invertebrata have no such skeleton, and the nervous system, instead of being centred in one brain, is collected into several lumps (called *ganglia*) in different parts of the body.

The vertebrated animals, again, are readily divided into four great classes: Mammalia, (or those which suckle their young) Birds, Reptiles and Fishes; and the anatomical characteristics of each are derived chiefly from the locomotive organs, as the extent of the development of these is dependent on the organs of respiration and circulation.

It is not so easy to subdivide the invertebrata. They were separated by Cuvier into three classes: Mollusca, or soft animals, many of them covered with shells; Articulata, animals with distinct articulated limbs, such as lobsters, &c., insects, and worms; and Radiata or Zoophyta, a miscellaneous class, including a vast multitude of species possessing few analogies with one another, and which have since been subdivided into two groups, chiefly from peculiarities of the nervous system. The sea urchin and the numerous tribes of polys, and of infusorial animalcules, may give an idea of some of the animals referred to in this class.

The author then proceeds with the classification of the vertebrata:—

The Mammalia, the first of the four great classes, into one or other of which all vertebrated animals are grouped, contains those species in which there is a complete double circulation, the whole of the blood being transmitted from the heart to the lungs, and received back into the heart before it is in a state to circulate through the system. All the animals of this class are brought forth alive, and are nourished by milk secreted by the mother, until they are able to seek their own food.

The Mammalia are divided into nine orders, characterized (1) by the structure of the extremities, on which depends much of the activity and many very important habits and peculiarities of the animal, and (2) from the organs of manducation, or the teeth and jaws, which determine the nature of the food, and are intimately connected with everything relating to the function of digestion, and a multitude of other differences, including even those which have reference to the development of the intellect and the instincts of the animal.

1. The first order of Mammalia includes but one species, Man, the order being named Bimana, or two handed, because man is the only animal provided with two hands at the anterior, and feet at the posterior extremity. This structure of his extremities enables him to obtain, and that of his teeth to masticate, all kinds of food; and he is, beyond all other animals, possessed of the greatest variety of powers, and the greatest degree of adaptability to change of circumstances, whether of temperature or food.

2. The second order, the Quadrumana, contains the monkeys and lemurs, who are provided with hands at each of the four extremities. The teeth of Quadrumana are of two kinds; the monkeys resembling man in having blunt tubercles on the molars or grinding teeth; but the lemurs having sharp tubercles, like those of the insectivorous animals of the next order.

3. The Carnivora form the third order, and include a large number of species, living almost exclusively on animal food. They are nearly all quadrupeds; the form of their teeth is better adapted to cut than to grind food; their jaws are nearly incapable of lateral motion; and the form of the skull is modified to give great strength and volume to the muscles which work the jaws.

They are subdivided into four great families: (1) the *Chiroptera*, or bats; (2) the *Insectivora*; (3) the true *Carnivora* (containing two sub-families, *Plantigrada* and *Digitigrada*), distinguished by the structure of the extremities; and (4) the ***Amphibia***, inhabiting the sea, whose extremities are short and rudimentary, and intended to serve rather as fins than feet.

It is only when we reach the true Carnivora that we find a sanguinary appetite for flesh, joined to great strength and activity. All the genera of this subdivision have long, stout, and separated canine teeth or tusks, between which are six incisive teeth in each jaw, and the molars are wholly cutting, as in the feline tribe, or are blended with blunted tubercles, as in the bear. Of the two sub-families, the *Digitigrade* includes (1) weasles, &c., (2) the dogs and civets, and (3) the hyæna and cat tribe, animals all naturally extremely carnivorous, and walking upon the extremity of the toes and fingers. The *Plantigrades* walk upon the extended palm; they are much slower than the Digitigrades, and are able to support themselves on their hind feet in climbing trees, or in seizing their prey. The bears are the type of this tribe, and their tuberculated molar teeth indicate the frugivorous habits which, under ordinary circumstances, these animals exhibit.

Lastly, the Amphibia, including the seal and the morse, form a family of marine Carnivora, their extremities being adapted to the element in which they are to live.

4. The Marsupials are animals of which the female, after bringing forth her young alive, receives them for a time into a peculiar pouch, to which they have recourse for shelter at the approach of danger, even long after they are able to walk.

The subdivisions of this order seem to form groups analagous to the different orders of Mammalia; their mode of dentition is extremely variable; they are, with very few exceptions, peculiar to New Holland, and their habits are ill understood.

5. Rodentia. This order includes a number of animals provided with two large incisors in each jaw, separated from the molars by a vacant space, and acting as chisels or files, enabling the animals to gnaw wood and other substances, with great facility. With this structure of the incisors there is combined a peculiar form of the molar teeth, which have flat crowns, whose enamelled eminences are so arranged as always to be in opposition to the horizontal movement of the jaw, and which serve admirably for trituration. The beaver is a good example of an animal of this order, which also includes the squirrel, the rat and mouse, the hare and rabbit, the guinea pig, and the dormouse.

6. The Edentata are animals without teeth in front of the jaw; and in their large nails, which embrace the extremities of the toes, as well as in the gigantic proportions of some extinct species, they seem to form a link between the unguiculate animals to which they belong, and the ungulata or hoofed quadrupeds. The anatomy of the animals of this order is extremely interesting to the geologist, as a considerable number of extinct species, lately discovered in South America, have been referred to it, although in magnitude they far exceed the dimensions of the largest species now known to exist. The

**Edentata** were subdivided by Cuvier into three tribes: (1) the sloths; (2) the ordinary Edentata, including the armadillo and the ant-eaters; and (3) the *Monotremata;* whose habits are so peculiar, and their structure so anomalous, that its two genera are with difficulty included in any general definition.

The "Ungulata" of Linnæus, were grouped by Cuvier into the two orders, *Pachydermata* and *Ruminantia;* the latter of which contains all those hoofed quadrupeds who return their food to the mouth to be masticated, after having first deposited it in a false stomach; this process being called ruminating.

7. The Pachydermata, or thick skinned animals, are sufficiently remarkable not to require any long description. They are subdivided into (1) the *Proboscidiana*, or those provided with a long trunk, as the elephant; (2) the ordinary Pachiderms, viz. the hippopotamus, the pig, the rhinoceros, the tapir, and several extinct genera; and (3) the *Solipedes*, of which the horse is the type.

8. The Ruminants form an order containing by far the greater number of the animals useful to man, but whose remains are exceedingly rare in a fossil state, except in strata of the most recent period. It is sufficient to mention the names of the different genera of which this order is made up, to recal their peculiar habits and structure. The camel, the deer tribe and antelopes, the giraffe, the goat, the sheep, and the cow, are all perfectly well known. They are all characterized by the peculiar structure of the stomach, already alluded to, and by the absence of incisors, or cutting teeth, except in the lower jaw, where they are eight in number: there is also a vacant space between the incisors and molars, which latter have their crown marked with two double crescents, the convexity of which is turned inwards in the upper, and outward in the lower jaws.

9. The last order of Mammalia is that of Cetacea, under which name is included a number of warm-blooded animals, much more resembling fishes than quadrupeds, both in their external appearance and habits. In every case, however, anatomical investigation has shown that there exists, in a rudimentary state, all the bones which mark the approximation, in structure, of these animals (apparently fishes) to the most highly organized vertebrata.

*(To be continued)*

## IMPROVEMENTS IN THE MANUFACTURE OF IRON

Arthur Wall, of Bistern Place, Poplar, Middlesex, Surgeon, has recently obtained a patent for "certain improvements in the manufacture of iron."

The invention may be divided into two classes, the first is the addition of certain mixtures or substances to the iron when in a state of fusion; and secondly, in submitting the iron to the action or influence of electricity. With regard to the first part of the invention, the compositions which are of two kinds, consist first of a mixture of steel or wrought iron in a comminuted state, such as filings, &c., and resin, which are to be mixed together in the proportion of about 2lb. of iron or steel filings to about 5lb. of resin, this mixture is made into balls of about 5lb. weight each, which balls are to be thrown upon the surface of the iron when in a state of fusion, in the cupola or other furnace, one ball being used to about every 5 cwt. of iron.

The second composition consists of a mixture of common salt, resin and charcoal, or other carbonaceous matter. Although the inventor prefers the above, other fluxes may be used, such as borax, nitre, &c., in place of common salt; the above being made into balls are to be used when the metal is in a state of fusion, and after the first mixture has been added in the proportion of 1lb. to about every 100lb. of iron.

The second part of these improvements consists in subjecting the iron to the action or influence of electricity. In carrying out this part of the invention, Mr. Wall causes a current of electric fluid to pass through the iron in every possible direction, by stretching or extending copper wires across the mould in which the casting is to be made, and by means of a galvanic or voltaic battery, causes the electric current to pass through the metal whilst in a fluid state, and also whilst approaching and when in a solid state, more especially when casting ordnance, in which case the patentee recommends that the electric current should be passed through the piece after it has become solidified, care being taken not to continue it so long as to entirely decarburate the iron, and bring it into a malleable state. The inventor also proposes to pass the electric current through the iron when in the furnace or cupola, by inserting a piece of iron into the top hole so as to touch the smelted metal, and another piece of iron or other conductor into one of the tuyre holes, which piece may be moved about on the surface of the metal, so as to pass the electric current the same in every possible direction.

## PROFESSOR JOHNSTON'S LECTURES ON GUANO.

*(Delivered at the British Institution.)*

*(Continued from Page 144.)*

In the Ichaboe sample there was seventeen per cent., and in the Bolivian only eight. The latter, therefore, so far as the absence of water was concerned, was decidedly the most valuable. He had, however, never seen more than one sample of this valuable manure, and understood that no more was to be had. That which contained the greatest quantity of water was the least valuable, and the value of that which had the largest amount of ammonia was, on the other hand, proportionably increased. That substance, viz. ammonia, would cost the farmer more to buy than any other of the ingredients; it was therefore the most valuable, because, to produce it artificially, it would be the most costly. The quantity of this valuable substance in the samples of the "Levenside" varied from 52 to 58 per cent.; in the "Star of the West" it was 32 per cent.; in the Ichaboe, 55.; and in the Bolivian, 65,—showing, therefore, that the quantity in the latter was double the amount of the "Star of the West." They would say, therefore, in this point of view, that the Bolivian was the best, and the "Levenside" the next best. Before coming to this conclusion, however, let them look to the sulphate of soda and common salt contained in each. This was a cheap article, and got in Glasgow, he believed, for 4*l.* per ton—a price much below what they were required to pay for the guano. The proportion in the "Levenside" was 6 per cent.; in the "Star of the West" so much as 33 per cent., and in the Ichaboe it was less than 5 per cent. It was still less in the Bolivian; and, always remembering that this was a cheap article, they came to the conclusion that the Bolivian was the best, and the Ichaboe the next best.

The small quantity of earthy matter in the Ichaboe, compared with others, also greatly enhanced its value They came next to the phosphate of lime, which was necessary to make any manure valuable, and might be held as next of importance to the ammonia For the proportions in the different samples he referred to the Table They would see therefore that guano contained almost all that was essential to constitute a perfect manure The lecturer then alluded briefly to the importance of thus having concentrated in one manure so many substances which the soil was likely to need, and be benefitted by He would now briefly point out the analogy which existed in the connexion between bones and guano Some might ask, would guano benefit the after crops? This had been done by bones Then, if bones had improved the after crops, guano should do the same thing, for phosphate of lime constituted a large portion of the one, and it was a valuable ingredient in the other They had also salts and soda in each They had the cartilage in bones which produced the nitrogen, and this was represented by the ammonia of the guano There was this difference in favour of the guano, that when it was applied to the soil the ammonia was ready made, and immediately exerted a beneficial influence on the roots of the plant but in the case of bones they had to decompose before the ammonia was [illegible]e for the uses of vegetation The manures, [illegible], might often be mixed with benefit—the guano for the purpose of acting immediately, and the bones for exerting their influence after it He would briefly allude to one most important quality which it possessed, viz its extreme portability It appeared that from 4 to 6 cwt per acre might be safely put in if guano was used alone, and this in fertilising powers would be equivalent to 40 or 50 loads of farm yard dung Suppose, therefore, that there was a tract of country, which it was impossible to traverse but by means of mules, they would be enabled to fertilise it by guano, when it was impossible to approach it with such a bulky article as farm-yard manure They had already seen this exemplified in the case of bones to a considerable extent in this country They had brought a large tract of land into cultivation in the wolds of Yorkshire and of Lincolnshire, where the bones were carried to the tops of the hills and clothed them with vegetation, But guano was still more easily carried inland than bones, and when once obtained it was a much more perfect manure It would have another effect It would enable the farmer to apply large portions of his farm-yard manure to spots which were easily accessible, and be the means of reducing the price of every other kind of manure, in the same way as had already been done with rape-dust, bones, &c In fact, the introduction of guano was creating quite a sensation in large towns, such as Edinburgh and Glasgow, from the vast reduction which it would effect in the price of the street manure, and the falling off in which would render the imposition of an additional assessment necessary In Edinburgh in the course the present year the assessment was expected to be 1700*l* more than last year, solely on account of the difference in price of the street dung He would conclude with one important point,—Was it proper to use guano alone? Would it be good husbandry? He did not think so, and though he had not time to enter into all the reasons for this opinion, he might state that guano did not supply all the substances of farm-yard matter any more than bones did It would not, therefore, be safe to recommend farmers to use it alone. This year, they might get a good crop by its means alone but if continued alone, it would tell by and by, particularly on the soils which were poor in what was termed vegetable matter Therefore, he would consider it the best husbandry to recommend a course similar to that which had been generally employed in the using of bones. This had been to raise one crop by means of bones and the next by means of farm-yard manure, or to use them half and half. He would think it safer, therefore, to recommend that guano should be used half and half with farm yard manure, or that they should be used alternately.

## OYSTERS.

Oysters are produced and grow in all seas and salt water One oyster brings forth many thousands; the young or spawn of them are increased in numberless quantities between May and August, yearly, in which time none are taken or marketed, for that season is called their sickness in which they are not fit to be eaten The spawn, or brood oysters, are not subject to destruction, as the eggs and fry of other fish, nor are they marketed for consumption if taken, till due size, but laid again in the fisheries to grow The oyster spawn is distributed over all seas, rivers, and waters, by the flux and reflux of the tide, for when the eggs are first shed, they rise in a very small bubble, and float on the surface, and are moved to and fro, till by the air and sun they are brought to maturity, and the shell is formed, and then by their natural gravity, they subside.

## FORMATION OF FAT.

BY DR JUSTUS LIEBIG

THE carnivorous races of animals thrive on azotized food, which supplies material to replace their wasted tissues, and these wasted tissues again afford material to be oxidated or burned in respiration, and support the animal heat But besides azotized matter, the food of the graminivorous races contains sugar, starch, and gum, which are not employed in the proper nourishment of their bodies, but solely for the generation of animal heat by combustion at the expense of the oxygen of the air The disappearance in like manner of fat in the animal system, in circumstances where rapid oxidization is known to occur, seems to point out a similarity in the use of the latter, which thus becomes burned in the body into carbonic acid gas and water, in the absence of the vegetable principles above mentioned It is well known that graminivorous animals, abundantly supplied with food containing starch or saccharine matter, and whose respiration is, to a certain extent, checked by want of motion and exercise, become in a short time loaded with fat which the above consideration indicates to have been formed out of the excess of non-azotized food over and above that required for respiration This is supposed to take place by a metamorphosis analogous to that by which alcohol and carbonic acid are produced from sugar. This opinion of the origin of fat has recently been called in question by M Dumas, who contends, that the whole fat of an animal has been furnished ready formed, in that state, by the food itself, and cites an experiment in which a goose has been fed for some time upon maize, supposed to be free from fatty matter, the starch of the grain appearing to have generated the fat found in the bird, an inference which he rejects by showing that maize itself contains a large quantity of oil: it therefore became desirable to obtain additional evidence on the subject. In an experiment at Giessen, three young pigs were fed, during thirteen weeks, on peas and potatoes, the quantity of fat contained in these vegetables being calculated from the researches of Braconnot and Fresenius. It was found, at the expiration of that time, that the bodies of these animals contained no less than about seventy pounds more fat than could possibly have been given in the food, and which was therefore inferred to arise from an alteration of the starch. An equally satisfactory experiment is described by Boussingault, in which the butter furnished by a cow was found to exceed greatly the fat of the food. The author then states the result of a chemical examination of hay and straw, with reference to fatty matter, and describes them to contain about 1·5 per cent. of a crystalline waxy matter, mixed with chlorophyll, altogether different from ordinary fat. The excrements of a cow, fed on those substances, corresponded very closely to the whole quantity contained in the food; so that it appears quite evident that the fat of butter does not arise from this source. The author concludes with observations on the composition of maize, which contains very different quantities of oil, from one to nine per cent. in different localities.

## MENDIP HILLS.

PROFESSOR PHILLIPS in a recent communication made to the Royal Institution, on the Phenomena in the Mendip Hills, illustrative of the lapse of geological time, stated, that about fourteen years ago, his attention was directed to the structure of that part of the Mendip Hills which is near the town of Frome, in Somersetshire; that he there observed strata of mountain limestone, inclined at an angle of 45°, and covered by other horizontal strata of a totally unlike nature, (in fact, magnesian conglomerate, lias and inferior oolite). He observed that the surface formed on the edges of these disturbed limestone strata was remarkably levelled and polished, as if by mechanical friction, and where covered by the oolite, the rock was overspread by adherent oyster-shells, and also perforated by bivalve mollusca; the oolite above, and the limestone below, were replete with organic remains, characteristic of the widely different ages of these rocks. He further asserted, on the authority of a subsequent survey with Sir H. De la Beche, that this flattening of the limestone was common throughout the district; and that the effects of the lithophagous mollusca were observable over wide areas. The Professor then entered on the constitution of the Mendip Hills, as being composed of various stratified rocks, resting on old red sandstone; calling attention to the many laminæ of sand and micas, each marking, as successive definite sandy deposits from inundations of rivers do, a distinct period of time, the many beds of limestone full of successive groups of shells, corals, and encrinites, and the various beds of coal in the vicinity, accompanied by innumerable land plants. Professor Phillips then noticed another phenomenon extending over large tracts both of this country and the Continent. The rocks already described are often bent about in synclinal, convex, and articlinal axes. From hence he inferred, that a vast disturbance must have extended, with great force, over an immense range of the surface of this planet, after the deposition of the coal strata, but many ages before the historical period: that then came a period of violent water action, continued long enough to degrade the ridges of the rocks already mentioned to the nearly plane surface of the Mendip Hills, fringed by conglomerates, which marked the edge of the ancient sea. Then another period of tranquility followed, when strata of new red sandstone, lias, and inferior oolite were deposited nearly horizontally over the dislocated and levelled limestone and coal. The Professor illustrates these operations by the known effects of the littoral action of the waves of the sea on rocks. After the production of a part of the inferior oolite, the sea nourished lithophagous shells, (allied to Modiola and Lithodomus,) whose perforations remained in the limestone. The same shells in similar perforations have been found at distances of several miles from the Mendips, in the lower beds of the inferior oolite—a proof that even in the production of a rock only fifty feet thick, so much time elapsed that the lower parts were consolidated and penetrated by lithophaga before the upper beds were formed. The same shell has been found abundantly in corals of the oolite rocks, which it had penetrated. The perforation of the mountain limestone and oolite, the Professor referred, not to the mechanical force of a boring shell, but to the chemical effects of the carbonic acid secreted in respiration by the animal inhabiting it. The holes produced in the rock were larger than the shell (lithodomus) which, unlike pholas, is smooth, and apparently incapable of penetrating a hard substance, except by a solvent. Dr. Buckland has shown that it is by the same means that a species of land snail (*Helix aspersa*), by secreting carbonic acid, continues to dissolve rocks. Having exhibited specimens of limestone and oolite pierced in the manner he described, and appealing to the perforated columns and vertical movements of the Temple of Pozzoli, the historical analogies to the greater phenomena, and longer periods exemplified in the Mendip Hills, the Professor concluded by referring to some siliceous deposits, probably the effect of hot springs, which had flowed at the epoch of the lias on the north side of the Mendip Hills, and by adverting again to the almost infinite lapse of time required to produce the various mechanical, chemical, and vital effects visible in a portion of the earth's crust, which must have been formed ages after the beginning of geological, and as many before the commencement of historical time.

## DRY GAS METER.

A PATENT has lately been obtained by Mr. Stephen Hutchison, of the London Gas Works, Vauxhall, Engineer, for "Improvements in gas meters."

The necessity which has long existed for an instrument of the description now introduced, and recommended to the notice of the public, and by which an accurate and intelligible mode of registration of the gas consumed could be obtained, has long occupied the attention of scientific men. The inconveniences that result from the peculiar construction of the wet meter, as well as the unsatisfactory manner in which it registers the consumption of gas, both called for the introduction and adoption of some superior plan by which consumers might be supplied with more uniformity, and that they might also comprehend the registration of the quantity which has passed through the meter, and with which they became chargeable.

Mr. Hutchison's improvements in gas meters is an apparatus which he has named "An Aerometer," it consists of a cast iron plate and box with passages leading into four compartments, and thence into the upper part cast in the same, and fitted with four lower cup valves, which are sealed with quicksilver; four tin-plate compartments fixed into the cast iron pipes; four flexible leather bags saturated with tar, naptha, and oil, are attached to the compartments with heads, rods, beams, connecting rods, cranks, carriages, &c., to communicate motion to the valves and shaft, which revolving communicates with the index. An index with dial five inches square is inclosed in a box and external casing with brass unions for the inlet and outlet pipes; the hands of the index revolve similar to those of a clock, the short or hour hand denoting thousands of cubic feet, and the long or minute hand indicating tens of cubic feet. The possibility of escape of one atom of gas without it being duly registered by the index, the inventor states is entirely obviated by the quicksilver in the cups. Attached to the shaft is a catch to prevent its revolving the reverse way.

The Aeremoter not only works without the slightest resistance to the flow of gas, but assists its current to the burners; it requires the least possible pressure in the mains to work it, and affords a steady uniform light without any interference, and the construction is of so simple a nature that its derangement by ordinary means is an impossibility. The valves and the other mechanical contrivances are made of a metallic compound, which resists the action of sulphuretted hydrogen or ammoniacal gases, its duration may therefore be considered to be secured for a very long period. There are likewise not any stuffing boxes to get corroded.

The inventor considers that his new metor or Aerometer has the following advantages over the old meter:—That the heat or cold cannot possibly interfere with, nor disorganize the mechanical arrangements connected with the action, that the wear and tear will be found to be inconsiderable, that the lower part is not liable to decay, it being made of cast iron, and that the index will enable the consumer to ascertain with ease and certainty the quantity of gas that has actually passed through the meter, the correct registration of which is insured by the absence of any liquid which in wet meters not only often prevents it, but causes a very considerable loss to the companies supplying the gas, equal to one-sixth the quantity manufactured.

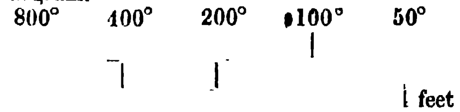
## PROFESSOR FARADAY ON HEAT.

*A course of four Lectures delivered at the Royal Institute.*

Lecture III.

(*Continued from page 140.*)

When bodies are heated at one part, they gradually give up their heat to the other parts, till they are equally hot all over. This, which is called power of conduction, exists to some extent in all substances, in solids to the greatest extent, in gases to the least. The law of conduction, or the rate at which heat travels through the substance, is found to be uniform with all solid bodies, and is expressed by saying that as the distances increase in arithmetical progression, the heat decreases in geometrical progression; thus, a bar heated to 800° at one end, if at one foot distance it was reduced to 400°, would at 2 feet be at 200°, at 3 feet 100°, at 4 feet 50°, and so on, as in the diagram.




But bodies differ from each other very greatly in in their degree of conductibility, some being excellent conductors, others very bad conductors. A rod of metal will serve best to illustrate this travelling of heat. A series of balls fixed on the under side of a bar of copper heated at one end, by their falling one after the other, indicate its progress. If a bar of iron be heated under the same circumstances, it will be seen that three balls will fall from the copper to one on the iron, showing the great conducting power of the former. This point is of great importance in many arts, particularly in building, as on a hot day all the materials employed expand in different proportions, and contract with cold. A frequent mode of illustrating this is to have a series of cylinders of copper, iron, glass, wood, and brick, and to place them on a hot plate of metal, and a paper indicator fixed on the top of each by means of a little wax; the indicators will be found to fall in the order in which they are named. German silver, which is being so much used for domestic purposes, is not nearly so good a conductor as silver, therefore hot substances can be eaten with it without fear of burning. The relative conducting power of various substances is shown in the following table:—

| | | | |
|---|---|---|---|
| Gold | 1000 | Tin | 304 |
| Silver | 973 | Lead | 180 |
| Copper | 891 | Porcelain | 27 |
| Platinum | 381 | Marble | 14 |
| Iron | 374 | Brick | 11 |
| Zinc | 11 | | |

Bad conductors are frequently employed to stop conduction. Thus the smith who punches a hole through red hot iron, protects his hand from the heat his tool acquires, by fixing it in a wooden handle. The handles of domestic articles, such as curling tongs, are for this purpose covered with string. In the manufacture of coal gas, the men in the retort house are exposed to an intense heat; at first they wore canvass shirts, but they soon found that it was more judicious to work in flannel shirts, flannel being a much worse conductor than canvass, and therefore better suited to the purpose. It is true, it was not philosophy that pointed it out to these men, but practice. The accumulation of badly conducting matter is occasionally very injurious. Fur should never be allowed to accumulate in kettles or boilers, as the heat then has to penetrate a thin stratum of stone, and not being rapidly enough absorbed, destroys the metal of the boiler. From salt water the accumulation is much more abundant than from fresh, and instances have been known where, owing to the deposit in the boiler, holes have been burnt, during one journey, large enough for a man to crawl through.

Want of continuity lessens very much the conducting power of substances. Owing to this, hot metal may be carried on chains with impunity. At Gibraltar advantage was taken of this property of non-continuous bodies, for it is said that red-hot balls were carried in wheelbarrows merely by interposing a layer of sand between the wood and the ball. The hand, even, can support a red-hot ball for a short time, by laying some sand on it, taking care to protect the other part of the hand from the heat of radiation. Aldini, Galvani's nephew, introduced into this country the use of the filamentous substance asbestos, as a protection against heat, a person clothed in a dress of this kind being able to withstand for a short time the action of flames. Obsidian, which is lava in a state of glass, is a tolerable conductor of heat, but when frothed up into pumice, it is one of the worse conductors known. If continuity is broken by the interposition of a bad conductor, the effect is very great, as may be shown by a metallic vessel with three handles, one continuous, the second in two pieces fitting on to each other, the third the same as the second but with a piece of paper interposed. Phosphrous being placed on each handle, and boiling water poured into the vessel, it will be found that on the continuous handle will soon fire, that on the handle in two pieces will be some little time after, and that with the paper interposed perhaps will not light at all.

All bodies conduct heat, but fluids do so with difficulty. A red-hot ball may be brought to touch the surface of a small vessel full of water, and yet a delicate air thermometer at the bottom of the liquid will not be affected. Count Rumford showed that water may be kept boiling at the surface, whilst ice remained at the bottom. Indeed so slightly does it conduct, that philosophers once thought that fluids did not conduct at all. But the effect of the mixture of hot and cold water, shows that they do. Food frequentiy surprizes us by its conducting power; whilst one kind cools very quickly, another maintains its heat for a long time. In the water foot bath, heat can be borne by keeping the feet still which cannot if they are moved about. This is because the feet abstract the heat from the water next to it, but the remainder of the water gives up its heat but slowly and therefore it can be borne. The same thing takes place with porridge, one part becoming cool whilst the other parts are hot. This may be shown strikingly by substituting a copper tube with ether in it, for the spoon. When first put into the porridge the ether is vaporized and may be lighted, but the flame soon lessens and is nearly extinguished, because it has deprived the surrounding part of its heat; but move it to another part, and the flame of the ether is vastly increased, indicating greater heat.

Air is almost a non-conductor. The flame of a spirit lamp communicates great heat to air, but owing to its being so bad a conductor, gunpowder may be dropped through the flame without inflaming, whilst iron filings, which require much more heat to burn, are consumed in this manner; but here the effect is increased by the good conduction of the iron. The warm of wadding or eider down arises from its non-conduction, but this is not due to the substance of the material, but to the air which is enclosed. Count Rumford showed that if these porous substances are twisted tight, they become far better conductors. The small quantity of solid matter that many of these textures contain is truly surprising. If a jar be filled with alcohol, wool may be gradually inserted till several times the bulk of the jar, without the level of the alcohol being materially affected.

Metals are said to be colder than wood, but they are not so. To the hand they feel colder, but that arises from their conduction, as they carry away the heat much more quickly than wood does. When heated, on the contrary, they are said to be hotter than wood, because they give up the heat they have acquired, more quickly. This is well illustrated by rolling a slip of paper round a rod of wood, and another round one of copper; that on the wood is so charred, whilst that on the copper remains unhurt, because the heat is conducted away so quickly. Effects exemplifying these facts are often seen in daily life. A very hot cinder falling on to water, causes bnt little steam until it has become somewhat cooler, when its action is violent; this is because it forms, when very hot, a vapour of steam all around it, which by its non-conduction protects the water from actual contact. until, by its cooling down, its atmosphere of steam is removed. Exactly similar to this is the curious phenomena attending the pouring a drop of water on a very hot silver basin; the water runs over the surface like a beautiful pearl, with no perceptible evolution of steam, until the basin becoming cooler, the water touches the surface, and is suddenly converted into steam. Potassium, thrown on the surface of water, acts in a similar manner; for after combustion, the head of potassa formed runs over the water for a short time, but at last is dissolved, evolving at the moment much steam.

## VARIETIES.

*Rules for preserving Health.*—1. Rise early, and never sit up late. 2. Wash the whole body every morning with cold water, by means of a large sponge, and rub it dry with a rough towel, or scrub the whole body for ten or fifteen minutes with flesh brushes. 3. Drink water generally, and avoid excess of spirits, wine, and fermented liquors. 4. Keep the body open by the free use of the syringe, and remove superior obstructions by aperient pills. 5. Sleep in a room which has free access to the open air. 6. Keep the head cool by washing it when necessary with cold water, and abate feverish and inflammatory symtoms when they arise by persevering stillness. 7. Correct symptoms of plethora and indigestion by eating and drinking less per diem for a few days. 8. Never eat a hearty supper, especially of animal food; and drink wine, spirits, and beer, if these are necessary, only after dinner.

*Culture of Flax in Norfolk.*—A meeting has just been held of the Agriculturists af St. Faith's, Norwich to promote the culture of the flax plant. Some which had been grown by Mr. Warre, of Bolwick Hall, and scutched and heckled upon the spot, proved to be of excellent quality. It appeared from the statements that good flax could be procured from seed of which 4½ coombs were used to the acre, which produced a superior article of fibre. A deputation from several branch associations in Norfolk and Suffolk were in attendance; and another meeting was appointed to receive the report of a deputation from Ireland. Mr. J. Warne, jun., set out for Ireland the same evening, with the object of engaging the most improved machinery and instructors, for manufacturing the coarser descriptions of flax, and bringing it into a marketable state.

*New Astringent Tropical Remedy.*—A remedy long well known for contusions of horses has recently been used in France by Dr. Putegnay. He has employed it with success in sprains; contusions, with or without wounds; in fractures with enormous tumefaction and vast effusion of blood; in erysipelas, incipient whitlow, and varicose ulcer. It is 500 parts each of alum, and sulphate of iron; sal-ammoniac, white vitriol, and oxide of copper, of each 30 parts. The whole are to be fused at a gentle heat, and a small piece is to be dissolved in water. a cloth dipped in which is to be placed over the part affected.

## GLYPHOGRAPHY.

GLYPHOGRAPHY, when it first appeared, was proposed as "a cheap substitute for wood engraving;" a title it may very fairly claim, under some circumstances: those who will be content with something certainly inferior to good wood engraving, at from thirty to fifty per cent. less cost, may employ glyphography; but even then it is suitable for a limited class of subjects only--undoubtedly not all. For free sketching, subjects of landscape, and buildings, where a line more or less is not of vital importance to the design, glyphography, in the hand of *one accustomed* to it, may produce something very passable, but for figure subjects, involving any nicety of expression, for faces and hands, all the specimens we have seen, convince us that glyphography, in its present state, is not applicable. A rapid cut with the graver through the ground, made half at random, gives a clean line—but to a nervous, slow, *feeling* touch, at the critical point of an eye or mouth, the prepared ground does not properly answer. The lines run one into the other—the lines are choked up, by the wax pressing against them. The very nature of the tool used—a sort of fish-hook in shape—cramps and alters the character of the line, at least in the hands of an inexperienced workman. These defects are somewhat modified by practice, but it is contended for glyphography, that any one who can draw can use it successfully, that he can learn the use of the tool, "perhaps in less than half an hour;" that it enables artists to dispense with the engravers, that it "is every way capable and *must* render most faithfully the intention of the artist, whether expressed by him either in fine, broad, or any other sort of execution." To do the best that can be done with glyphography, seems to us to require almost as much peculiar skill as wood engraving itself. We have no doubt that good artists might, if they would devote themselves to glyphography, produce something better than has yet been seen; but it would require sedulous application—a study of all the peculiarities of the material—and an adaptation of their art to it. But the best artists we are sure will never take to glyphography, partly because the result is very uncertain, and the process teazing to execute—partly because it will never sufficiently repay them, and partly because even their best possible work on glyphography would not be so satisfactory as a first-rate engraving on wood, for want of mellowness of tone. As far as glyphography shows itself at present, it will require, like wood-engraving, a special agency for its execution: who then would prefer the glyphographer to the wood-engraver? what saving would there be in cost? and when done, what is the result in art? something decidedly inferior to wood-engraving — something too, farther removed from the artist's original work, for surely a good engraving of the artist's own drawing on wood, would have more strongly marked characteristics than a glyphograph copied from the artist's design, but in which he had no hand at all. If, therefore, glyphography is not destined to have the peculiar merit of dispensing with an engraver, but must require a second hand to cut the waxen ground with a crooked awkward tool, it will not possess the chief feature it lays claim to. We might even be partially satisfied with the result, though not one of great mechanical excellence, to have the designer's own work, with all its characteristics, but these we shall not have if a second person is employed. What, then, are its chances of success? It is beyond dispute, so far as the new plan has shown itself, that the best glyphograph is inferior in many points to a good wood-engraving. The whole tone of the glyphograph is cold and raw—metallic and hard—the lines starved and without mellowness or rotundity—without gradation of strength; for though separate lines may be of varying thickness, it is almost impossible to obtain by the glyphographic tool a *single clear* line having various widths, because the tool being hard, and the copper on which it is worked being hard too, any modification of pressure in its use is resultless. Not so with a lead pencil on wood, by which almost every conceivable kind of execution may be produced, and it is quite a mistake to say, that "so tied and fettered is the wood draftsman, that he is obliged to leave the tints entirely to the engraver's taste and skill." To save labour, wood-draftsmen wash the tints instead of drawing them, but there is no imperative necessity to do so—and in the best wood-drawings the shadows and tints are almost wholly the draftsman's own lines. In fact, the wood draftsman is fettered by nothing; he can make what lines he pleases, and, provided his work *is* expressed in fair honest lines, whatever they may be, the skilful wood engraver can execute them perfectly. If the process become generally used, it will fall into the hands of a second-rate class of artists, who, being incompetent to the highest branches of art, may find it worth their while to bestow attention on the mechanism of this process, and become skilful glyphographers, and we can easily conceive some very tolerable art in a peculiar style suited to glyphography to be the result. We shall be agreeably disappointed, indeed, to witness an effective glyphograph from such artists as Mr. Mulready or Mr. Eastlake. We have no difficulty in conceiving that amateurs who can draw well, and who will master the difficulties, might produce their own designs in glyphography, and, with the help of one of Mr. Cowper's parlour presses, might themselves take impressions; and the whole process would be simpler and easier than obtaining an etching, though inferior to it as a work of art.

## CUVIER'S SYSTEM.

(*Continued from page 148.*)

The ordinary whales are more or less carnivorous in their habits, but some of the largest of them, although of gigantic size, are entirely without teeth, and live on the small worms, mollusca, and zoophytes, which float by myriads in the seas; and this food they separate from the water by a net-work of elastic bone in the upper jaw,—the water being violently expelled, from time to time, by a narrow opening on the top of the head. The herbivorous whales are distinguished by their flat-crowned teeth, indicating their mode of obtaining food, and they are not provided with the blowing apparatus above alluded to.

Of the other vertebrated animals, the birds were defined by Cuvier to be "Oviparous Vertebrata, with double systems of circulation and respiration, organized for flight." In these animals the circulation is much more rapid, and the respiratory organs more complete and active, than in Mammalia; and there are particular contrivances for this purpose, not only in the structure of their lungs, but also in their bones and integuments. Their remains are, however, so very rarely found in a fossil state, that it will not be necessary to dwell on the details of their classification.

Reptiles are cold-blooded animals, by which is meant that only a portion of the blood passes from the heart to the lungs at each respiration. They are oviparous, but do not, like birds, hatch their eggs by sitting upon them. Their brain is small in proportion to the size of the body: their habits for the most part are slothful; their digestion is tedious; their sensations blunt; they are capable of enduring extreme cold and hunger without exhibiting apparent pain; and they can also exist for a long time in a state of torpidity.

Fishes are also cold-blooded and oviparous, and they breathe by gills instead of lungs, and through the medium of water,—to which element alone their organization adapts them. They are inferior in all points of structure to the other vertebrata, and form a link uniting the most highly organized beings with those more simply constructed; from which we are led, by insensible gradations, to the lowest and least complicated. There are some cases in which the fish, possessed as it is with a rudimentary brain and the appearance of a vertebral column, falls short, in completeness of organization, of some of the higher invertebrated Mollusca.

The Invertebrata are conveniently described under four classes. The first class of invertebrated animals, and that which exhibits the most complicated forms of organization, is called Mollusca, and is subdivided into seven orders. Of these the *Cephalopoda* exhibit the nearest approach to vertebrated animals: they usually possess an internal osseous skeleton, but are occasionally provided with an external shell, secreted by a fleshy skin called the mantle.

The *Pteropoda*, the next order of Mollusca, comprises only a few species; but these are incredibly abundant; and the individuals referred to them swim in myriads through the ocean, forming occasionally the food of the largest living animals. The Pteropoda are provided with broad fleshy expansions, or fins, which enable them to move rapidly through the water, and distinguish them from the *Gasteropoda*, to which they are in other respects nearly allied.

The *Gasteropoda* are so called from their peculiar method of locomotion, the animals gliding slowly along by means of contractions of the fleshy skin with which it is covered. This order includes the whole tribe of land and water univalve shells, with the exception only of the Cephalopoda.

The fourth order of Mollusca, the *Conchifera*, also includes a very extensive and well-known group of animals, comprising, with few exceptions, the inhabitants of all bivalve shells. These exceptions are formed into a fifth order, the *Brachiopoda*, which is so named from two long spiral arms placed on either side of the mouth of the animal, and, in some species at least, capable of being unrolled to a considerable length and protruded in search of food. The singular contrivance being accompanied by the existence of a peculiar respiratory apparatus, and other remarkable differences of structure, justifies the establishment of a distinct order.

A group of very singular animals, enveloped in a tough skin, but often so delicate as to be perfectly transparent, forms a sixth order, under the name *Tunicata*, while the last or seventh order, the *Cirrhopoda*, so strangely combines the limbs of the Articulata with the external characters of the Mollusca, that it may also be looked on as intermediate between the two. The Cirrhopoda receive their name from certain hair-like appendages, by whose rapid motion a species of current is formed in the water, attracting in its vortex any light small animals that may be floating about within reach of the mouth, by which they are at once seized and crushed.

The class Articulata includes five orders, sufficiently well known as to require merely the mention of their names. They are the *Crustaceans* (crabs, lobsters, &c.); the *Arachnidans*, or spiders; the *Insecta*, or true insects; the *Myriapoda*, or centipedes; and the *Annelidans*, or worms.

The Radiata of Cuvier have been separated by later naturalists into two groups; of which one, exhibiting the higher types of organization, and having a distinct nervous system, is called Nematoneura, from the thread-like form to which that part of the animal structure has become reduced. It is divided into five orders, of which the first is the *Echinodermata*, and includes a vast number of fossil species.

The animals of this order are for the most part highly typical of that peculiar radiated structure which has given its name to the class and the body usually consists of five similar parts, symmetrically disposed. This curious structure is carried out to a remarkable extent, and may be traced from the globular shell of the sea urchin to the infinitely branching crinoidean, found in a fossil state, and whose organization can have advanced but little beyond that of the most simple polyp.

The remaining orders of Nematoneura are (2) the *Epizoa*, or external parasitic animals; (3) the *Rotifera*, or wheel animalcules; (4) the *Bryozoa*; and (5) the *Cœlelmintha*, or internal parasitic animals which are, for the most part, found preying on the integuments of other animals, and are so minute as usually to require the aid of the microscope in order to observe them.

The second group of Radiata exhibits the lowest and most simple forms of animal life, and has been called Acrita. It includes five orders; but none of the species referred to it show any trace of nervous structure, most of them having scarcely any of those functions which we are in the habit of considering inseparable from vitality. The first order is called *Sterelmintha*, the different species of which live exclusively in the alimentary canal, the liver, the brain, and other parts of more highly organized animals; (2) *Acalephæ*, animals floating in swarms in the ocean, and exhibiting to the common observer the appearance of a lump of jelly, and no traces of that elaborate structure which they really possess; (3) the *Polygastrica*, or infusorial animalcules, of which myriads may be found in every pool of dirty water, and which increase so rapidly, that from a single animal as many as 270,000,000 of new beings may be produced in a month; (4) the *Polyps*, including the coral animalcules, whose labours in secreting and depositing carbonate of lime are permenantly recorded in the history of the world, and which have by their vast numbers, and never ceasing activity, actually formed a large proportion of the solid materials of the earth, and, lastly the *Sponges*, those animals, if indeed they can be called animals, which give no indication of any sensation, which have no voluntary motion, which exhibit no internal receptacle for food, no apparatus for digestion, and in fact, which only differ from the solid rock to which they are affixed by the possession of canals, which communicate with one another, and permeate the whole body, conveying the water which surrounds the mass to all parts of its structure.

This view of the animal kingdom is necessary to elucidate the relations of palæozoology, and its important bearings, and Professor Ansted's treatment of the subject is exceedingly interesting, and affords a favourable example of the system of instruction adopted throughout the work, in which the student is led on, step by step, by a careful explanation of the elements, and by an avoidance of all theoretical points of dubious authority, and unnecessary for the explanation of the point under consideration.

## ANIMAL MECHANICS.

### MECHANISM OF CIRCULATION.

Cells, it is well known, perform a most important part in the animal economy, and are, indeed, the basis of all subsequently organized tissues. From a succession of cells placed end to end, by the obliteration of the partitions between their cavities, and the continuous union of their membraneous sides, vessels take their origin. The vessels, which are of various kinds—some conveying air, others a fluid to be exposed to the action of the atmosphere, and others again the fluids destined for the nourishment of the organization, do not in plants, appear to exert any compressing force on their contents, so as to compel them onwards; they seem, in vegetable structures, to be mere channels for the fluids, destitute of any action on the latter. But in animal bodies the case is different. The vessels here, by their elasticity or superadded powers, contract on their contents, as the blood, &c., forced into them; and the fluids they contain are, probably, in every part of their course, acted upon and changed, more or less, by the vital agencies of their containing structures. Both these effects are exemplified in the arterial system of man and the higher animals. The arteries in the human subject are composed of three distinct coats. The outer is firm and strong, consisting of condensed cellular tissue. The middle coat consists of a yellowish fibrous tissue—the fibres of which are disposed obliquely around the vessel, crossing each other in their course; this coat is thicker than the external, but fragile, and apt to be broken through readily, by force applied to it from either without or within. Its most remarkable feature, however, and that with which we have principally to do in this place, is its elasticity. This enables it both to accommodate itself to the quantity of blood it may be forced to contain, and to aid the heart in propelling the same blood onwards, into the smaller vessels. The inner coat, or lining membrane of the arterial system, is a thin glistening structure, of a nature unlike that of any other throughout the body, but the function of which is of a vital and secreting, and not of a mechanical kind.

The arrangement of the circulating apparatus in the animal frame is well worthy of attention. The arteries start from the heart by one great trunk—the aorta—which gives off, in its course, numerous branches, large and small, and finally subdivides, in the abdomen, into two subordinate trunks, which supply blood to all the lower half of the body. These trunks, as well as most of the arteries, elsewhere, throughout the frame, themselves subdivide into two branches—each of these branches into two more—and so on, until their ultimate ramifications, called *capillaries*, are too small to be perceptible to the unassisted eye. Mr. Erasmus Wilson, in his Human Anatomy, &c., correctly remarks—"In the division of an artery into two branches, the combined areas of the two branches *is greater* than that of the single trunk; so that if the combined areas of all the branches of the capillaries, at the surface of the body, were compared with that of the aorta, it would be seen that the blood, in passing from the aorta into the numerous distributing branches, was flowing through a cone, the apex of which might be represented by the aorta, (or the heart,) and the base by the surface of the entire body." Thus the aggregate containing space at the centre of the capillary system are immeasurably greater than those of the aorta at its emergence from the great centre of the circulation. "The advantage of this," he adds, "in facilitating the circulation is sufficiently obvious; for the increased channel, which is thus provided for the current of the blood, serves to compensate the retarding influence of friction, resulting from the distance of the heart, and the division of the vessels." But this is not all. The arrangement of the arteries, and of the veins too, for these proceed in a contrary direction *towards* the heart, at which point also terminates the apex of the cone they may be represented to form—has a material effect in facilitating the progress of the circulation, on important hydraulic principles. Effectual aid is further derived to the same process from anatomical peculiarities of different parts of the vascular system—as well as from the influence of elevated temperature on the circulating fluids. To these influences we shall presently allude.

We need be only brief respecting the structure of the heart. It comprises four cavities—the right auricle, right ventricle, left auricle, and left ventricle. The veins of the body generally convey the blood that has been already used for its nourishment, and other purposes, into the right auricle—from which it is speedily transferred into the right ventricle. From the right ventricle, a strong muscular chamber, the same blood is sent through what is called the pulmonary artery, into the lungs, to be there exposed to the influence of the atmosphere (in breathing) and refitted for the purposes of life. From the lungs the blood returns, by the pulmonary veins, to the left auricle—whence it is finally sent into the left ventricle; and from this last cavity (a strong muscular sac, like the right ventricle) it is discharged through the aorta, to be distributed all over the frame. The four great orifices of the heart—namely, the opening between the right auricle and ventricle, that from the right ventricle into the pulmonary artery, that between the left auricle and ventricle, and that from the left ventricle into the aorta, are all furnished with complicated valves. When the auricles dilate to receive the blood, the valves between them and the ventricles close so as to make the auricles closed chambers on that side. The chief use of the valves between the ventricles and the great vessels (pulmonary artery and aorta) is to prevent any regurgitation of the contents of these vessels back again into the heart.

The force of the heart, or rather that exerted by the left ventricle, in the propulsion of the blood, has been variously assumed. Borelli extravagantly estimated it as high as 180,000lbs. Keill reduced it to 5½ ounces? It is very difficult to reach absolute truth, on this point; for the living organs are placed under circumstances which preclude our attaining the same accuracy in observations on them as on inert and dead matter. Nevertheless, the truth would seem to lie between the two extremes above indicated; and some approximation has, perhaps, been made to it, by more recent inquirers. Hales, in his statistical inquiries, found that in an upright tube, the cavity of which had an area of an inch square, placed in the aorta of a living horse, at its exit from the heart, the blood at each contraction of the ventricle rose to the height of ten feet. Now a tube an inch square in dimension holds nearly a pound of water in every two feet of its length. Hence there is, says, Arnott, a pressure of nearly 1lb. exerted for every two feet of fluid raised in the tube—on which data 10 feet would give a total pressure of at least 4½lbs on a square inch of surface. But the area of the human aorta, at its origin, is no more than about three quarters of an inch square, the size and force of the heart being in proportion; and circumstances have led to the assumption that, in the human subject, the blood would rise only to 8 feet in a tube such as that before described; thus giving a force to the human heart (left ventricle) of about 4lbs to the square inch. Dr. Arnott, however, calculating that the heart has to overcome the inertiæ of the blood already in the arteries, and the breaking of its force, which results from the yielding nature of the sides of the aorta, estimates the actual force of the ventricle at 6lbs to the square inch. And further estimating that the contents of the ventricle, when distended, have about 10 square inches of surface, he assumes that the heart exercises a total force on its contained blood equal to about 60lbs. Hales and other authorities have estimated it at 50lbs. *Uterque libet.* The choice of opinions is open to all.

But great differences of opinion have prevailed as to whether the heart be the sole agent of the arterial circulation; and well-founded doubts have, we conceive, been urged against the assumption that it is so. We have already alluded to the elasticity of the middle coat of the arteries—a quality which cannot be without its influence in promoting the current of the blood in those vessels. Independently of this elasticity, however, the living arteries are endued with a vital contractile power, as it is proved by various facts. Thus, if a living artery be cut across, it contracts, by its vital power, to a calibre much less than that to which the same artery, either living or dead, would, by its mere elasticity, contract after distension. Again, in an animal bled to death, the arteries of the body at large contract, during life, closely upon the blood which they have to carry, how small soever that quantity may become. It is generally agreed, that the mere elasticity of the arteries is greater the nearer they are to the heart, and consequently, the less that an inherent contractile power is required in them; while, in proportion as the arteries are at a distance from the heart, and the blood is then consequently removed from its influence, so much the greater is their contractile force. According to this arrangement, the capillary vessels ought to be in the highest degree endued with vital contractile force; and that they are so, is believed by the majority of physiologists. We might, *a priori*, have expected that the force exerted by them on their contents would be so much the greater than in the larger vessels, from the calibre of the arteries progressively diminishing more quickly than the thickness of their coats. The minuteness and tenuity of the capillaries prevent our following the middle coat of the arteries into their structure; but there is no circumstance capable of interposing an absolute denial of its existence in them; and, indeed, we are warranted in considering the elastic tissue as continued through them into the venous system, with which they communicate; though the elastic fibres appear, even in the large veins, in very much smaller number than in the coats of the corresponding arteries. It may be necessary that the capillary vessels should have power, whether elastic or vitally contractile, efficient enough to forward the circulation; since the blood, when it arrives at them, has lost nearly if not quite all, the impetus given to it by the heart (and arteries); for while it moves in the aorta, at its emergence from the heart, at a rate of eight inches per second, in the capillaries its rate of motion is no more than one inch in a minute. But the great retardation of motion in the ultimate vessels is of the highest importance in the animal economy, for the important functions of secretion, respiration, and for the most part, absorption, are performed exclusively in the capillary system.

*(To be continued.)*

## COAL-BREAKING MACHINES.

Among the many improvements which have lately taken place in the business operations of this region, there is none more striking than the saving of expense in breaking and screening coal. A few years since every ton of coal which was broken for shipment cost from 30c. to 37½c. to reduce it to proper sizes, while now the expense will not much exceed one-fifth of this amount. This truly surprising result, like many others of a similar kind, is the effect of machinery, and has been brought about by successive experiments and improvements. The attempt to break coal by machinery, we believe, was first made by Mr. Sabbaton, and afterwards by Mr. Larer, but not proving as successful as was anticipated, they were afterwards abandoned. Improvements were then made upon the old system of breaking with the hammer, and instead of breaking in the pile, cast-iron plates, with holes sufficiently large to allow coal of proper size to pass through were used. This was found to diminish the expense considerably, making the cost of breaking about 20c. or 25c. per ton. A further improvement was then made by turning the screens by steam instead of hand, which caused a still further reduction in the expense of preparing the coal for market, the cost being from 12c to 18c per ton. But satisfactory as these results were, and greatly reduced as the expenses have been by these improvements, Mr. Battin, of Philadelphia, has improved upon them, and invented a coal-breaking machine, which will, in all probability, supersede every other invention of the kind, and eventually enrich its ingenious inventor. One of these machines was first erected at Mr. Bast's mines, for the purpose of breaking white ash coal, and found to answer every purpose intended; but, at the same time, fears were expressed that it could not be used to advantage in breaking the red ash. Subsequent events have shown that these fears were groundless, and a machine is now in operation at Milnes and Spencer's mines by which the red ash is broken with no greater loss than on the cast-iron platform. Encouraged by these successful experiments, other machines are now in the course of erection at the collieries of Andrew B. White, and also at the Delaware Coal Co.'s works, the latter of which will, probably, go into operation during the present week, and the former the ensuing week. These machines, to work advantageously, require engines of about 20-horse power, and will break the coal at an expense of from 8c. to 10c. per ton, according to location, including 3c. per ton, which is paid to the patentee. Another machine for the same purpose, but constructed upon an entirely different principle, we learn has been put in operation by the Beaver Meadow Coal Company. This machine consists of a square box, in which are several iron bars placed longitudinally at such distances apart as will make the coal of proper size, while a roller is so situated as to pass over and force the coal through the openings. The invention is favourably spoken of, and will no doubt answer a good purpose in breaking the white ash, although we learn the waste is much greater than that caused by Mr. Battin's machine.—*Miners' Journal (of America).*

## ON PRESERVING INSECTS SELECTED FOR CABINETS.

I ONLY know of two methods to guard prepared insects from the depredations of living ones. The first is, by poisoning the atmosphere; the second is, by poisoning the preserved specimens themselves, so effectually, that they are no longer food for the depredator. But there are some objections to both these modes. A poisoned atmosphere will evaporate in time, if not attended to, or if neglected to be renewed; and there is great difficulty in poisoning some specimens, on account of their delicacy and minuteness. If you keep spirits of turpentine in the boxes which contain your preserved specimens, I am of opinion that those specimens will be safe as long as the odour of turpentine remains in the box; for it is said to be the most pernicious of all scents to insects. But it requires attention to keep up an atmosphere of spirit of turpentine. If it be allowed to evaporate entirely, then there is a clear and undisputed path open to the inroads of the enemy: he will take advantage of your absence or neglect; and when you return to view your treasure you will find it in ruins. Spirits of turpentine, poured into a common glass inkstand in which there is a piece of sponge, and placed in a corner of your box, will create a poisoned atmosphere, and kill every insect there. The poisoning of your specimens by means of corrosive sublimate in alcohol is a most effectual method. As soon as the operation is properly performed, the depredating insect perceives that the prepared specimen is no longer food for it, and will for ever cease to attack it. But, then, every part must have received the poison; otherwise those parts where the poison has not reached will still be exposed to the enemy; and he will pass unhurt over the poisoned parts, till he arrive at that part of your specimen which is still wholesome food for him. Now, the difficulty lies in applying the solution to very minute specimens, without injuring their appearance; and all that can be said is, to recommend unwearied exertion, which is sure to be attended with great skill; and great skill will insure surprising success. I myself have attended to the preservation of insects with the assiduity which Horace recommends to poets:—" Nocturnâ versate manu, versate diurnâ." The result has been astonishing success, and a perfect conviction that there is no absolute and lasting safety for prepared specimens in zoology, from the depredations of insects, except by poisoning every part of them with a solution of corrosive sublimate in alcohol. I put a good large teaspoonful of well pounded corrosive sublimate into a wine bottle full of alcohol. I let it stand over night, and the next morning draw it off into a clean bottle. When I apply it to black substances, and perceive that it leaves little white particles on them, I then make it weaker by adding alcohol. A black feather, dipped into the solution, and then dried, will be a very good test of the state of the solution. If it be too strong, it will leave a whiteness upon the feather.

A preparation of arsenic is frequently used; but it is very dangerous, and sometimes attended with lamentable consequences. I knew a naturalist, by name Howe, in Cayenne, in French Guiana, who had lost sixteen of his teeth. He kept them in a box, and showed them to me. On opening the lid —" These fine teeth," said he, " once belonged to my jaws: they all dropped out by my making use of the *savon arsenetique* for preserving the skins of animals." I take this opportunity of remarking that it is my firm conviction, that the *arsenetical soap* can never be used with any success, if you wish to restore the true form and figure to a skin.

I fear that your correspondent may make use of tight boxes and aromatic atmospheres, and still, in the end, not be completely successful in preserving his specimens from the depredation of insects. The tight box and aromatic atmosphere will certainly do a great deal for him; but they are liable to fail, for this obvious reason, viz, that they do not render, for ever, absolutely baneful and abhorrent to the depredator, that which in itself is nutritious and grateful to him. In an evil hour, through neglect in keeping up a poisoned atmosphere, the specimens collected by your correspondent's industry, and prepared by his art, and which ought to live, as it were, for the admiration of future ages, may fall a prey to an intruding and almost invisible enemy; so that, unless he apply the solution of corrosive sublimate in alcohol, he is never perfectly safe from a surprise. I have tried a decoction of aloes, wormwood, and walnut leaves, thinking they would be of service, on account of their bitterness: the trial completely failed. Wherefore, in conclusion, I venture to recommend the preserver of insects not to put much trust in simples.

" Contra vim mortis, non est medicamen in hortis."
Against the deadly moth, can I,
From herbs, no remedy supply.

It having been stated that the solution I have recommended above, " cannot be applied to the outside of most insects (especially Libellulæ), without, in course of time, injuring their colours," I request attention to the few following observations:—There are two grand distinctions to be made in the colours of insects. Those colours which originate from without, as in the moths and butterflies, remain unimpaired in pristine splendour after death, until they are destroyed by force or by accident. On the other hand, those colours which have their source from within, and proceed from moist substances, gradually fade after the death of the insect; and in some cases, even totally disappear, when the substances from which they drew their origin have become dry and hard. By long experience, I know that the colours of insects which are produced internally, as in the red dragon fly of Guiana, cannot be made permanent by any process after the death of the insect; but those colours can be renewed with great and durable effect. Suppose your correspondent were to take an English dragon fly (which I must inform him I have never dissected), and sever the head from the thorax, the thorax from the abdomen, and then subdivide the abdomen at every third ring: this would enable him to clear away all the moist internal parts, from whence the colours draw their source. A nearly transparent shell would remain; and he would only have to introduce into it colours similar to those which the insect exhibited in life, after having washed it well with the solution. The joining again of the dissected parts would complete the process. All this appears difficult: still it may be effected. I have read somewhere of a Frenchman who could harness a flea: I, myself, have dissected the Cayenne grasshopper, and renewed its colours with great success. In 1808, after dissecting the bill of the toucan, I completely succeeded in renewing the blue, which had been removed by the knife; and I believe the specimen which I produced was the first ever exhibited in its renewed colours since the discovery of America. In the *Wanderings*, is a full account of this.

With regard to using the spirit of turpentine in preserving insects, I can only say, that I have long and successfully made use of the spirit of turpentine. In 1808, having tried many useless experiments to expel living insects from dead ones, and from other preparations in natural history, on opening one day an old magazine (I forget now of what denomination) in a planter's house in Essequibo, I read the following remark:—"Spirit of turpentine is known to be the most fatal poison to insects." Taking it for granted that the spirit was fatal through an atmosphere, as I was sure no insect would drink it voluntarily, and I did not see how it could be forced down their throats, I put some spirit of turpentine into a trunk of preserved skins of birds, and into which the moth had found its way. The next morning, I saw that the spirit of turpentine had killed all the moths. In the course of time, the use of the corrosive sublimate in alcohol succeeded to this, and rendered the spirit of turpentine wholly unnecessary, wherever the sublimate could be applied to every part of the preserved specimen. But as on some occasions I only washed the inside of the skins, and, in this case, the feathers themselves, not having received the poison, were still liable to injury from insects, especially in tropical climates, I always took the precaution to have spirit of turpentine in the box. In order to make myself clearly understood, I will describe exactly what I did. I bought common hair trunks which are sent out with goods from Europe to South America; I strewed the bottom of the trunks with cotton, upon which I placed the preserved bird-skins, and the different insects which I had collected. Both birds and insects were placed promiscuously in the same trunk. I then saturated a piece of sponge with spirit of turpentine, and hung it up in a corner of the trunk; I renewed this spirit from time to time. From that period to this, no living insect has been detected in the trunks. The plumage of the birds is as vivid as it was at the time I shot them; and the moths and butterflies as splendid as when in life; but most of the other insects, except some of the beetles, have faded. Thus I am enabled to say, by actual experiment, that the atmosphere of spirit of turpentine will allow neither acarus nor any insect to live in it; and, moreover, that it does not injure the colour of preserved birds, and furs, and insects, provided they do not come in contact with the spirit of turpentine.

I have used corrosive sublimate in paste for years; I have applied the solution to my hat, and to the long Indian arrows (which are very subject to be eaten by the worm), with complete success; and here, in Europe, with equal success, I have applied it to ladies' ostrich feathers, to camel-hair brushes, and to the lining of my carriage. The solution has been the remote cause of my discovering an entirely new method of preserving specimens in natural history; and which method at once shows upon what erroneous principles the old method has been, and is still conducted. To conclude, the solution has proved my best support; without it, I could have done nothing.—*Waterton's Essays.*

## THE HYSSOP OF THE SCRIPTURES.

At the last meeting of the Royal Asiatic Society, a paper was read by Professor Royle, on the identification of the Hyssop of the Scriptures with the Caper plant. The Professor said that he had on this, as on former occasions, been led to the identification by finding in lists of drugs in Arabian medical writings, a name similar to that of hyssop in Hebrew. He then read some passages of Scripture where the hyssop is mentioned; from which it follows that the plant must have grown in Lower Egypt, and about Mount Sinai before and during the Exodus, and afterwards, about Jerusalem; that it must grow on walls or rocks; and that it must get to a sufficient size to yield a rod or stick; that it must have formed a bunch to be used in sprinkling; and that it must have cleansing properties; and also that it should have a vernacular appellation similar to its Hebrew name. Many plants had been brought forward, but none of them possessed all the requisites. They either did not grow on walls, or they did not form a stick, or they had no cleansing properties; and none of them had a name like the Hebrew *ezob* or *ezov*. Dr. Royle had seen in Rhazes that a species of hyssop grew near Jerusalem; and Burckhardt describes a plant which he saw in the neighbourhood of Mount Sinai called *aszef*. The name and description caused him to infer that this must be the caper plant, one of whose names is *asuf*. He then proceeded to show that the plant possesses all the qualities required for its identification with the hyssop: its name is similar; it grows upon rocks and walls; it is mentioned as becoming a shrub of a hardy and woody substance, when growing in a congenial climate; ancient authors speak of its detergent qualities; and it is still retained as an aperient root in some of the continental pharmacopœias. From all these characteristics the Professor concluded that the caper plant was the Hyssop of the Bible.

## ON THE ADULTERATION OF COFFEE, AND THE MODE OF DETECTING THE FRAUD.

Roasted and ground Coffee is extensively adulterated by the grinders and retailers of this substance; and the public, we suspect, is scarcely aware of the great extent to which the practice is carried. We propose, therefore, in the present article, to point out the substances used for this purpose, and the mode of detecting them.

The principal adulterating ingredient is *chicory*. This is the dried, roasted, and ground root of a syngenesious plant, called by botanists *Cichorium Intybus*; better known, probably, to most of our readers by its English appellation of *wild succory*.

Two kinds of chicory are sold by dealers, the foreign and the British. *Foreign Chicory* is the produce of Prussia, Belgium, and France, but is roasted and ground in this country. It is the most esteemed. *British Chicory* is the growth of this country, but the roots produced in England are more woody and less fleshy than those which are imported. They yield, when roasted and ground, a chicory powder, which has a paler colour than the foreign, and a more speckled appearance. Hence British chicory is of inferior value, and is usually coloured with *Venetian Red*. (Venetian red is the sesquioxide of iron, obtained by calcining copperas, adulterated to suit the various prices of the market.)

But while the grocers, on the one hand, cheat their customers by adulterating coffee with chicory, the chicory-dealers in turn cheat the grocers by adulterating chicory. The substances employed in effecting the latter fraud are principally *Hambro' powder* and *coffee-flights*.

*Hambro' powder* consists of roasted and ground peas, &c., coloured with Venetian red. The term *coffee-flights* is applied to the thin membranous coat (endocarp) which separates from the coffee-seed in the act of roasting.

Having now explained the nature of the substances employed in adulterating coffee, we proceed to point out a ready mode of detecting *chicorized coffee* from *genuine coffee*; premising, that by "chicorized coffee" we mean not only coffee which has been adulterated with genuine chicory (foreign or British), but also that which is mixed with *spurious chicory*, viz., Hambro' powder.

If a little *genuine ground coffee* be thrown on a wine-glassful of cold water, it for the most part floats, becomes very slowly moistened, even when shaken up with the water, and communicates scarcely any color to to the liquid. Very gradually it imbibes water, the liquid acquires a very pale sherry tint, and at the end of several hours the greater part of the powder is found to have fallen to the bottom of the glass.

If *powdered chicory* be treated in the same way, the phenomena are very different. It very speedily absorbs moisture, communicates a deep reddish-brown tint to the water, and in a few minutes falls to the bottom of the liquid, *Foreign chicory* yields a strong, dark, blood-red tint to the water. *British chicory, coloured with Venetian red*, gives a less deep, but rather more brown colour. *Hambro' powder* communicates a somewhat weaker colour than the last, but the tint is of the same kind. Owing to the presence of torrefied starch in Hambro' powder, the water to which the latter has been added, acquires a deep *purplish* colour on the addition of a solution of iodine; whereas the water to which either coffee or chicory (British or foreign) has been added, merely acquires a deeper reddish-brown tint, when a solution of iodine is mixed with it.

These differences in the action of water on coffee and chicory furnish us with a means of detecting chicory in ground coffee. Throw about a tea-spoonful of the suspected coffee on a wine-glassful of water, and stir the mixture with a spoon. If the coffee be pure, the phenomena will be as above described for genuine ground coffee. If, however, it be *chicorized*, the presence of chicory (genuine or spurious) will be readily detected by a portion of the suspected powder rapidly sinking, and communicating to the liquid a reddish-brown tint, which will be more or less deep according to the amount of chicory present. If the coffee be adulterated with Hambro' powder or roasted corn, we have a farther test in iodine, which communicates a purplish or bluish-red tint to the water to which either of these substances has been added.

The preceding test is sufficiently delicate and valuable, in all ordinary cases, for detecting chicory in coffee; but to those familiar with microscopic investigations, the microscope furnishes another mode of proceeding, fragments of dotted ducts being found in chicory, but not in pure coffee. They are not met with, however, in great abundance; and some patience and care, therefore, are requisite in searching for them. The starch grains of Hambro' powder are readily detected by the microscope, as also the blackening effect of a solution of iodine on them.

There is another substance which is sold for mixing with coffee, under the name of *refining powder*. It is a dark rusty-brown powder, intermixed with glistening scales. Its odour is that of caramel or burnt sugar, its taste is bitterish. Heated on the point of a knife over a candle or lamp, it fuses, swells up, evolves an inflammable gas, and leaves a coal which by incineration yields a whitish ash. Thrown on water it almost immediately sinks, and communicates a dark red colour to the liquid; and by these characters it may be detected in coffee. It appears to owe its most remarkable qualities to partially charred saccharine matter. A decoction of it when cold is unaffected by iodine, showing the absence of starch, It is bought by the keepers of coffee-shops principally. Half a teaspoonful is sufficient for a quart of coffee. By means of it the beverage is said to be of equal strength with a much less consumption of coffee It is sold in tin boxes, on which the name and address of the manufacturer are stamped,—*Pharmaceutical Journal.*

## REFUGE HARBOURS.

The second Admiralty Commission appointed to inquire into the subject of Harbours of Refuge on the south-eastern coast, met at Worthington's Ship hotel, Dover, and commenced operations. Our readers are aware that her Majesty's steamer 'Blazer,' Capt. Washington, has for some weeks back been engaged on the same service on this coast, taking soundings, &c., preliminary to the personal survey of the Commissioners, On Tuesday morning the Commission (which consists of the following members—Admiral Sir Byam Martin, Lieut.-General Sir Howard Douglas, Rear Admiral Deans Dundas, Captain Symonds, Captain John Washington, Lieut. Colonel Colquhoun, Lieut. Colonel Alderson, Sir John Pelly, Captain Fisher, and James Walker, Esq., President of the Society of Civil Engineers), embarked on board the 'Blazer', and proceeded to Ramsgate and Foreness, to procure ocular proof of the nature of the coast, On Wednesday they visited Dungeness, and surveyed the coast there. On Thursday a number of witnesses were examined at Dover, touching the capabilities of the different points of the coast for Refuge Harbours; and yesterday morning they preceeded in the 'Blazer' towards Brighton, on a similar mission.

Since the report of the first Commission on this subject in 1840, we have been more than sanguine that Dover would be the first port selected as a site for a Harbour of Refuge; and, from all that we can learn, its chance of being so has increased by subsequent inquiry. Nor is this to be wondered at—for, looking at Dover Bay, as we have often before stated, it seems as if nature has destined it as a haven of shelter for ships in distress; and, when we take into account the extent and commanding position of its fortifications, we find a place of shelter from an enemy, already formed. Under all the circumstances of the case, therefore, we cannot but conclude that the recommendations of the present Commission, constituted, as it is, of men of science and profound nautical skill, must be similar to that of their predecessors,—namely, that Dover is the A 1 as a site for the first refuge port, whichever may be the second.—*Dover Chronicle.*

## PURIFYING METALS.

JOSEPH DUKINSE SIAGG, of Middleton, in Teesdale, Durham, Manager of Smelting Works, has just patented "A new and improved plan of collecting, condensing and purifying the fumes of lead, copper, and other ores, and metals, and also the particles of such ores, and metals arising or produced from the roasting or manufacture thereof, and also the noxious smoke, gases, salts and acids, soluble and absorbable in water, generated in treating and working such ores and metals."

This invention consists in causing the fumes of lead, copper, and other ores, and also the particles of such ores, &c., to pass through water contained in an air-tight vessel, which vessel above the surface of the water is divested of air and kept constantly exhausted by means of an air-pump or other mechanical contrivance. For this purpose the inventor causes the fumes and vapours to pass through a flue or chimney, to which is attached a pipe bent down at the end at right angles, and made to dip a few inches below the surface of the water contained in the cistern, which may be of any required depth. This cistern, which may be constructed of wood sufficiently strong to withstand the atmospheric pressure, is divided by means of partitions into compartments, each alternate partition commencing at the top of the cistern and descending to within a few inches of the bottom, the intermediate ones commencing at the bottom of the cistern and ascending near to the top. The pipe through which the fumes or vapours pass from the chimney, enters the cistern at one end, and at the opposite end there is a pipe leading to an exhausting apparatus, which consists of a double acting air pump worked by a small steam engine.

The action of this apparatus is as follows:: motion being imparted to the air pump, the cistern will be exhausted of air and will have the effect of creating a draft in the chimney sufficient for clearing the manufactory of the fumes generated, which fumes or vapours are caused to pass over and under the several partitions, and through the water contained in the cistern, which water will be greatly agitated, and have the effect of purifying, and condensing or detaining such portions of other vapours as are soluble and absorbable in water. Such portions as are not absorbable, passing off through the air pump into the atmosphere in a comparatively pure state, those portions left in the cistern can afterwards be resmelted, and whatever valuable salts or acids are held in solution in the water can be separated by the process of distillation.

## VARIETIES.

*Unusual Abundance of Amber.*—A remarkable phenomenon, which has been observed during the present year, on the shores of the Baltic, has proved a source of great profit to the inhabitants. The amber gathering has been more productive than it is remembered ever to have been. In the village of Kahlbeerg alone, where the amber gathering is farmed, a quantity of amber, amounting in value to 20,000 thalers, has been obtained within the last few weeks. Probably the violent storms that have prevailed this winter, especially during the month of December, have brought this treasure up from the bottom of the sea.—*German Paper.*

*Liquid Blue.*—Put into a small matrass or common phial an ounce of Prussian blue reduced to powder, and pour over it from one ounce and a half to two ounces of concentrated muriatic acid. The mixture produces an effervescence, and the prussiate soon assumes the consistence of thin paste. Leave it in this state for twenty-four hours; then dilute it with eight or nine ounces of water, and preserve the colour thus diluted in a bottle well stopped. The intensity of this colour may be lessened, if necessary, by new doses of water. If the whole of this mixture be poured into a quart of water, it will still exhibit a colour sufficiently dark for washing prints.

*Mode of Floating Large Stones for Building Sea-Walls in Deep Water.*—At the meeting of the Institution of Civil Engineers of the 12th March, Mr. Bremner read a paper describing the casks used for floating the large stones for securing the foot of the sea-walls of Banff harbour, which had failed. The casks were strongly built of fir-staves, hooped externally with iron, and supported inside by radiating bars like the spokes of a wheel. Two of these casks, of 445 cubic feet capacity each, were used to convey stones of 30 tons weight, by passing two chain cables, which were wound round them, through the eyes of the lewises, which were fixed in the stone at low-water, at which time the chains being hauled down tight, when the tide flowed, the buoyancy of the casks floated the stones, and they were towed by a boat over the place where the stone was intended to be deposited. The lashing being then cut away, the stone fell into its seat. This method was found to succeed in weather that would have destroyed any crane-barges; and the works of Banff harbour were thus secured from further degradation, and were subsequently restored at a comparatively small cost.

*Electricity connected with Thermography.*—It has been suggested that electricity may be engaged in the production of these spectral figures. I have just tried an experiment which appears to show the probability of this element being involved in some way in these very complicated phenomena. I arranged four electro-positive metals, nickel, bismuth, cadmium, and silver, and two electro-negative ones, arsenic and antimony, on a copper plate, and they were allowed to rest upon it for three hours. Being removed, the plate was submitted to the vapour of mercury. The space covered by the nickel was marked by being left free of vapour; that on which the cadmium lay was still more decidedly marked in this way; where the bismuth was placed the image was exceedingly faint, but still it was observable by a deficiency of vapour; and the silver was more decidedly outlined with vapour, but none on the spot it covered. On the contrary, the space occupied by the antimony *was covered in a most remarkable manner with vapour, presenting a perfect white spot*, which, in all positions, distinguished it from the other parts of the plate, whilst the arsenic left no trace behind.—*Hunt.*

PROPOSED CASINO ON PRIMROSE HILL.

## RECREATION FOR THE PEOPLE.

Casinos, although hitherto unknown in England, are common enough on the continent, and are found to be exceedingly agreeable adjuncts to parks and other places of public resort; and it is greatly to be desired that they were introduced into this country, where so many improvements conducive to the health, comfort, and pleasure of the people at large have of late years been effected. Some efforts have recently been made to call the attention of her Majesty's Commissioners of Woods and Forests to this subject, in reference, in the first instance, to the metropolitan parks under their control. But whatever may be done by those functionaries, they will not fail of finding numerous followers among those who have the management of public places all over the kingdom; so that these efforts deserve the thanks of every one who feels an interest in the highly important subject of public health. Foremost among those who have thus earned the gratitude of the public is Mr. Curtis, the well-known aurist and oculist of London, who for many years has indefatigably laboured to arouse the attention of the community to the too-much-neglected subject of public health, and who, in his various works, omits no opportunity to impress upon his readers the vital truth, that by far the greater part of the ill health, including affections of the nerves, of hearing, and sight, which prevails is attributable to the neglect of the sanatory conditions on which health depends, and among others, of an abundant supply of fresh air. In his zeal for this public blessing, Mr. Curtis some time ago submitted to the Commissioners of Woods and Forests a plan for a cassino in one of the metropolitan parks; and he has kindly permitted us to present a representation of it to our readers. We are certain that the adoption of such a place in every public park in the three kingdoms would be a great boon, and add very much to the usefulness of those places of resort. In what way this would be effected, we cannot better show than the following passage from Mr. Curtis's recent work on 'Aural Surgery.'

"The vast extent of London rendering it almost impossible to escape from its interminable streets into any open space, is another circumstance highly injurious to the healthiness of its inhabitants, the majority of whom are engaged in sedentary occupations; to counteract the ill effects of which, they ought habitually to take considerable exercise in the open air. But what inducement is there for the tradesman to wander up and down streets, the facsimiles of those in which he has all day been toiling? And yet to escape from them he must walk perhaps several miles. There has for some years been a growing sense of the necessity for providing a remedy for this evil, and at length something is on the point of being done to procure open places for public resort and amusement. Were the gardens of all squares opened to the public, even for a short time daily, an important step would be taken towards this object; and if casinos were erected in all the parks, where visitors could be furnished with breakfast or tea in the open air, in fine weather, the novelty of the thing would attract many, and thus induce some to leave their beds an hour or two be- [illegible]sual time, and inhale the fresh morning [illegible] it is impregnated with smoke."

[illegible]ely do we hope that the advantages to be [illegible] from the erection of casinos will not be overlooked. The views of Mr. Curtis are about being carried out, we understand, by Mr. Richard Vaughan Yates, in a really spirited and excellent undertaking.

On the other side of the water, the Commissioners of Birkenhead, in laying out their park, have agreed to the views of their landscape gardener, Mr. Paxton, who is fully sensible of the advantages which the public will derive from the introduction of places so conducive to health and comfort: a short time will see them in full activity in this district. We may as well complete what we have to say about the parks by noticing another proposal made by Mr. Curtis to the Commissioners, to erect a kiosk in Kensington gardens for the use of the military bands which, during the summer months, play there at stated times. The advantages of this would be that the men would be sheltered from sun and rain, they would be better heard and seen, and the building itself might be made an ornament to the grounds in which it was placed. This plan also we consider well worthy of adoption everywhere, and cannot help saying we think the public might enjoy the gratification of hearing a military band much oftener than they do at present wherever a regiment is stationed.

With the following extract from the work already quoted we take our leave of this subject for the present.

"When in Belgium last summer during the Queen's visit, I was much pleased with a concert in the open air, in the park at Brussels, given by the Harmonic Society, and will briefly describe the arrangements, which seem to me to be well worthy of imitation here. The performers were stationed in an elegant building called a kiosk, resembling a temple or pavilion, which shelters the musicians, and yet presents no obstruction to the sound. This kiosk is frequently occupied by a military band, which performs for the amusement of the visitors to the park, and is no doubt a powerful attraction. Now, were kiosks erected in the three parks of London, and the bands of the regiments stationed in the metropolis directed to perform in them at stated times during fine weather, far greater numbers of persons would resort to the parks, which would thus become more extensively useful and health promoting."

## TERRESTRIAL ELECTRICITY.

BY JOHN JOSEPH LAKE.

*The diffusion of the electric fluid, an origin of Electric Currents.*

The particles of electric fluid repel and force each other from the interior of any body on which they are collected to the surface. Hence it is that the conductor of an electric machine when charged has fluid only on the outside. It does not even penetrate to the inside of a cylinder of wire gauze. Therefore, when a sphere is charged, the fluid remains only on the exterior, whilst the interior is in a negative state.

Hence the electric fluid must be forced from the internal parts to the surface of our globe, which cannot be saturated with it, as some have supposed, and there must be a point or centre in the earth where all electric effects are neutralised; for, being equidistant from every particle, each acts with equal force upon it. It must, therefore, be the point of the greatest negation or absence of fluid.

Circumstances will occur to make the fluid follow another route than the surface when moving from one place to another. For instance, it may meet with a stratum of better conducting power than the surface, when (according to an ascertained law that the fluid always follows the best conductor, without regard to the distance it may in consequence have to travel) it will pass along the well-conducting stratum until the latter comes again to the surface, or the fluid meets with another similar stratum that does so. In summer this often happens, for the surface becomes so dry as in a great measure, if not altogether, to destroy its power as a conductor.

It is found that if there are any elevations on the surface of an electrified body, the fluid is present there in the greatest intensity, and predisposed to pass off thence to surrounding bodies, in which it previously induces a negative state. The cause of this intensity of the electric fluid at elevations is the same repulsion of the particles that forces them to the surface.

It follows, therefore, that the electric fluid on the surface of the earth is in greater density in mountainous and elevated parts than in low lands and the surface of the sea.

The electric fluid is in a constant state of movement from various disturbing causes. These are often very simple, owing to its volatile nature and great desire to effect an equilibrium of its effects over the entire surface of the globe. A cloud that is charged will induce a negative state in all the parts over which it passes, and its effects may often extend to a great distance; if it passes, for instance, over the end of a stratum, which is the best electric communication between the surface of the earth at its extremities. Evaporation also produces much disturbance of the equilibrium of the fluid by inducing a negative state in the parts from which the vapour ascended; for each particle of vapour before it ascends is in the same electric state as the part from which it rose, and carries up with it a portion of fluid over its whole surface, which is more than it had when in the state of water. The extent of evaporation may be observed by the great supply of water which constantly flows into the Mediterranean from the Black Sea and numerous large rivers; and, in addition, a steady current always sets into it from the Atlantic. The quantity of electricity which ascends with this evaporation must be great, and very materially affect the mass of it on the surface of the earth.

In consequence of water, when it ascends from the earth in the state of vapour, carrying with it more electric fluid than it possessed before the alteration in its condition, a want or beginning of a negative state is induced in the part whence it arose, which destroys the electric equilibrium over the surface of the earth. The fluid, consequently, flows, from other parts towards that from which the vapour ascended, to supply the deficiency occasioned by the loss of the portion the latter carried up more than its share when forming a part of the moisture of the earth.

The greatest evaporation is where there is the greatest heat, that is, where the sun is vertical or between the tropics.

The electric state of the atmosphere during the day was observed so far back as 1753, by the Abbé Mazeas. He found that the electricity of the air was sensibly felt every day from sunrise until seven or eight o'clock in the evening, when the weather was dry; but that in the driest night of that summer he could discover no sign of it, nor till the morning when the sun began to appear above the horizon, and that it vanished again in the evening about half an hour after sunset; and, further, that the strongest common electricity of the atmosphere during the summer was perceived in the month of July, on a very fine day, the heavens being very clear, and the sun extremely hot, that is, at a time when the greatest evaporation prevailed.

Hence there is a constant current of electric fluid following the sun, and flowing to the spot over which he is vertical.

The rapidity of the motion of electric currents is regulated by that of the earth on its axis; for as each spot comes successively under the action of the sun, it becomes in turn, to a greater or less degree, negative; and the instant this state commences, the fluid flows toward the part to restore the equilibrium. Hence, as the motion of the earth on its axis at the equator is 15°, or 1,04½ English miles, an hour, the current of fluid must move at the same rate, to supply the deficiency and restore the equilibrium. Otherwise a spot which has become negatively electrified will remain so for some time after having moved from under the disturbing cause; and if this period is only a few seconds, it is contrary to experience; for the velocity of the motion of the electric fluid, to produce an equilibrium or general diffusion of itself, is such that no one has yet been able to measure it.

*Earthquakes; with some observations on volcanic Fires, and the origin of hot springs.*

Many things have been considered to produce earthquakes; as volcanoes, steam, falling in of caverns, explosion of gases, and the like. Of all these, the most general, if not the only, agents are volcanoes; to which may be added electricity. The former is commonly the cause only when in a state of eruption or internal disturbance. The latter is the more general origin of these catastrophes; and it is intended in this paper to explain its action in producing them.

Of an earthquake which occurred at Tacna, in Peru, on the 16th of September, 1833, it is recorded, that suddenly in the evening there occurred a single loud report with an upward movement of the ground.* On the morning of the 18th there was a much more violent movement, the earth heaving at once up and down, and also laterally, accompanied by a frightful subterranean noise. The agitation seemed to have reached the greatest height, when suddenly the earth, as if striving to get rid of some mighty load, made a more terrible movement than ever in every direction. At Achizumio the noise was as if an immense mass of porcelain had, after being raised in the air, been let fall and dashed to pieces. An earthquake occurred in New Grenada, on the 21st of September, 1834, in which the movements of the earth were entirely vertical; and also one in Chili, on the 5th of February, 1835, during which the sea retired several times to a great distance, and returned in great billows.

In these cases we may observe the following effects of an electric discharge:—First, the upheaving and vertical motion of the ground; Second, the loud reports.

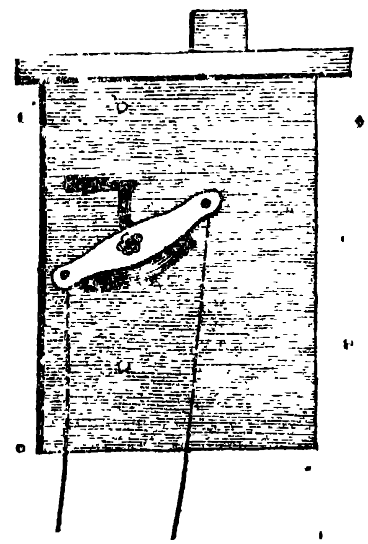
Among many similar cases, that of Calabria, in 1638, strongly supports the above explanation. Cercher, who was on the coast with his vessel and an eye-witness, says, that it seemed first to affect the sea, which became unusually agitated. The gulf of Charybdis appeared to be whirled round in such a manner as to form a vast hollow, verging to a point in the centre. Mount Etna cast forth volumes of smoke of mountainous size; a dreadful noise was heard, a sulphurous stench was perceived, and men were filled with apprehension that some dreadful calamity was impending. Though the weather was calm and serene, not a breeze stirring nor a cloud appearing, sounds like an infinite number of chariots fiercely driving, with the cracking of whips, were heard, and a dreadful earthquake ensued. The ground vibrated as if it had been in the scale of a balance that continued waving, so that people were thrown prostrate on the ground. This is a very singular instance of electric discharge in the earth through an alternating series of good and bad or non-conducting media, acting on the principle of a series of spots of tinfoil pasted on a sheet of glass without touching each other. It was this kind of discharge that produced the sound as of chariots fiercely driving and the cracking of whips, by causing, as it were, a succession of discharges and the vibratory motion. The fluid that occasioned this earthquake appears to have been generated in, or, at least, to have passed through, Etna, and thence into Italy; for it first affected that mountain, then the sea and Charybdis, and then Calabria.

The presence of electricity in the Jamaica earthquakes of 1692 was proved by the appearance of the sky, which assumed a dull red colour, like a glowing oven. But the most remarkable evidence of its presence was the phenomena attending the shocks that continued for two months after the great catastrophe. They were noises as of rustling wind and rumbling thunder. The former arose from the passage of the fluid by points or edges through some imperfectly conducting substances, perhaps through powdered brimstone, blasts of which attended the shocks. When the smaller shocks and discharges had effected changes that made the obstructions to the passage of the fluid greater, a stronger discharge took place, with the sound as of hollow rumbling thunder.

A difficulty occurs with many cases of earthquake arising from electricity, in the appearance of red-hot stones, ashes, and other volcanic substances, which frequently attend them. But these arise from the electric discharges disturbing ignited portions of strata as it disturbed Etna in 1638. And it cannot be supposed that electric action ceases at the depths to which volcanic fires extend; for we can scarcely conclude that they reach to any great depth compared with the diameter of the earth. It is vast in comparison with our common notions of vastness, but nothing when viewed with the magnitude of the globe. It has been thought that as the height of the highest mountains does not exceed six miles, so the greatest depths of the sea are not more. Suppose volcanic fires extend twice that depth, it is nothing to the diameter of the earth. But there is no proof that they extend to the presumed greatest depths of the sea—six miles. Electric effects have, however, been made visible at greater depths than volcanic, of which a remarkable case occurred during the earthquakes of 1755.

It has been assumed that the interior of the earth is composed of a fiery mass. Of this, however, there is no proof. But we know that there are materials in the earth predisposed to combustion, and when circumstances occur to generate it, it takes place; and thus the elements of volcanoes are in the bowels of the earth, but they cannot burn until they come in contact with the oxygen of the air; for we have no knowledge of any means by which the supposed internal fire of the earth is supplied with air. Hence we may infer that volcanic fires do not burn in the central parts of the earth, or even under all the ground between the various volcanoes of the earth, but only in the neighbourhood of their craters, where the combustible materials and gases produced therefrom come in contact with the atmosphere.

But whence are the hot springs of Germany, England, and other places? Do they not result from subterranean fire? The reply is very simple; for water poured upon unslacked lime produces such intense heat that it is commonly used in Paris in the *cafes* and *restaurants* to dress refreshments, on account of the scarcity and high price of fuel, and is found to answer the purpose perfectly. Many other chemical mixtures generate heat; and it is much more probable that something of this kind produces it in these springs than that it arises from subterranean fire.



## THE REVERTOR, OR DOOR GUARD.

A very ingenious instrument, named the Revertor, has just been introduced by Messrs. Burbidge and Healey, Fleet Street, for the purpose of preventing intrusion into a sleeping room. It is fixed with great ease and rapidity upon the handle of a chamber door key, and enables persons to lock and unlock the door from their bed, in whatever part of the room this may be situated. It thus performs all the functions of a drop bolt, at less than half the expense; while it may be instantaneous applied, or removed (when required) to various rooms without trouble or charge, which is not the case with a drop bolt. It is also so small and light as to be transmissible by post. Invilids, and all persons who require the services of an attendant in their bedrooms, will find the Revertor a valuable addition to their comfort.

## ANIMAL MECHANICS.

### MECHANISM OF CIRCULATION.

(*Continued from page 156.*)

The agencies which return the blood through the veins back again to the heart, have afforded a subject for keen controversy among physiologists.

The weight of the high authorities which are ranged on both sides of this question, does not admit of our pronouncing *ex cathedra* on this matter; but we shall endeavour to explain the process almost wholly on hydraulic principles. We have seen that the force of the heart and arteries is nearly if not quite expended by the time that the blood reaches the capillaries or ultimate ramifications of the arterial vessels; and that the veins are almost destitute of the elastic (and contractile?) fibres* which are so abundant in the arterial trunks. So small, indeed, is the actual force present in the veins, that Hales found that, while the blood rose to a height of ten feet in a tube placed in the aorta of a horse, at its *exit from* the heart, it rose to no more than six inches in a tube of the same calibre placed in the great vein—the vena cava—at its *entrance into* the heart. The blood returning from the head and upper parts of the body, might certainly descend by the force of gravity alone; but it is obvious that the blood returning from the lower parts of the body must ascend *contrary to gravity*. But it is a law in hydraulics, that a fluid let downwards has always a tendency to re-ascend to the level of the reservoir from which it has its source. We should naturally expect, therefore, that the blood sent downwards from the heart by the arteries would be enabled to return to the heart in other proper channels by the agency of this law alone, even without the exertion of any force by the heart in addition to the force of gravity. But other circumstances come in aid of this effect. It has been seen that the arteries divide and subdivide, so as to present the greatest *total capacity* of the arterial system at the greatest distance from the heart, and contrarywise, the veins unite and re-unite in a corresponding manner, so as also to insure the least total capacity of the venous system at the point at which this system joins the heart. If, then, velocity, is lost in the arteries by the fluid they contain being poured into branches which have collectively a greater capacity than the trunks from which they arise, velocity must be gained, in a corresponding degree, by the contents of the veins being impelled into trunks having a less area than the branches which combine to form them, and accordingly the fact is found to be, that the nearer the heart, the greater is the force and rapidity of the current in the veins. Add to this, that the blood in the veins is perpetually forced onwards by a pressure from behind, which is re-inforced at every stroke and contraction of the heart and arteries. We need not dwell upon the assumed effect of a vital contractility in the capillaries, nor on the agency of atmospheric pressure in urging on the blood through the venous system; neither can space be afforded to canvass the averred action of the right auricle after the fashion of a pump: but some other provisions must not be so passed over

In proportion as the arteries recede from the centre of the circulation, the narrower in general is the angle at which their subdivisions diverge from each other, and in proportion also as the veins are distant from the heart, the more acute is the angle they form by their union. In both cases force is economised, and, as respects the veins, by this arrangement the important hydraulic principle is taken advantage of, whereby a flowing current assists in emptying a lateral stream which joins it, by the mere impetus of its flow. Certain anatomical differences between the arteries and veins doubtless adapt the latter for their peculiar function. The arteries are generally deep-seated, being placed as far as possible out of the reach of external injury, while a large proportion of the veins run near the surface of the body (where they are supposed to be influenced by atmospheric pressure,) or are interposed between muscles, the play of which facilitates the impulsion of the venous current. The veins of the extremities are furnished, in order to check any regurgitation, with an abundance of valves, which are wholly denied to the deep veins of the interior of the trunk and to the arteries. In addition to all these circumstances, the veins (except the superficial) are almost universally placed beside arteries, the dilations of which, owing to the jets of blood forced into them, must exert successive pressure on the veins. The blood in the veins is precluded from retrograding by the valves; but it is invited to ascend towards the heart, because there no such pressure is exerted on the main venous trunk by the main artery.

Some circumstances of arrangement in the circulating apparatus, call for particular notice and admiration. The heart, not only in man but in other animals, particularly such as occasionally walk erect, is situated considerably above the middle of the body, so that it has a much less distance to propel the blood against the force of gravity than it has in the same direction in which the gravitating power acts Again, little, if any, force is lost where it it so much required, namely, where the blood has to be sent upwards to the head, &c., against gravity. The aorta, at its commencement, has the form of an arch, from the ascending portion and summit of which the carotid arteries have their origin; so that the blood sent upwards from the heart (on the right side especially) at first deviates but little from a straight direction. The circumstance too of the aorta being arched instead of bending downwards abruptly, secures the greatest available force for the downward current also; for it is a well-known axiom in hydraulics, that water flowing in a tube will be retarded by any sudden angle in the tube, and, conversely, that a curved tube will dischage a fluid with considerably more force than another tube bent to the same extent, but in an angulated manner. In accordance with this, care has been manifested throughout the frame that arterial branches should not go off abruptly from trunks, so as to involve a loss of power, and the farther the arterial branches are from the heart, the smaller are the angles at which they leave their arterial trunks. In certain instances, for special purposes, this provision has been departed from, and certain arteries are given off from a short trunk in different directions, somewhat like the sails of a windmill. But these *axes*, as they are called, arise only from lateral or descending arterial trunks, where power can be spared, and never from ascending trunks, where power has to be economised; they are also at no great distance from the centre of the circulation

There is a law of hydraulics, by reason of which a stream flowing from a cistern through an orifice is contracted to 5·8ths of its original bulk, at a distance from the orifice equal to half the diameter of the latter. This law has been beautifully taken advantage of in the construction of the aorta. This vessel, at its origin, is dilated into a triple pouch, for certain physiological purposes, on which we shall not enter. But immediately beyond this, the artery is contracted, and its contraction happens at the precise point at which the current of the blood as poured from the heart is at its smallest diameter: the purpose is obviously that no power might be lost by the cavity being larger than the stream it receives, thereby risking a loss of due elastic resistance. Want of space prevents our entering more fully on these and some other points, such as the mode in which the influence of friction is lessened, &c. But the arrangement of the vessels by which blood is supplied to the brain, imperatively demands a few words. The overwhelming importance of this great nervous centre requires that it should have a copious supply of the circulating fluid: while the great delicacy of its structure imposes a necessity that the force of the circulation should be very carefully distributed through it. Now, to meet the first of these demands, the brain, with its membranes, is supplied by four large arteries, the two internal carotid and the two vertebral, besides some minor branches. The vertebral arteries, in marked contradistinction to the law that prevails everywhere else in the body, instead of subdividing, unite as they enter the skull to form *a single trunk*, branches from which meet with others from the carotids, to form a great arterial circle at the base of the brain. From this circle numerous branches are given off, which wind in a tortuous manner over all the surface of the brain, and furnish blood to its structure only through a multitude of small ramifications. In this way, with a great amount and vigour of supply, the brain has that supply delivered to it in the gentlest and most regular manner possible: it is truly a practical illustration of the *suaviter in modo* with the *fortiter in re*. From the remarkable union of two arteries into one, of course results an accelerated circulation, which is the more necessary in animals the more they are habituated to the erect posture. In grazing animals, on the contrary, where from the abasement of the head much impetus would be dangerous, the vessels, as soon as they enter the skull, subdivide into an abundance of small branches. Force is of necessity expended by such an arrangement, and these animals rank but low in the scale of quadrupeds, from a consequent inferior development of the brain.

We have thus given a hasty sketch of the aids which the function of circulation in animals derives from hydraulic laws. The brevity of the essay must necessarily have rendered it incomplete; but we believe that the most prominent considerations connected with the subject have been presented to our readers.

## ON THE INCIPIENT DISENGAGEMENT OF ELASTIC FLUIDS.

The following short paper, by John Thomas Woodhouse, M. D., on an interesting subject, is extracted from the *Edinburgh New Philosophical Journal* and supplies a very complete solution of a question which has frequently been submitted to us.

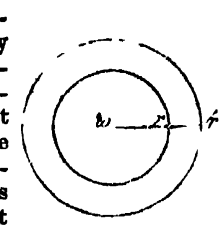
I have never seen or heard a satisfactory explanation of the well-known fact, that when a tea-kettle with boiling water in it is removed from the fire, the bottom is only moderately warm. It has been referred to like causes (subtituting steam for vapour), as when spirits are thrown upon the skin and a sensation of cold is produced, in which case heat is first given to the fluid, succeeded by a change in the state of the fluid.

This explanation appears to me defective and unsatisfactory; and I will now endeavour to show where it is defective, and supply the defect.

When the kettle boils, the water in it will raise the thermometer to 212° Fahrenheit; the fire is much hotter, and yet the hand which soon after touches it feels only a moderate warmth—in a short time the heat becomes intolerable, *i. e.* of the same heat as the superincumbent fluid,

Now, admitting when the heat of the bottom is becoming greater than 212°, that the water undergoes a change by its conversion into steam, and that the heat of the contents of the kettle is thus partly latent,—admitting that this would account for the bottom not indicating a greater heat than 212°, I contend it is unequal to explain why the bottom should be less than 212°: for the water is 212°, the steam under the ordinary atmosphere is supposed to be 212°, and the fire which was under it more than 212°. The object of this paper is to explain why the bottom, immediately on its removal from the fire, should indicate a heat less than 212°, and soon after a heat equal to that of the water upon it.

Let $w$ represent a portion of water. Let the sphere, whose radius is $w\,r$, represent the space occupied by the steam, into which this portion is converted by the communication of heat. The heat of the steam filling this sphere would be 212°; but, in explaining the object of this paper, I suggest that the heat of the steam may be less than 212°, and to establish this, I propose the following theory:—



I assume, that when a portion of water is converted from its fluid into its gaseous state, a sudden expansion, or what may be termed an explosion, happens, *i. e.*, supposing the steam in its quiescent state and under the ordinary pressure of the atmosphere would occupy the sphere $w\,r$, at the instant of its conversion, by its elasticity or momentum of its particles, it proceeds to fill a sphere whose radius is $w\,r'$, which is greater than $w\,r$.

Now, according to the acknowledged doctrine of latent heat, when water receives heat which converts it into steam, the steam under atmospheric pressure would occupy a space varying with the quantity of caloric imparted to it. By the same doctrine of latent heat, if the same quantity of steam under the same pressure be made to occupy the greater space $w\,r'$, it would require a greater quantity of caloric; and supposing the change from its filling the sphere $w\,r$, to its filling the sphere $w\,r'$ to be effected mechanically by its elasticity, it would be covetous of caloric, and would take it from any substance which touched it.

This theory will, (I conceive.) explain all the phenomena, A certain portion of water is converted into steam at the internal bottom of the kettle, which, in its quiescent state, under atmospheric pressure, would occupy the space $w\,r$, but by its elasticity or momentum of its particles, at the instant of its conversion it occupies the space $w\,r'$, becomes colder than 212°, and thus takes heat from the bottom, reducing it below 212°, after the supply of heat from the fire has been removed. This reduction of heat can only happen whilst the water is boiling; after the water has ceased to boil it soon communicates its own heat to the bottom, which explanation accords with the phenomena.

I cannot prove by experiments, that when gas is liberated from its prison of a fluid or a solid, at the instant of its libeation it goes to occupy more space than it would do solely by the admitted laws of latent heat; but I suggest the following consideration, which may make this probable;—if a spring be fixed in a table, be bent towards the right, and afterwards released, it does not merely go back to the place where it will ultimately rest, but by its elastic property, it would go considerably to the left, and would pass its resting place several times before it be still. May not the spring held down by the finger on the right side represent, or bear an analogy to gas confined in a fluid or solid; and may not its proceeding to the left of its resting-place represent its expanded condition immediately after it has gained its freedom.

I must now mention another circumstance, which is closely connected with and comes in aid of the present subject.

It has been observed, that on the first removal of any metallic vessel from the fire containing boiling water, the ebullition is increased. The solution may be this:—The cold air then surrounding and coming in contact with the outside of the vessel, by the subtraction of heat may cause its external surface to contract, and this may mechanically contract it internally, and so heat may be evolved. This explanation is nearly the converse of the previous one of the steam which has been given. There a chemical expansion first happens, followed by a mechanical expansion, by which heat is absorbed. Here, in the metal, a chemical contraction first happens, succeeded by a mechanical contraction, by which heat is evolved.—*Glasgow Mechanic.*

---

## VEGETABLE DYE-STUFFS.—MADDER.

THIS substance rivals indigo in value as a dye-drug, both from the beauty and permanence of the colours it produces. It is the root of a plant or shrub, named the *rubia tinctorium*, that grows naturally in the Levant, Italy, southern parts of France, and in Switzerland. It is cultivated to a great extent in Holland. Its culture has been often attempted in England, but without success. This plant was well known to the ancient Greeks and Romans, and was much used by them as a dyeing agent, and in medicine.

It is the root of the madder that is used for dyeing; it requires to be three seasons in the ground before fully grown. Of the practice of culture, we are not acquainted in this country. The roots when fully grown are about the thickness of a common quill. When properly dried, if they are broke or cut with a knife, they present to the eye a red yellowish colour, which assumes a dense brownish red colour when moistened; but the more yellowish the root appears when dry, the more available is the colouring matter. Madder when fresh in the root, and after being cut and ground to powder, in which last state it is used by the dyer, gives off a heavy sweet smell with somewhat of an earthy flavour. Madder of a bitter, stale, or sour smell, is invariably of in-

Madder has been subjected to a great many chemical inquiries, the study of which is highly useful to those who use this dye-drug in their operations. The first investigation into the chemical properties of madder, led to the discovery of two distinct colouring matters which it contains; one yellow, which is very soluble in cold water, and was named *Xanthin*; the other red, moderately soluble in hot water, and is extracted from madder in considerable purity by sulphuric acid, it is called *Alizarin*. Several methods of extracting alizarin by sulphuric acid have been proposed; the following is probably the most easily practised. "One pound weight of madder is mixed with an equal weight of concentrated sulphuric acid, the vessel so closed up that no heat is evolved, and allowed to stand in a cool place for three or four days. By this process, all the constituents of the madder are converted into charcoal, except the alizarin. When this charring process is completed, it is carefully dried, and then digested in alcohol, which dissolves the alizarin, and leaves the charcoal. The solution may now be diluted with water, and the whole put into a retort and kept at a heat of 170°, the beak of the retort being connected with a receiver, the alcohol distils over, and is recovered; water and alizarin remain in the retort, which being filtered, the alizarin remains upon the filter in a state of great purity. It is of a beautiful red colour, and communicates the same colour to boiling water.

Alizarin is soluble in turpentine, naptha, and fat oils. Chlorine turns it into a yellowish brown; sulphuric acid dissolves it, and at the same time enlivens the colour; muriatic and nitric acids both dissolve it, changing the colour from red to yellow; alkali gives it a violet colour; alumina forms with it a deep red brown precipitate; oxides of tin the same. Phosphate of soda has a very powerful attraction for alizarin, hence the reason that those animals who take madder into their system, have their bones dyed of a red colour. This fact has been long known to practical dyers who use madder in their operations.

From the above facts, it was conceived that alizarin constituted the true colouring matter of madder; and means were then adopted to separate this colouring matter from the vegetable, and use its pure; but it was afterwards found that a fixed dye could not be obtained by pure alizarin, and it therefore was not the true colouring matter of madder. This led to further investigations and further discoveries respecting these colouring substances, from which it appears that madder contains five different colouring matters which have been named,—*madder purple, madder red, madder orange, madder yellow*, and *madder brown*.

*Madder purple* is obtained by the following process: The madder is washed in water at about summer heat, then boiled in a strong solution of alum for an hour, the clear liquor is afterwards decanted, and sulphuric acid added, which precipitates the madder purple with a number of impurities. These are removed by washing with boiling water, then with pure muriatic acid, and afterwards dissolving in alcohol. Madder purple is soluble in hot water, and if pure, gives the water a dark pink colour. If the water contain lime, a part of the madder purple is precipitated as a dark reddish-brown substance. Cotton saturated with the acetate of alumina is dyed a bright red, if the quantity of madder purple be not in excess; when it is so, the colour will have more of a purple cast. A boiling solution of alum forms with the madder purple, a cherry red solution. Caustic potash forms with it a fine yellowish red colour. Carbonate of soda and potash affect it in the same manner. Sulphuric acid produces a bright red colour, or dark rose.

*Madder Red* is separated from madder purple, in consequence of its not being soluble, in a strong solution of alum. It is obtained by boiling madder in a dilute solution of alum, when a reddish-brown precipitate is obtained. This is repeatedly boiled in pure muriatic acid then well washed with water and boiled in alcohol. This dissolves madder red, and madder purple. The alcoholic solution is evaporated and allowed to cool, when there is deposited an orange-yellow precipitate; this is repeatedly boiled in a strong solution of alum. So long as the solution becomes coloured, the insoluble portion is madder red. It is a yellowish brown powder, and imparts to cotton impregnated with the aluminous mordant, a dark red colour when in excess; but if the cotton be in excess, a brick-red colour is produced. Caustic potash forms a violet-purple solution; carbonate of soda a red liquid; sulphuric acid a brick-red solution.

*Madder orange* is obtained from the two former colouring matters by its little solubility in alcohol. It is obtained by macerating madder for twenty-four hours in distilled water, the infusion strained off and allowed to repose for a few hours, the liquor carefully decanted and filtered through paper, the madder orange remains upon the paper; it may be washed with cold water, and afterwards purified by spirits of wine in which it is not soluble. It is a yellow powder; imparts to cotton impregnated with the aluminous mordant a bright orange colour. When in excess, a boiling solution of alum forms with madder-orange an orange-yellow solution; caustic potash a dark rose colour; carbonate of soda, orange colour; sulphuric acid, an orange-yellow colour.

*Madder yellow* is characterized by its easy solubility in water; it is a yellow gummy mass; communicates to mordanted cotton a pale nankeen colour, but does not of itself form a true dye. Madder which contains much of this, is inferior in quality, as the yellow becomes so incorporated with the other colours as to materially deteriorate them, and to require several operations to free the goods from it afterwards. Madder brown is a brownish-black dry mass, is of no importance as a dye-stuff, and does not enter into any of the colours dyed by madder; is neither soluble in water nor alcohol.

Besides these five colouring matters, madder contains two acid substances named *Madderic acid* and *Rubiacic acid*, which have no dyeing properties, and therefore are not to be detailed further than to show the intimate knowledge which chemists possess of this agent, so important were any investigations upon madder considered, that the Société *Industrielle de Mulhouse*, for several years offered 2000 francs as a premium for the best analytical investigation of this substance.

It will be observed in the brief outline of the five colouring matters of madder, that only three of them are of importance to the dyer. It will also be observed, that these three colouring substances have a similarity of action upon mordanted cottons, taken singly; not one of them forms a good dye, but they constitute the elements, which together produce the richest and most permanent red that we are in possession of: therefore, speaking practically, it is only necessary here to consider madder as having two colouring matters, the one dull or yellow, which constitutes the impurity of madder, and which the dyer endeavours to get rid of. This colouring matter does not combine with the cloth alone, but it has a powerful attraction for the other colouring matters, and combines with them when on the cloth, and has to be separated by after processes. The other, a red colouring matter, which includes the madder red, orange, and purple, for they unite with mordanted cotton as one, and are known to the practical dyer as one. This colouring matter is with difficulty soluble in water, has no strong decoction, can be obtained by boiling, which makes it much less useful in the fancy dye-house, it is generally used to give a peculiar tint to light *drabs* and *fawns*, and for dyeing light salmon colour. When deep colours are to be dyed with madder, the goods must be put into the dye-bath along with the madder, such as described under barwood. But madder, in the hands of a skilful dyer, can be made to produce almost any colour by the variation of the mordants, and the colours produced are all characterised by a degree of permanency which no other dyewood possesses; but the operations for obtaining them are generally tedious. Much skill is also requisite for obtaining and applying the proper mordants for madder.

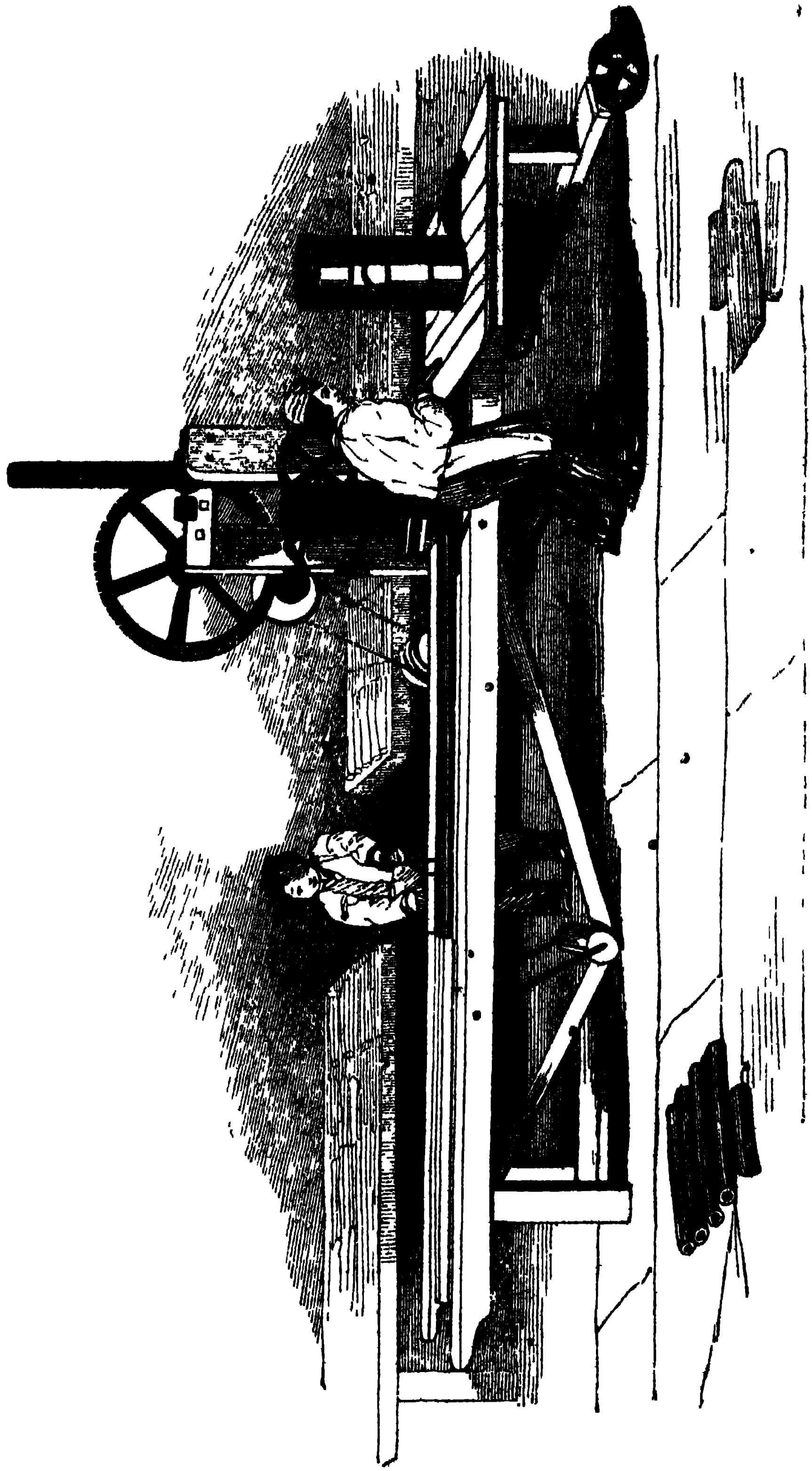
The first step in dyeing full and permanent colours by madder, is clearing the cotton well with alkaline leys, and then in oily liquor in which sheep's dung is macerated; this operation is repeated several times, according to the nature of the colours wanted. Many attempts have been made to substitute different salts for the sheep's dung, and in some cases with considerable success; but the accounts given of these experiments we have always considered a little exaggerated. There appears to be some peculiar influence in the dung to fulfil the purpose intended, that no substitute we have seen tried can equal. After the goods are considered sufficiently prepared by the alternate washings and macerations, they are what is termed in the language of the dyehouse, galled—that is steeped, or wrought for some time in a decoction of galls, or what is now more commonly used, sumac, when they are ready to receive the proper mordant for the colour required. The various mordants used are the acetate of alumina, acetate of iron, or sometimes a mixture of these two for different shades of brown. The chloride of tin, acetate of lead, and, for variety of shade, the ammoniate and acetate of copper. In dyeing with madder by an iron mordant, it is of the utmost importance that the iron be applied in the state of a protosalt. We have already alluded to an easy method of applying the iron salt in this state by adding a piece of clean iron to the liquor sometime previous to using, by which means any persalt is reduced to the state of a protosalt; but it requires great caution and dexterity to preserve it in such a state when applied to the cloth for such a length of time, as from the mordanting to the immersion in the dye-bath. But these treatises being more particularly applicable to fancy colours, we will not enter into details of the colours obtained from madder, as they will be more properly treated of under the head of *fast colours* upon cotton.

*(To be continued.)*

## VARIETIES.

*To preserve Woodwork.*—Boiled oil and finely-powdered charcoal: mix to the consistence of a paint, and give the wood two or three coats with this composition. Well adapted for water spouts, casks, &c.

*Madden's Knife Cleaner.*—This invention is a simple and useful contrivance, consisting merely of two surfaces of leather prepared with some metallic ingredient, which are brought nearly in contact by a pair of metallic springs, and through which the knives are quickly drawn. It is a good substitute for the present knife-board, whilst it answers its purposes very effectually.



HATCHER'S BENENDEN TILE MACHINE.

## HATCHER'S BENENDEN TILE MACHINE.

In the choice of implements and machines, and in their adaptation to animal, water, or steam power, the engineer may often beneficially advice the agriculturist, and aid him in economizing his outlay, or in rendering it more effective; also, in planning farm-buildings, with reference to the convenient disposition of machinery, as respects the barn, stack-yard, fold-yard and feeding-sheds, the construction of roofs, tanks, and apparatus for preparing animal food, &c.

The drainage of wet land is a work of such acknowledged importance, that a consideration of the most efficient, enduring, and least costly methods of accomplishing it, is of as much interest to the professional drainer as to the owner or occupier of the soil, &c.

The drainage of land subject to floods, or of fens and marshes lying below the level of natural outfalls, has long occupied the attention of engineers, and been executed by them.

The above machine is by far the most efficient and economical Apparatus that has hitherto been invented for the purpose of moulding Drain Tiles. By varying the pattern-die, it can be accommodated to any shape of tile whatever—round, horse-shoe, flat, &c. Being simple in construction, it requires but little previous practice in the working of it. It requires also but few hands; viz.—one man to fill and change the cylinder; a youth to force down the piston by turning a winch; and two boys with rollers and cutting wires, to take off and deposit the tiles. With this amount of labour, the daily product is as follows:—

| *Diameter of Tiles.* | *Number that can be made in a day of 10 hours.* |
|---|---|
| 1-in. | 11,000 |
| 1¼-in. | 8,000 |
| 1½-in. | 5,800 |
| 2-in. | 4,000 |
| 2½-in. | 3,200 |

Over and above several important improvements in the pattern-dyes, the piston and the cylinder, the mode of taking out all stones from the clay, the application of a wooden roller, with cutting-wire accurately adjusted, are the leading characteristics of this machine.

## ELECTRO METALLURGY.

The following remarks extracted from Mr. Smee's recently published valuable and interesting volume on the above subject, will serve as an introduction to a series of papers which we purpose to introduce to our readers.—

"As a surgeon I feel bound to pass my opinion upon the effect which an extensive application of electro-metallurgy would have on the health of the workman, and in one word I may state, that I believe the mode of working in metals by the galvanic fluid is more wholesome, and would be attended with far less deleterious properties than the method now practised. The use of the salts of gold, silver, and platinum is liable to discolour the fingers, but the other salts have no particular effect. However, in passing the above decided opinion, strengthened as as it is by watching the effects of the experiments on myself, and also from paying attention to the health of some who have reduced electrotype copper by the hundred weight, I feel but litte doubt that if the electro metallurgist was several times in a day to leave his work with fingers covered with metallic solution, and take his meals without any ablution, and repeat this for a long time, that the quantity of metal which he would thus draw insensibly into his system might be attended with inconvenience, several of the processes here detailed, as those of gilding, &c., are likely most materially to benefit the health of the workman, as they supersede the use of pernicious mercurial fumes."

*On Galvanic Batteries.*

"As chemists have arranged an extensive series of effects under the general term of heat, so they have named another series light, and a third, they have called Electricity. Of the first cause of all these, as of that of vitality, we are ignorant, for we can only examine them by their effects, and even their nature is equally obscure. We find, if we examine organized bodies, that all these principles are capable of being produced through the medium of life; for nearly all animals have the power of evolving heat; many insects, moreover, can voluntarily emit light, and the property of producing electricity is well evinced in the terrible shock of the electric eel, as well as in that of some other creatures.

"Their weight is inappreciable by the most delicate balances, and hence they have been termed the imponderable agents; a property in which they all agree, and in numerous cases appear to be singularly and intimately connected with each other.

"Electricity is the only one which we have particularly to treat of in this work, and this subject is subdivided into several departments, as, electricity of tension, or frictional electricity, where the effects of electricity derived from the electrifying machine are considered; thermo or steræo-electricity, where it is derived from solid bodies through the agency of heat; animal electricity, from organized bodies; magnetic electricity, from the natural or artificial magnet; and voltaic or galvanic, where it is obtained from the voltaic pile.

"Although these names, from their multiplicity, may tend to confuse, be it remembered, there is but one electricity which thus manifests itself in such different ways, either under varying circumstances, or from differences from whence it is derived. Our enquiry will not extend into all these details, but simply into its effects when obtained from the voltaic battery.

"The phenomena, to which the name of voltaic or galvanic electricity has been given, are those which arise from the voltaic or galvanic battery, so named from its discoverers, Volta and Galvani. They found that two pieces of metal, possessing different facilities for combination with oxygen, produced, when properly united, singular convulsions in a dead frog; and following out this experiment, they constructed the battery, which has now, from the improvements of later discoverers, become so powerful and valuable an instrument.

"Without pursuing in detail, the interesting experiments of subsequent authors, it must always be borne in mind, that to make a galvanic battery, with advantage, two conducting substances must be employed with a compound conducting fluid intervening, capable of being decomposed; and the first substance should have the strongest possible affinity for one element of the fluid, and the second substance the least possible affinity. Thus, in a simple circuit, composed of zinc, silver, and water (the water being rendered a good conductor by the addition of acid) zinc has a very strong attraction for the oxygen of the fluid, whilst silver has a very slight attraction; and therefore a powerful current is generated.

"With regard to the relative conducting powers of bodies, the metals, and all the varieties of carbon, excepting the diamond, hold the foremost rank among solids. The fluids are generally imperfect conductors; none more so than pure water; though in combination with the acids, pure alkalies, or any of the salts, it forms a good conductor. Fused chlorides and iodides are also good conductors. The metals are conductors in the following order; silver, copper, lead, gold, brass, zinc, tin, platinum, palladium, and iron.

If we except the earthy and alkaline metals, as potassium, sodium, &c., zinc has by far the strongest affinity for oxygen; and on this account is invariably used as the electro-positive metal (the term applied to the metal which is acted upon by the solution, or which in reality acts on the fluid.) All other metals, in any *acid* solution, are electro-negative to them; the term used to imply the opposite state to electro-positive. The following table shows the state of electricity in which the metals stand, with regard to each other, in acid solutions, where every metal is positive to all below it, and negative to all above it. This series relates only to acid solutions, for it varies with almost every solution used:

| | | |
|---|---|---|
| Potassium | Iron | Silver |
| Barium | Bismuth | Palladium |
| Zinc | Antimony | Gold |
| Cadmium | Lead | Charcoal |
| Tin | Copper | Platinum. |

"This order appears to me to require to be again made the subject of experiment; I would suggest that for this investigation, every metal should be used in a finely divided state, similar to the finely divided platinum of my battery.

"A galvanic battery exhibits two important properties, quantity and intensity. Quantity depends directly upon the size of the negative metal or strength of the solution, while intensity depends upon much more hidden causes. Quantity requires but one cell, and this has been referred to in all the preceding experiments, for we have seen that we must have two metals with an intervening fluid. These will remain inactive while they do not touch; but as soon as contact takes place, either in the exciting fluid, at a distance, or through a fluid of more easy decomposition than the exciting fluid of the battery, the action immediately commences. The contact may be made through a great length of wire, with the same result. In this case, however, if the wire be either long, of small diameter, or of a metal of no great conducting power, it will be seen that the hydrogen evolved from the negative metal will be materially lessened, showing that an obctacle is presented to the electric fluid; but if intensity be given to the fluid, then the hydrogen will be evolved as freely as before.

"To obtain this intensity we must have recourse to a number of galvanic batteries, arranged as a series; that is, the zinc of one battery connected with the silver of the next, and this in regular continuation, leaving the extreme zinc and silver free. In this way a hundred batteries may be conjoined, but no more quantity obtained; for only the same amount of electricity passes as when one cell is used. Now, however, this same amount can pass through a much greater resistance, for it would seem as if at every alternation of the battery, the electric fluid obtained a push to overcome any obstacle afforded to its passage, and this push is called its intensity.

"To the beginner, these two properties are very difficult to understand, but perhaps a rough idea may be formed of them by comparing quantity to the piston imparting motion to a railway train, which moves readily with one engine on a level road; let the train meet an obstacle, as an inclined plane or a hill, two, three, or one hundred engines may be required to move this same train over, and yet the piston which turns the wheels of the carriage would move no more times than if one engine had been employed.

[*To be continued.*]

## VEGETABLE PHENOMENON.

In the garden of Mr. W. Grimstone, of the Herbary, Highgate, is now to be seen a pea plant in full bearing, which is remarkably illustrative of the great length of time the germinating property can continue in seeds. This plant was produced from one of three peas presented to the above gentleman by Mr. J. T. Pettigrew, Surgeon of Saville Row, having been taken by the latter and the authorities of the British Museum, from one of the vases recently extracted from an Egyptian sarcophagus; and where, according to computation, it must have remained for no less a period than 2844 years. The vases contained a large quantity of dust, supposed to be the decomposition of a number of grains of wheat, vetch, and peas. Some of the grains of wheat have been sown and found productive, but the vetch peas have not germinated, the other pea resembling the British culinary pea, has in the above instance been tried effectually. The three peas were placed by Mr. W. Grimstone's gardener in a hot bed, and watched with great care. After some time one only was found to sprout, it gradually increased in height, growing like a sprout, and finally burst forth a beautiful white bloom with green stripes, having only four petals (an English pea having five), at the end of each are three singular fangs. Each flower was of a bell shape something like a convolvolus but not so large, from the centre of which the pods have shot forth and are now nineteen in number and fit to gather, and they are in shape something between our marrowfat and scymiter peas. They have of course not been tried, but it is believed they are suitable for culinary purposes judging from the blossoms having been white. Mr. Pettigrew, and several eminent botanists, scientific and other gentlemen, have seen this vegetable phenomenon, and take great interest in it.—*Times.*

## VEGETABLE DYE-STUFFS.

(*Continued from page 168.*)

### *Anotta or Roucon of the French Dyers.*

This substance, is obtained from a shrub originally a native of South America, and now cultivated in Guiana, St. Domingo, and the East Indies. It is termed the *anotta tree*, or *Bixa orellana*. It seldom attains to more than twelve feet in height, the leaves are divided by fibres of a reddish-brown colour, they are four inches long, broad at the base, and tend to a sharp point. The stem has likewise fibres which in Jamaica are converted into serviceable ropes.

"The tree produces oblong bristled pods, somewhat resembling those of a chesnut; these are at first of a beautiful rose-colour, but as they ripen, change to a dark-brown, and bursting open, display a splendid crimson farina or pulp, in which are contained from thirty to forty seeds somewhat resembling raisin stones. As soon as they have arrived at maturity, these pods are gathered, divested of their husks, and bruised. Their pulpy substance, which seems to be the only part which constitutes the dye is then put into a cistern, with just enough water to cover it, and in this situation it remains for seven or eight days, or until the liquor begins to ferment, which sometimes requires as many weeks, according to circumstances. It is then strongly agitated with wooden paddles and beaters, to promote the separation of the pulp from the seeds, this operation is continued until these have no longer any colouring matter adhering to them. The liquor is then passed through a sieve, and afterwards boiled, the colouring matter being thrown to the surface in the form of scum, or otherwise allowed to subside, in either case it is boiled in coppers till reduced to a paste, when it is made up into cakes and dried."

Another and more preferable mode of extracting the colouring matter from these seeds is rubbing them one against another under water, so that the mucilaginous and other impure matters contained in the interior of the seeds are not mixed with it. When extracted in this way, the colouring matter is allowed to settle, the water drawn off, and the anotta left to dry. When prepared in this manner it has a fatty feel, and very homogenious and of a deep red colour, which changes to dark-brown by drying; it has no taste, but generally a disagreeable smell, which is not natural, but owing to stale urine having been added to it, for the purpose of improving its colour and keeping it moist.

Muriatic acid has no action upon anotta; chlorine discolours it; nitric acid completely decomposes it, giving rise to several chemical compounds which have not been investigated. Sulphuric acid poured upon it in the solid, gives it a deep blue colour like indigo, which changes into a dark dirty green, and then to a blackish purple.

Anotta contains two colouring matters; one yellow, the other red. They are very difficultly soluble in water, but easily in alkalis, and are by this means prepared for dyeing. The alkali used is carbonate of soda of potash, but common soft soap does equally well, and for certain light shades upon silk and cotton, is superior. A quantity of anotta is prepared at a time, and kept as a sort of stock liquor; but the practice is bad as it soon becomes stale, and loses a great portion of its dyeing properties; it ought to be used when newly prepared. It is prepared as follows: into a boiler capable of containing from ten to twelve gallons of water, is put 10lb. weight of anotta, 2lb of carbonate of soda, and 2lbs of soft soap the whole boiled together until the anotta is all dissolved. Cloth put into this solution will be dyed a dark orange, and every tint of shade from an orange to a light cream colour may be dyed by this solution, by merely using it less or more diluted according to the shade required; the cloth requires no previous preparation; but for light shades, the colour is brightened by having a little soap dissolved in the water where they are dyed: in this case the goods are merely wrought in the liquor for a little, wrung out and dried. The addition of acids turns the colours dyed by anotta to a yellowish red, so that by passing a piece of cloth dyed orange with anotta, through a little acid water, it is turned into a scarlet, and so on down to a light salmon colour. But it is to be regretted, that all the colours dyed by anotta are exceedingly fugitive; and although neither acids nor alkalis can completely remove the colours given by this substance from the cloth, yet they are constantly changing and fading by exposure to air and light, and consequently this substance is very little used to produce a dye by itself in a cotton dyehouse, but as an auxiliary, or what dyers term, giving a bottom to colours, as in the case of scarlet, the cloth is first dyed orange by anotta, and a crimson dyed above it by safflower, which together produces a beautiful scarlet.

It is used in considerable quantity for dyeing silk and woollen the various shades of orange, salmon, nankeen, &c., the objection, just referred to, respecting its use for cotton are not so applicable to silk and woollen, probably owing to the superior affinity that animal substances have for dyeing agents, when compared to vegetable substances.

Anotta is eminently fitted for dyeing the shades alluded to above upon goods of a mixed quality, such as Canton crape, Batiste, and all such cloth composed of cotton and silk, cotton and woollen, silk and woollen,—a kind of goods, which require a considerable experience in the art, to be able to produce an equality of shade of every colour upon the different materials.

### *Catechue.*

This is a dry extract prepared from the wood of a species of sensitive plant named *acacia catechue.* This substance was long considered as an earth which was found in Japan, and was consequently called *terra Japanica.* Its true character was first pointed out by Mr. Kerr, who published a paper, describing the process of obtaining and manufacturing it from the plant. This plant is indigenous to Hindostan, flourishing abundantly in mountainous parts. It grows to about twelve feet in height, and one foot in diameter, and is covered with a thick, rough, brown bark. The extract obtained from the tree is made from a decoction of the wood. As soon as the trees are felled, all the exterior white wood is carefully cut away, the interior or coloured wood is then cut into chips; narrow mouthed unglazed pots are nearly filled with these, and water is added to cover them and reach to the top of the vessel. When this is half evaporated by boiling, the decoction without straining is poured into a shallow earthen vessel, and further reduced two-thirds by boiling. It is then set in a cool place for one day, and afterwards evaporated by the heat of the sun, being stirred several times during that process. When it is reduced to a considerable thickness it is spread upon a mat or cloth, which has been previously covered with the ashes of cow dung. This mass is divided with a string into quadrangular pieces, which are completely dried by being turned frequently in the sun, and are then fit for sale. It is a brittle, compact solid, of a dark brown or chocolate colour; has no smell, but a very stringent taste; is soluble in water; contains a great amount of tanin, and a peculiar acid which has been named catechuic acid; it is the reaction of these with oxygen and other chemical agents that constitutes its dyeing properties. A solution of catechue in water is a beautiful red brown colour, which will enable the reader to follow within his mind the action of the following re-agents with a solution of catechue in water:—

Acids brighten the colours of the solution.

Alkaline substances darken the solution which increases by standing.

Protosalts of iron gives an olive-brown precipitate.

Persalts of iron, olive-green with a brownish tint.

Nitrate and sulphate of copper, turn the liquor yellowish brown, giving a precipitate by a short exposure.

Acetate of copper, a deep brown precipitate.

Salts of lead, salmon colour precipitate.

Tin salts, browish yellow.

Bichromate of potash, deep red brown precipitate.

These precipitates are all insoluble, and have an attraction for vegetable and animal substances, so that catechue in the hands of the intelligent dyer becomes an agent of extensive application. It is but a few years since this substance was first introduced into the fancy dyehouse, as an agent for dyeing permanent browns upon cotton yarn. Its introduction raised a considerable excitement throughout the trade, but the parties who introduced it had not a long monopoly, from their giving the name of the brown that of *catechue brown;* which at once betrayed their secret, and before long, catechue brown became common throughout the whole trade. But during the experiments to get at the method of dyeing brown, its application to many other colours became known, so that not only browns, but *fawns*, *drabs*, *olives*, and *blacks* were all produced by catechue.

When catechue is dissolved in boiling water it has a gummy consistence, so that yarn cannot be dyed in this state. The addition of some metallic salt, such as the nitrate or sulphate of copper, sulphate of zinc, chloride of tin, &c. destroys the gummy principle, so that some one of these salts must be added previous to dyeing yarns by catechue. The chemical change which takes place on the addition of these salts is not well understood. The explanation generally given, is, that the salt added, oxidises the catechue, producing an insoluble oxide which however is soluble in a solution of catechue not oxidised, so that the salt added only oxidises a part, which remains in solution in the portion not oxidised. We do not think this explanation is correct, because the oxidation of catechue is its conversion into another substance of a darker colour; whereas the addition of a little nitrate of copper, for instance, renders the solution lighter, besides, the fixation of the colour upon the yarn depends upon its oxidation, so that the portion oxidised before going upon the goods would neither alter in shade, nor produce a different shade from that it receives in the solution. As an instance of this, if into a solution of catechue in water, there be put sulphate of zinc instead of nitrate of copper, a piece of cotton put into this receives a light buff or nankeen colour; if this is not passed through a weak solution of lime, and then exposed to the air, it absorbs oxygen, and in a few hours becomes a dark permanent brown, little inferior to that dyed in the usual way. There is however no doubt that the addition of a metallic salt facilitates the oxidation of the catechue when upon the goods.

To dye brown the catechue is boiled in water till dissolved. Let the boiling cease, then add a little nitrate of copper, say that a penny-piece is dissolved in two gills of aquafortis, this will do 10lbs of catechue. The whole is well mixed and the cotton immersed and allowed to remain in it till the solution becomes cold, generally over night; it is then to be taken out and well wrung and wrought for nearly twenty minutes in a solution of bichromate of potash (chrome) at nearly a boiling heat, it is then washed and finished through a solution of soap, sufficiently strong to stand a lather after the goods come out. This produces a very rich permanent brown, and is already superseding the use of madder for the same colour, being nearly equally permanent and much more easily obtained. The shade is varied according to the proportion of the ingredients used, so that a rich vauterine or a dark chocolate may be obtained with equal facility.

We have now gone over the principal vegetable dyeing agents which are used in the dyeing of cotton. There are no doubt many others used in the art of calico printing, and also in dyeing silk and woollen, but we have all along confined ourselves to what is termed the fancy dyehouse, and here the mineral kingdom has in many instances superseded the vegetable; so that we shall have to devote a few papers to substances in which the chemical principles of the art will be much more easily developed, as the nature of the substances and their re-action with other mineral bodies have been more thoroughly studied and explained than the vegetable bodies.

---

*To the Editor of the Magazine of Science.*

Sir,

Having had occasion a few days ago, to copy some engravings, &c., by the Chromatype, I was at a loss for a piece of plate glass to put into the frame, the only piece in my possession being a reflector belonging to an old camera obscura and ground on one side, I at first rejected it, thinking it nearly useless; but on being dissappointed by a piece of crown glass, I was determined to give the former a trial, which I accordingly did; and much to my satisfaction, for the results excelled the usual plan of using clear glass in two points, first, the process was evidently accelerated, and secondly, the paper was acted upon in a much more equal manner.

The first result I can readily account for, in the sun's rays, not being reflected by the glass (the ground side being outermost), but was as it were *absorbed*, a term which I leave for *Opticians* to rectify. But the second I must refer to you, and hope some of your scientific correspondents will be able to account for the same.

J. BURMAN.

## MASONRY.

Walling.—In stone walling the bedding joints are usually horizontal, and this should always indeed, be so when the top of the wall is terminated horizontally. In building bridges, and in the masonry of fence walls upon inclined surfaces, the bedding joints may follow the general direction of the work. The footings of stone walls should be constructed with stones as large as may be, squared and of equal thicknesses in the same course, and care should be had to place the broadest bed downwards. The vertical joints of an upper course are never to be allowed to fall over those below, that is, they must be made as it is called to *break joint*. If the walls of the superstructure be thin, the stones composing the foundation may be disposed so that their length may reach across each course from one side of the wall to the other. When the walls are thick, and there is difficulty in procuring stones long enough to reach across the foundations, every second stone in the course may be a whole stone in breadth, and each interval may consist of two stones of equal breadth, that is, placing header and stretcher alternately. If those stones cannot conveniently be had, from one side of the wall lay a header and stretcher alternately, and from the other side another series of stones in the same manner, so that the length of each header may be two-thirds, and the breadth of each stretcher one-third of the breadth of the wall, and so that the back of each header may come in contact with the back of an opposite stretcher, and the side of that header may come in contact with the side of the header adjoining the said stretcher. In foundations of some breadth, for which stones cannot be procured of a length equal to two thirds the breadth of the foundation, the works should be built so that the upright joints of any course may fall on the middle of the length of the stones in the course below, and so that the back of each stone in any course may fall on the solid of a stone or stones in the lower course. The foundation should consist of several courses, each decreasing in breath as they rise by sets off on each side of three or four inches in ordinary cases. The number of courses is necessarily regulated by the weight of the wall and by the size of the stones whereof these foundations or footings are composed. A wall which consists of unhewn stone is called a rubble wall, whether or not mortar is used. This species of work is of two kinds, coursed and uncoursed. In the former, the stones are gauged and dressed by the hammer, and thrown into different heaps, each containing stones of the same thickness. The masonry is then laid in horizontal courses, but not always confined to the same thickness. The uncoursed rubble wall is formed by laying the stones in the wall as they come to hand, without gauging or sorting, being prepared only by knocking off the sharp angles with the thick end of the scabbling hammer. Walls are most commonly built with an ashlar facing, and backed with brick or rubble work. In London, where stone is dear, the backing is generally of brickwork; which does not occur in the north and other parts, where stone is cheap and common. Walls faced with ashlar and backed with brick or uncoursed rubble are liable to become convex on the outside from the greater number of joints, and, consequently, from the greater quantity of mortar placed in each joint, as the shrinking of the mortar will be in proportion to the quantity; and therefore such a wall is inferior to one wherein the facing and backing are of the same kind, and built with equal care, even supposing both sides to be of uncoursed rubble, than which there is no worse description of walling. Where a wall consists of an ashlar facing outside, and the inside is coursed rubble, the courses at the back should be as high as possible, and the beds should contain very little mortar. In Scotland, where there is abundance of stone, and where the ashlar faces are exceedingly well executed, they generally back with uncoursed rubble; in the north of England, where they are not quite so particular with their ashlar facings, they are much more particular in coursing the backings. Course rubble and brick backings admit of an easy introduction of bond timber. In good masonry, however, wooden bonds should not be continued in length; and they often weaken the masonry when used in great quantity, making the wall liable to bend where they are inserted. Indeed, it is better to introduce only such small pieces, and with the fibres of the wood perpendicular to the face of the wall, as are required by the fastenings of battens and dressings. In ashlar facing, the stones usually rise from twenty-eight to thirty inches in length, twelve inches in height, and eight or nine inches in thickness. Although the upper and lower beds of an ashlar, as well as the vertical joints, should be at right angles to the face of the stone, and the face, bed, and vertical joints at right angles to the beds in ashlar facings; yet, when the stones run nearly of the same thickness, it is of some advantage, in respect of bond, that the back of the stone be inclined to the face, and that all the backs thus inclined should run in the same direction; because a small degree of lap is thus obtained in the setting of the next course; whereas, if the backs are parallel to the front, no lap can take place when the stones run of an equal depth in the thickness of the wall. It is, moreover, advantageous to select the stones so that a thicker one and a thinner one may follow each other alternately. The disposition of the stones in the next superior course should follow the same order as in the inferior course, and every vertical joint should fall as nearly as possible in the middle of the stone below. In every course of ashlar facing in which the backing is brick or rubble, *bond*, or, as they are called in the country, *through* stones should be introduced, their number being proportioned to the length of the course; every one of which stones, if a superior course, should fall in the middle between every two like stones in the course below. And this disposition should be strictly attended to in all long courses. Some masons, in carrying up their work, to show that they have introduced a sufficient number of bond stones into their work, choose their bond stones of greater length than the thickness of the wall, and knock or cut off their ends afterwards. But this is a bad practice, as the wall is liable to be shaken by the force used in reducing, by chiselling or otherwise cutting away the projecting part, and sometimes with the chance even of splitting the bond stone itself. In piers, where the jambs are coursed with ashlar in front, every alternate jamb stone should go through the wall, with its bed perfectly level. If the jamb stones are of one entire height, as is often the case when architraves are wrought upon them, and also upon the lintel crowning them, of the stones at the ends of the courses of the pier which are to adjoin the architrave jamb, every alternate stone should be a bond stone; and if the piers be very narrow between the apertures, no other bond stones will be necessary in such short courses. When the piers are wide, the number of bond stones is to be proportioned to the space. Bond stones, too, must be particularly attended to in long courses above and below windows. They should have their sides parallel, and of course perpendicular to each other, and their horizontal dimensions in the face of the work should never be less than the vertical one. The vertical joints, after receding about three quarters of an inch from the face of the work with a close joint, should widen gradually to the back, so as to form hollow wedge-like figures for the reception of mortar and *packing*. The adjoining stones should have their beds and vertical joints filled with oil-putty, from the face to about three-quarters of an inch inwards, and the remaining part of the beds with well-prepared mortar. Putty cement is very durable, and will remain prominent when many stones are in a state of dilapidation, through the action of the atmosphere upon them. The use of the oil-putty is at first disagreeable, from the oil spreading over the surface of the contiguous stones; but after a time this unpleasant look disappears, and the work seems as though of one piece. All the stones of an ashlar facing ought to be laid on their natural beds. From inattention to this circumstance, the stones often flush at the joints; and, indeed, such a position of the lamina much sooner admits the destructive action of the air to take place. Where walls or insulated pillars of very small dimensions are to be carried up, every stone should be carefully bedded level, and be without concavity in the middle. If the beds should be concave, as soon as the superimposed weight comes to be borne by the pier or pillar, the joints will in all probability begin to flush; and it is moreover better, if it be possible, to make every course in the masonry of such a pier or pillar in one stone. When large columns are obtained in a single block, their effect, from that circumstance alone, is very striking; but as this is not very often to be accomplished, the next point is to have as few and as small joints as possible; and the different stones, moreover, ought to be selected with the view, as much as possible, of concealing the joints, by having the blocks as much of the same colours as possible. It will immediately, of course, occur to the reader, that vertical joints in columns are inadmissible.—*Gwilt's Architecture.*

## RAILWAY AXLES.

At the meeting of the Institution of Civil Engineers, of the 23rd ultimo, Mr. Glynn read a paper on the fracture of railway axles, which he attributed to the constant succession of blows received by the axles in travelling. The action was stated to be similar to that of an axle laid on the edge of an anvil, and subjected [illegible]ies of smart blows of a hammer, while in con[illegible]tion. The fracture presented the appear[illegible]lean annular cleft all round, for the depth of half an inch into the body, the centre part being crystallized, and reduced so much as to be unable to bear the weight and the torsion to which the axle was subjected, by the pressure of the break on one of its ends. These observations had induced the Railway Company to apply the power of the break upon both wheels simultaneously, thus avoiding the torsional strain.

## COLT'S SUB-MARINE BATTERY.

The following paper taken from *Miles's National* (American) *Register* for July, 1842., will be read with interest at this time when Captain Warner's experiment has attracted so much notice.

Mr. Colt made an experiment on Saturday, with his newly invented Sub-marine Battery, which was considered as highly satisfactory. The explosion took [illegible]ace opposite Castle Garden, and was attended by [illegible]ll, heavy, rushing sound; and a huge column of water was thrown suddenly and violently to the height of twenty or thirty feet in the air. The can containing the combustibles was sunk under the hulk, and a wire conducted from it to the deck of the North Carolina, some 200 or 300 yards distant. At the moment fixed, Mr. Colt, on the deck of the North Carolina, applied the acid to his plates (Voltaic plates) and quicker than thought, the deck was thrown into the air and scattered into fragments. A more complete experiment never was performed. Tens of thousands of people witnessed it from the Battery.** Another account say:—Mr. Colt, having his Magnetic Battery ready on the quarter-deck of this ship, the wires having been prepared under water, and connected with the explosive machine under the ill-fated vessel, said to the gentlemen, "I am ready; look out!" when, with the quickness of the electric flash, the vessel was blown up into ten thousand fragments. The suddenness with which the vessel, which I suppose to have been of some hundred tons burden, disappeared, was more like an optical delusion than reality; for in the twinkling of an eye, the form and fashion of the boat was changed into a column of water and fragments. * * And now the scene was closed, all hands awarding to Mr. Colt the praise of having struck upon a device that will be a more certain protector to our ports and harbours against invading fleets, than would scores of batteries and men-of-war; for against these visible agents of defence, power can be employed and applied, but against this *immersed hidden and invisible agent*, with power enough to reduce to atoms the proudest navy that floats, in a moment, no power can be applied, and no vigilance guard against its devastating effects.

In the same work, and in the next month, August 27, we find the following:—"*Colt's Sub-marine Battery.*—Mr. Colt succeeded in the exhibition of his apparatus on the 23rd at Washington, as was witnessed by the President of the United States, heads of departments, members of Congress, public officers, and thousands of spectators." The consequent proceedings in the House of Representatives are reported in the following letter:—[Tuesday, August 23, 1842] "Resolved, That the Secretary of the Navy be, and he is hereby instructed, to render Mr. Samuel Colt facilities to test his Sub-marine Battery to an extent which will settle the question, whether these can with ease and safety successfully be employed, as a power sufficient to destroy the largest class of ships of war when in motion, passing in or out of the harbour, without *the necessity of* approach within *reach of shot from guns of the largest calibre*; and whether continued operations of the destruction of one or more vessels can be effected without renewing the means, under the exposure of an advancing squadron; and whether the same can be used for the defence of a harbour, without endangering the passage in or out of other than hostile vessels. And be it further resolved, That should Mr. Colt's Sub-marine Battery stand the above tests, he is hereby authorized to proceed, under the direction of the President, and the Secretaries of the Navy and of War, to fortify whatever harbour may be agreed upon for that purpose, provided he will undertake the same at the mean cost of the United States steam ships, Missouri and Mississippi. The necessary expenses to be paid out of any money in the Treasury, not otherwise appropriated." * * On the motion of Mr. Mallory, the resolution was referred to the Committee on Naval Affairs; and on September 3, 1842, "Mr. Archer, from the Committee of Naval Affairs, reported the joint resolution (in the Senate) of the House," to authorize experiments on Colt's Sub-marine Battery. * On the 14th of October, another experiment, quite similar to that above referred to, took place at New York, in presence of the Secretary of War, Adjutant General Jones, a number of officers of the Army and Navy, and 40,000 spectators.

This is the last notice of the subject which I find in my file of *Miles's Register*, which, however, only comes down to September 25, 1843. The report may or may not have been since made.—*Athenæum.*

## COAL GAS.

A paper on the purifying of coal gas, and the application of the products thereby obtained to agricultural and other purposes, was lately read at the Institution of Civil Engineers, by Mr. Angus Croll. The process consists in passing the gas through a solution of sulphuric acid, of the strength of two and a half pounds of oil of vitriol to 100 gallons of water, and by a continuous supply of acid, so that the proper amount of free acid might be always kept in the vessel, the whole of the ammonia in the gas was abstracted, preventing the corrosive effect of this impurity on the fittings and meters through which it was transmitted, and rendering the gas capable of being used in dwelling-houses, and also enabling the gas companies to use dry lime, instead of wet lime purifiers without producing any nuisance on the opening of the vessels, by which a considerable saving was effected, while at the same time sulphate of ammonia of great purity was obtained, and of such a strength, that the evaporation of one gallon produced eighty ounces of this valuable salt, instead of fourteen ounces, which was the quantity rendered under the former process. The author concluded by showing the advantage to agriculture by the application of this produce; he stated that various experiments upon an extensive scale had been tried with this manure with great success; one example will suffice for giving an idea of its powers. One half of a wheat field was manured with sulphate of ammonia, at the rate of 1¼ cwt. to the acre, and at a cost of £1. 2*s*., the other half with the ordinary manure; the latter produced only 23¾ bushels, but the former under the treatment of sulphate of ammonia produced 32¾ bushels. In the discussion that ensued, in which Professor Graham, Mr. Cooper and many members took part, the advantages of the system were confirmed, and the necessity of its extension insisted upon. The various modes of purifying gas, and the value of the products obtained for agricultural purposes, were canvassed at length. It was stated that seeds steeped for forty hours in a solution of one pound of sulphate of ammonia to one gallon of water, sown in unmanured land, produced a heavy crop, and remained green during a dry season, when every other kind of vegetation became yellow and withered. Another remarkable feature was, that faded flowers, when plunged in a weak solution of sulphate of ammonia, were in a short time restored, and that plants watered with it attained extraordinary health and beauty. The great loss resulting from the leakage of the gas through the joints and the pores of the cast iron pipes, was incidentally mentioned, and it was stated that in some instances it had amounted to from 25 to 75 per cent. of the total quantity produced.

---

## ERROR OF PAINTING SHIPS IN BLACK.

The 'Ragusie,' before-mentioned, is painted black a colour, which by the way we will mention, for it cannot be too generally known, is the most unfit for shipping; being the opposite of light, it absorbs all the prismatic hues of which light is formed, nature always striving at producing equality. As therefore light comes from the sun, it rapidly imbibes the sun's rays, and wood covered with it becomes heated to an extreme degree, and consequently has its pores quickly opened. Where such wood is immersed in water this expansion creates leaks, and their frequency produces decay. White, on the contrary, from containing all the prismatic colours, has the least attraction for solar heat, and is consequently best suited for this purpose. One example will be sufficient. About a dozen years ago H. M.'s ship the 'Excellent' (formerly the 'Bayni'), of ninety-eight guns, was moored at Portsmouth, east and west, and therefore had her starboard side constantly exposed to the sun. That part painted black became very leaky, while the corresponding portion on the larboard side remained sound. White was painted over the injured black part, upon which the leaks ceased, and although the vessel had begun to split in an astonishing degree, she became perfectly water-tight, and so continued.

## PRESERVING SPECIMENS OF PLANTS, OR OF ORGANIC SUBSTANCES GENERALLY.

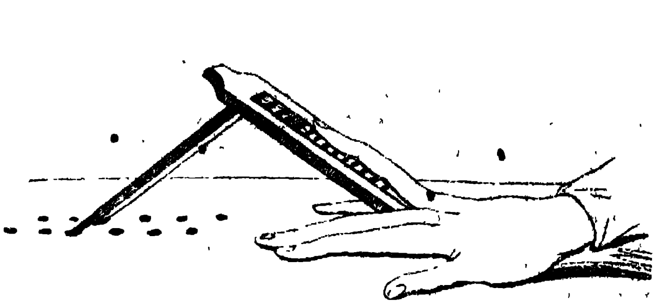
Dr. Riddell, of Louisiana, has found that, by wholly extracting the moisture from the specimens to be preserved, which he does by means of unslacked lime, and then enclosing them in hermetically-sealed cases, they may be exposed to the light without in the slightest degree losing their colour. By carefully surrounding fresh specimens of Rósa gállica with fine powder of quick-lime, in a close tin box, complete desiccation was accomplished in a single day; and the flowers, when taken out, were found of their natural shape and colour, but stiff and brittle from dryness. The rose, or other flower or plant, insect, &c., so dried, is next put into a case (like a wax flower), with a pane of glass in front, and the whole closed by means of putty, so as to be perfectly air-tight. Specimens of insects, fungi, fruits, &c., are effectually embalmed in this manner; but the most practically important part of the discovery to the botanist is, that cacti, and other succulents, may be perfectly dried in a few days, and afterwards deposited in ca[illegible] glass fronts, with their form and colour [illegible]y preserved.—*Gardener's Magazine.*

---

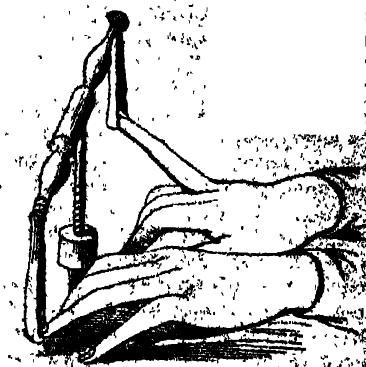
## VARIETIES.

*Population.*—The following curious fact connected with the late Census is recorded in a recent number of the Edinburgh Review:—"The five largest commercial towns in England, viz., the Metropolis, Manchester, Liverpool, Birmingham, and Leeds, with their suburbs, contain within an area of 96,000 acres, or nearly as possible the area of Rutlandshire—a population equal to the total numbers of the following seventeen purely agricultural counties—Bedfordshire, Huntingdonshire, Suffolk, Sussex, Berkshire, Buckinghamshire, Cambridge, Cumberland, Hertford, Yorkshire, North and East Riding, Dorset, Rutland, Hereford, Oxford, Westmoreland, and Northampton, with all the county towns within them—Counties which occupy an area of more than 10,000,000 of acres, or about of the whole extend of England; further, that the population of the same five towns is equal to that of the whole of Scotland with its 19,000,000 acres.

*To preserve Yeast.*—1. A close canvass bag, fill it with yeast, then press out the water and make it into cakes. I have tasted bread made with yeast preserved in this manner, and it has been excellent. The mode of using it is to dilute it with warm water, to which a little sugar and flour are added. 2. Whisk the yeast to a froth, and then with a paint brush lay it on writing paper: continue coating the paper, every time it dries, until a cake is formed; then divide it into squares with a knife.



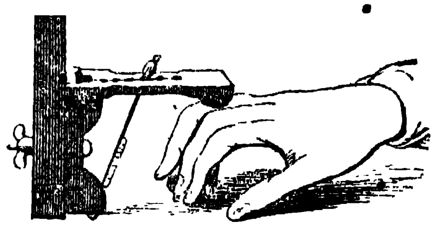
Exercise 3.



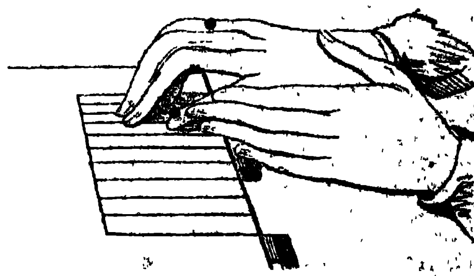
Exercise 4.

Exercise 5.

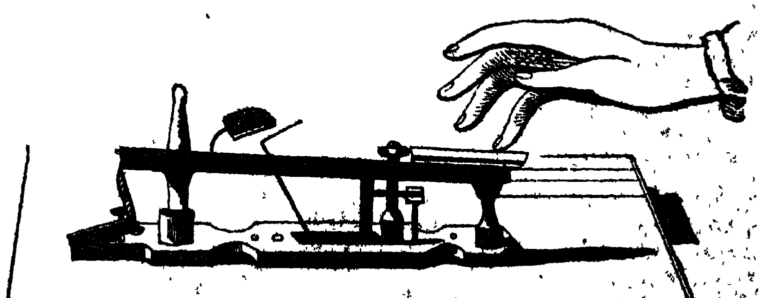
Exercise 6.



Exercise 7.



Exercise 8.



Exercise 9.

## THE CHIROGYMNAST, OR FINGER EXERCISE.

## THE CHIROGYMNAST, OR FINGER EXERCISES.

(Continued from page 146.)

3. This exercise is intended to facilitate the elevation of the third finger, by distending the flexible muscles of the hand. It is made of wood, and one end is fixed to the board by a hinge.

The apparatus resembles a ladder, the steps being represented by small rollers, and the exercise consists in placing the hand flat on the board, with the third finger on the apparatus previously elevated by the upright pieces of wood, as shewn in the engraving; and pushing the hand forward trying to reach if possible the most elevated of the rollers. Repeat this exercise until it can be made without effort, when it may be made more difficult by a further elevation of the board.

It will be found a most useful and improving exercise, strengthening in an astonishing degree the weakest finger on the hand.

4. This apparatus exercises both hands at the same time, and is intended to give a greater facility to the third and second finger, by raising them up; it produces on the fingers the same effect as the preceding exercise; and also gives more strength, by developing the contracting muscles.

It is made of a tube of wood, or brass, fixed into the board: in this tube is inserted a triple nut and screw, made of brass; at the upper end of this screw is fastened in the middle, a piece of wood eight inches in length by means of a pin; and at each end of this piece of wood, a leather strap is screwed, so as to form a bow, or stirrup.

Place the end of the third joint of each finger in each leather strap, and place the ends of the other fingers on the board, holding the wrist high, and keeping the hand in the same position as if you were playing on the Pianoforte.

Begin the exercise by lowering the third finger of the left hand, until it leans on the board, this lowering of the left-hand third finger will necessarily cause the right-hand one to rise; and afterwards lower the third finger of the right-hand, until it touches the board; and this see-saw movement will cause the third finger of each hand to rise alternately.

Repeat this exercise until it can be executed with the greatest rapidity, and always avoid raising the other fingers from the board.

To make this exercise more and more difficult, the piece of wood to which the leather straps are fastened, must be raised gradually, by unscrewing the brass screw, that is to say, by turning it from right to left.

5. This apparatus consists of three Piano keys, having notches at the back, upon each of the keys is a spring of brass: in placing the spring in one or other of the several notches, the key will be made harder. Thus, to exercise the first, second, and third finger, the corresponding keys to the first and second finger must be made easy, whilst the key for the third finger must be made harder. It is easily perceived that, by practising on these keys of *unequal* resistance, *two easy and one hard*, the finger that strikes the hard key must acquire greater strength than those which by practising on soft or easy ones, which have not at all their powers developed.

To practise this exercise, place the hollow of the hand on the hand supporter, so that the fingers which are to be exercised may touch the keys, taking care that the other two fingers may lean on the board.

6. This Apparatus is the smallest that composes the *Chirogymnast*, and ought nevertheless to produce results quite as advantageous in developing the flexibility of the hand.

The third finger, which has hitherto been only exercised by the aid of the different apparatus, ought now to be left to act and acquire the facility of raising itself to any height desired.

The part intended for this exercise is a small piece of brass screwed into the board of the *Chirogymnast*.

Place first the fingers on the board, holding the hand as if playing on a Pianoforte, with the exception of the third finger, the end of which must be placed on the brass oval nob, which piece of brass may be heightened or lowered by means of its screw.

The exercise consists in making the third finger strike on the board, forwards and backwards, by passing over the brass oval nob without touching it.

Raise the brass nob by unscrewing it, so as to augment the difficulty progressively. The use of this apparatus can be varied, by repeating the same movement from right to left, as if a *cadence* on the Piano were being executed with only one finger, and particularly with the third, whilst the others were occupied in holding an *accord plaquee*, which must be imitated by keeping the fingers constantly leaning on the board of the *Chirogymnast*, and parting them as much as possible one from the other.

Observe during every variation of this exercise, that it is only the extreme end of the finger that must pass over the brass nob.

7. Notwithstanding the third finger, by the aid of the foregoing apparatus, has obtained the advantage of moving in every direction, there yet remains something to be done to complete its education. This has been provided for by the exercise No. 6, which by offering an obstacle to the raising of this finger, strengthens the muscles which help to raise it. This apparatus is in direct opposition to No. 5. It is made of a piece of wood fixed to the board, and a key, or a lever, is adapted to the board, by means of a screw with a head. This key can be lowered or heightened, according to the age or length of the fingers of the person exercising. This key is covered with leather in front, and provided with a spring in the back part, which spring serves to bring down the key towards the board after it is raised, and for the purpose of rendering it harder to raise. Place the hand in the position before recommended. Take care to put the first joint (nearest the hand) of the third finger exactly underneath the leather covering, which is on the extreme end of the key, and be particular to place all the fingers on the board.

The exercise consists in elevating the third finger as high as possible, exactly as in No. 6 exercises. Observe, above all, that neither the wrist, or lower arm, makes the slightest movement, that none of the other fingers leave their place, that is to say, they must remain stationary on the board of the *Chirogymnast*.

The strength of the resistance produced by the spring, should be progressively augmented by means of the small button, which is on the lap of the key, and moving it backwards or forwards, the key will be rendered more and more difficult to raise. The third finger being required to raise this key with the first joint (nearest the hand) without moving the wrist or lower arm, whilst the other fingers are placed on the board, cannot fail to acquire the greatest independence of action.

8. The last exercise is intended more as a means of comparing the different degrees of extension acquired by the different gymnastics. It can also serve to exercise the thumb, by passing it under the first, second, and third finger, to effect which, each of the ten fingers must be placed between each of the ten spaces inlaid on the board of the *Chirogymnast*.

The thumb must be trained to pass successively under the first, second and third finger, and even, if possible, under the little finger, which can be accomplished by pushing the thumb with the other hand, taking care to bring it in its first position each time.

Observe attentively, in performing this exercise, to keep the elbows close to the waist.

9. This gymnastic is intended to exercise the fingers of the one hand, by repeating successively the same note with the second, third, fourth, or fifth finger. It is made of a key, a hammer, a check escapement, &c., &c, On this gymnastic must be exercised all the different modes of repeating a note, practised by the best masters, taking care to strike firmly and distinctly, with each successive finger, without moving the wrist or forearm. *The joints of the fingers are only to be used in this exercise.* The distinct strike which the hammer strikes on the copper or brass button will better enable the pupil to judge of the regular succession of pressure on each note, than could be ascertained by the smoothly covered hammers of a Pianoforte, which is put in a constant vibration by repeated strokes.

To make the key harder to strike, the small button, which is behind the key, must be tightened.

It is not proposed to confine the different exercises that can be made on the several parts which compose the *Chirogymnast*, to those only which have been defined. Each person can vary the different combinations, according to his views, or the size of the hand. Thus the exercises can be varied *ad infinitum*.

It is recommended that the exercises be used morning and evening, at least 5 minutes, on each apparatus, and by preference, before playing on the Piano, or any other Instrument. *Avoid, on principle*, making the exercises too difficult. It cannot be too much recommended, to render the difficulties on the different exercises *gradual*, and to leave the exercises during several days on each degree of difficulty, without continually altering it.

The invention has received the approbation of most of the scientific performers on the Piano, as may be seen by a long list of testimonials which the Inventor has in his possession.

## BARK.

The following is a description of the method of bark peeling, and the mode of disposing of it, in the North of England:—In a general way large lots of oak timber are sold standing, the purchaser being obliged to have it all removed within a specified time; and, therefore, at the proper season they employ a number of skilful woodmen to fell the timber in a workmanlike manner, not haggle and hack, as in some of the midland and southern counties, but cutting it by the axe, as low as possible. A number of boys follow, cutting off such branches as are worth peeling, which work is generally performed by women, many of whom are more expert than the men. The bark is dried in some open space by being laid on two rails or poles eighteen or twenty inches apart, and supported about distance from the ground by the poles resting cloven or forked stakes, driven into the groun which stakes, and also the rails, are often fou amongst the peeled timber. On this tempora scaffold the bark is usually dry in a fortnight three weeks, when it is carted to some shed, or in stacks in the open air, which if allowed to s long, will require to be covered with a canvas cloth, or straw; but it is usually prepared ready for the tanners by being cut into small pieces of not more than three or four inches across, any mossy or dirty pieces being previously scraped or pared away. It is then put up in sacks and weighed (being sold by weight, not by the uncertain way of measuring). The intended purchaser generally examines it before putting it in the sacks, and if the price be settled the seller delivers it when it is wanted. Generally speaking, the tanners of Newcastle, Sunderland, and Darlington, are all anxious to obtain good home-grown. Last year the article was 7*l.* 10*s.* to 8*l.* per ton, and the expenses against it may be from 2*l.* 5*s.* to 2*l.* 15*s.* per ton for peeling (including the felling of the trees), 10*s.* per ton for chopping, and 15*s.* per ton for carting it into the house, and from thence to its final delivery.

## GUNPOWDER.

Gunpowder is a mechanical combination of nitre, sulphur, and charcoal; deriving the intensity of its explosiveness from the purity of its constituents, the proportion in which they are mixed, and the intimacy of the admixture.

1. *On the nitre.*—Nitre may be readily purified by solution in water and crystallization, from the muddy particles and foreign salts with which it is usually contaminated. In a saturated aqueous solution of nitre, boiling hot, the temperature is 240° F.; and the relation of the salt to its solvent is in weight as three to one, by my experiments: not five to one, as MM. Bottée and Riffault have stated. We must not, however, adopt the general language of chemists, and say that three parts of nitre are soluble in one of the boiling water, since the liquid has a much higher heat and greater solvent power than this expression implies.

Water at 60° dissolves only one-fourth of its weight of nitre; or, more exactly, this saturated solution contains 21 per cent. of salt. Its specific gravity is 1·1415; 100 parts in volume of the two constituents occupy now 97·21 parts. From these data we may perceive that little advantage could be gained in refining crude nitre, by making a boiling-hot saturated solution of it; since on cooling, the whole would concrete into a moist saline mass, consisting by weight of $2\frac{3}{4}$ parts of salts, mixed with 1 part of water, holding $\frac{1}{4}$ of salt in solution, and in bulk of $\frac{7}{8}$ of salt, with about 1 of liquid; for the specific gravity of nitre is 2·005, or very nearly the double of water. It is better, therefore, to use equal weights of saltpetre and water in making the boiling-hot solution. When the filtered liquid is allowed to cool slowly, somewhat less than three-fourths of the nitre will separate in regular crystals; while the foreign salts that were present will remain with fully one-fourth of nitre in the mother liquor. On redissolving these crystals with heat, in about two-thirds of their weight of water, a solution will result, from which crystalline nitre, fit for every purpose, will concrete on cooling.

As the principal saline impurity of saltpetre is muriate of soda (a substance scarcely more soluble in hot than in cold water), a ready mode thence arises of separating that salt from the nitre in mother waters that contain them in nearly equal proportions. Place an iron ladle or basin, perforated with small holes, on the bottom of the boiler, in which the solution is concentrating. The muriate, as it separates by the evaporation of the water, will fall down and fill the basin, and may be removed from time to time. When small needles of nitre begin to appear, the solution must be run off into the crystallizing cooler, in which moderately pure nitre will be obtained, to be refined by another similar operation.

At the Waltham Abbey gunpowder works the nitre is rendered so pure by successive solutions and crystallizations, that it causes no opalescence in a solution of nitrate of silver. Such crystals are dried, fused in an iron pot at a temperature of from 500° to 600° F., and cast into moulds. The cakes are preserved in casks.

About the period of 1794 and 1795, under the pressure of the first wars of their revolution, the French chemists employed by the government contrived an expeditious, economical, and sufficiently effective mode of purifying their nitre. It must be observed that this salt, as brought to the gunpowder-works in France, is in general a much cruder article than that imported into this country from India. It is extracted from the nitrous salts contained in the mortar-rubbish of old buildings, especially those of the lowest and filthiest descriptions. By their former methods, the French could not refine their nitre in less time than eight or ten days; and the salt was obtained in great lumps, very difficult to dry and divide; whereas the new process was so easy and so quick, that in less than twenty-four hours, at one period of pressure, the crude saltpetre was converted into a pure salt, brought to perfect dryness, and in such a state of extreme division as to supersede the operations of grinding and sifting, whence also considerable waste was avoided.

The following is a brief outline of this method, with certain improvements, as now practised in the establishment of the 'Administration des poudres et salpêtres,' in France.

The refining boiler is charged over night with 600 kilogrammes of water, and 1200 kilogrammes of saltpetre, as delivered by the salpêtriers. No more fire is applied than is adequate to effect the solution of this first charge of saltpetre. It may here be observed, that such an article contains several deliqu scent salts, and is much more soluble than pure nitre. On the morrow morning the fire is increased, and the boiler is charged at different intervals with fresh doses of saltpetre, till the whole amounts to 3000 kilogrammes. During these additions, care is taken to stir the liquid very diligently, and to skim off the froth as it rises. When it has been for some time in ebullition, and when it may be presumed that the solution of the nitrous salts is effected, the muriate of soda is scooped out from the bottom of the boiler, and certain affusions or inspersions of cold water are made into the pot, to quicken the precipitation of that portion which the boiling motion may have kept afloat. When no more is found to fall, one kilogramme of Flanders glue, dissolved in a sufficient quantity of hot water, is poured into the boiler; the mixture is thoroughly worked together, the froth being skimmed off, with several successive inspersions of cold water, till 400 additional kilogrammes have been introduced, constituting altogether 1000 kilogrammes.

When the refining liquor affords no more froth, and is grown perfectly clear, all manipulation must cease. The fire is withdrawn, with the exception of a mere kindling, so as to maintain the temperature till the next morning at about 88° C. = 190·4 F.

This liquor is now transferred by hand-basins into the crystallizing reservoirs, taking care to disturb the solution as little as possible, and to leave untouched the impure matter at the bottom. The contents of the long crystallizing cisterns are stirred backwards and forwards with wooden paddles, in order to quicken the cooling, and the consequent precipitation of the nitre into minute crystals. These are raked as soon as they fall, to the upper end of the doubly-inclined bottom of the crystallizer, and thence removed to the washing chests or boxes By the incessant agitation of the liquor, no large crystals of nitre can possibly form. When the temperature has fallen to within 7° or 8° F., of the apartment, that is, after seven or eight hours, all the saltpetre that it can yield will have been obtained. By means of the double inward slope given to the crystallizer, the supernatant liquid is collected in the middle of the breadth, and may be easily laded out.

The saltpetre is shovelled out of the crystallizer into the washing chest, and heaped up in them so as to stand about six or seven inches above the upper edges, in order to allow for the subsidence which it must experience in the washing process. Each of these chests being thus filled, and their bottom holes being closed with plugs, the salt is besprinkled from the rose of a watering-can, with successive quantities of water saturated with saltpetre, and also with pure water, till the liquor, when allowed to run off, indicates by the hydrometer, a saturated solution. The water of each sprinkling ought to remain on the salt for two or three hours; and then it may be suffered to drain off through the plug-holes below, for about an hour.

All the liquor of drainage from the first watering, as well as a portion of the second, is set aside, as being considerably loaded with the foreign salts of the nitre, in order to be evaporated in the sequel with the mother waters. The last portions are preserved, because they contain almost nothing but nitre, and may therefore serve to wash another dose of that salt. It has been proved by experience, that the quantity of water employed in washing need never exceed thirty-six sprinklings in the whole, composed of three waterings, of which the first two consist of fifteen, and the last of six pots = 3 gallons E.; or in other words, of fifteen sprinklings of water saturated with saltpetre, and twenty-one of pure water.

The saltpetre, after remaining five or six days in the washing chests, is transported into the drying reservoirs, heated by the flue of the nearest boiler; here it is stirred up from time to time with wooden shovels, to prevent its adhering to the bottom, or running into lumps, as well as to quicken the drying process. In the course of about four hours, it gets completely dry, in which state it no longer sticks to the shovel, but falls down into a soft powder by pressure in the hand, and is perfectly white and pulverulent. It is now passed through a brass sieve, to separate any small lumps or foreign particles accidentally present, and is then packed up in bags or barrels. Even in the shortest winter days, the drying basin may be twice charged, so as to dry 700 or 800 kilogrammes. By this operation, the nett produce of 3000 kilogrammes (3 tons) thus refined, amounts to from 1750 to 1800 kilogrammes of very pure nitre, quite ready for the manufacture of gunpowder.

The mother waters are next concentrated; but into their management it is needless to enter in this memoir.

On reviewing the above process as practised at present, it is obvious that, to meet the revolutionary crisis, its conductors must have shortened it greatly, and have been content with a brief period of drainage.

2. *On the sulphur.*—The sulphur now imported into this country, from the volcanic districts of Sicily and Italy, for our manufactories of sulphuric acid, is much purer than the sulphur obtained by artificial heat from any varieties of pyrites, and may, therefore, by simple processes, be rendered a fit constituent of the best gunpowder. As it is not our purpose here to repeat what may be found in common chemical compilations, we shall say nothing of the sublimation of sulphur; a process, moreover, much too wasteful for the gunpowder-maker.

Sulphur may be most easily analyzed, even by the manufacturer himself; for I find it to be soluble in one tenth of its weight of boiling oil of turpentine, at 316° Fahrenheit, forming a solution which remains clear at 180°. As it cools to the atmospheric temperature, beautiful crystalline needles form, which may be washed sufficiently with cold alcohol, or even tepid water. The usual impurities of the sulphur, which are carbonate and sulphate of zinc, oxide and sulphuret of iron, sulphuret of arsenic and silica, remain unaffected by the volatile oil, and may be separately eliminated by the curious, though such separation is of little practical importance.

Two modes of refining sulphur for the gunpowder works have been employed; the first is by fusion, the second by distillation. Since the combustible solid becomes as limpid as water, at the temperature of about 230° Fahrenheit, a ready mode offers of removing at once its denser and lighter impurities, by subsidence and skimming. But we may take the liberty of observing, that the French melting pot, as described in the elaborate work of MM. Bottée and Riffault, is singularly ill-contrived, for the fire is kindled right under it, and plays on its bottom. Now a pot for subsidence ought to be cold set; that is, should have its bottom dart imbedded in clay or mortar for four or six inches up the side, and be exposed to the circulating flame of the fire only round its middle zone. This arrangement is adopted in many of our great chemical works, and is found to be very advantageous. With such a boiler, judiciously heated, I believe that crude sulphur might be made remarkably pure; whereas by directing the heat against the bottom of the vessel, the crudities are tossed up, and incorporated with the mass.

The sulphur of commerce occurs in three prevailing colours; lemon yellow verging on green, dark yellow, and brown yellow. As these different shades result from the different degrees of heat to which it has been exposed in its original extraction on the great scale, we may thereby judge to what point it may still be heated anew in the refinery melting. Whatever be the actual shade of the crude article, the art of the refiner consists in regulating the heat, so that after the operation it may possess a brilliant yellow hue, inclining somewhat to green.

In seeking to accomplish this purpose, the sulphur should first be sorted according to its shades; and if a greenish variety is to be purified, since this kind has been but little heated in its extraction, the fusion may be urged pretty smartly, or the fire may be kept up till every thing it melted by the uppermost layer.

Sulphur of a strong yellow tinge cannot bear so great a heat, and therefore the fire must be withdrawn whenever three fourths of the whole mass have been melted.

Brown-coloured brimstone, having been already somewhat scorched, should be heated as little as possible, and the fire may be removed as soon as one half of the mass is fused.

[*To be continued.*]

## ARTESIAN WELLS AT SOUTHAMPTON.

During the meeting of the Royal Agricultural Society, Dr. Buckland delivered a lecture on Artesian wells, and in particular on that which is now in progression at Southampton. Though uncompleted, it is a work of immense magnitude, vieing with the great well at Grenelle, by which Paris has been lately supplied. The depth of the Southampton well is at present 1,300 feet. The shaft descends through 78 feet of alluvium, 300 feet of clay similar to the London clay (which is a general substratum in the Southampton basin), and through another 100 feet of plastic clay, before it reaches the chalk, through which it descends 100 feet still further. Thus from the surface a well has absolutely been built downwards nearly 570 feet, and under such difficulties from irregularities in the strata that four iron cylinders have been placed in points where no attempt at masonry could have proved successful. Not the least singular part of this work is the manner in which this underground well has been built from the summit level downwards "into the very bowels of the land." This is a matter, however, which it would be tedious to describe; suffice it, therefore, that after reaching a depth of nearly 600 feet, the operations of the masons were suspended, and the boring-rods were brought into operation, and employed until through their instrumentality, the contractors have reached a depth of 1,300 feet. As might be expected, the supply of water is already abundant. It now rises to within 40 feet of the surface, and by the aid of powerful steam-engines no less than 55,000 gallons a day are literally poured into the town of Southampton. It is expected that the water will soon rise to the surface, when the supply will be immensely larger than even this.

## VEGETABLE EARTHS AND MINERAL EARTHS.

To analyse soils is peculiarly the province of the operative chemist: but when this task is completed however successfully, nothing useful is achieved without the additional means of ascertaining the properties of the ingredients which enter into their composition. Now, of the various substances which chemists classify under the term of *earths*, there are few which have not already been found to be nothing more than mineral oxides; that is, minerals reduced to their present appearance by the mere absorption of oxygen, and the presumption is that all are so. Thus, Sir Humphry Davy reduced potass to its primeval mineral state, from which, on being allowed to absorb oxgen from the atmosphere, it immediately reverted into potass again. But above these *earths* we everywhere find (except it be washed away by rain or removed by other causes) a light coat of mould, which used to be called *garden* earth, but for which we hope to find a more appropriate name. It is in this portion of the soil that we know the principle of fructification to reside; and that, even when mixed up with other earths, as in some degree it always is, vegetation is luxuriant as it predominates. Now, this earth differs entirely from the earths classified by chemists, inasmuch as it is not the mere oxydisation of a mineral, but the decomposition of vegetable and animal matter. That such is the case we might fairly infer from daily observation; but Buffon gives us a remarkable proof on a large scale. "I have frequently observed," he says, "on a Roman way, which crosses Burgundy for a long extent, that there is a bed of black earth of more than a foot thick *gathered over the stone pavement*, on which several trees of a considerable size are supported. This I have found to be nothing else than earth formed by decayed leaves and branches which have been converted by time into a black soil." Looking then to the vast difference between the bases of the *mineral* earth, and the basis of this "*vegetable* earth;" and looking to the simple and uniform means by which Nature ever re-produces vegetable life, it is by no means an extravagant, though novel suggestion, that the vegetable earth alone is the store from which vegetation is renewed, and that the mineral earths, to say the least, are *inert* in the process. From the latter, what can the vegetable draw proper for its nutriment, except their oxygen; against which there are two objections, first, that their affinity for their oxygen is probably too great for the calls of vegetation to overcome; and secondly, that Nature, who, however bounteous, wastes nothing, has already supplied the vegetable with a ready and easy supply of oxygen from the atmosphere. That plants will become tinctured by mineral solutions is true, but it is equally true that such a tincture contributes to anything but to their nutriment.—Well, allow that the mineral earths must be inert in vegetation, as all direct reasoning and natural analogy should induce us to conclude, and from thence it is no great stretch to suppose that some of them at least may be positively deleterious. But if so, why do we so frequently, and with so much evident success, mix mineral earths with the staple vegetable earth, to the improved fertility of the latter? Why, for instance, to some light loamy lands do we beneficially apply clay (alumen) as a manure? This question must be answered by another, upon which the whole problem depends. Do the mineral earths, after all, act on the vegetable earth as *manures?* Do they not act in a different and more simple manner? There is no obvious reason why they should act *positively* as a manure, but there is a strong natural reason why they should act *negatively* by another process. We always find the vegetable earth, wherever the hand of man has been, alloyed with some mineral earth: and, if our supposition be correct, that a mineral earth *per se* is injurious to vegetation, it is the essence of noxious matters, that there are others of the same kind which, from their very affinity, they seize upon and render inactive; and in this manner the application of a mineral earth may assist the vegetable earth, not by positively adding to its powers of fertility, but by *neutralising* some other deleterious earth with which it is already charged. And now it may be said, what does it matter practically whether the application of a mineral earth acts by manuring or neutralizing, because the effect is the same, call it by what name you will? Everything! You manure with the mineral earths *blindfold*. You may neutralize by them (if that be the true nature of their action) *with certainty*. After the operative chemist has taught you how by analysis to detect what mineral earth predominates in your soil, it will cost him a great deal less ingenuity and trouble to teach you what other mineral earth will counteract and render it quiescent. There would then be no risk of doing harm instead of good, as is now too frequently done even with that best understood of all preparations, lime. Other advantages might be pointed out, but this is so palpable and important, that the subject had better be here dropped for the present.

## ELECTRO METALLURGY.

(*Continued from page 171.*)

*Mechanical Battery.*

"This battery, after I had minutely investigated every property which belongs to the metals of which batteries are constructed, was made upon noticing the property which rough surfaces possess, of evolving the hydrogen, and smooth surfaces, of favouring its adhesion. Thus whatever metal we use for our negative plate, we take care that it be roughened, either by a corrosive acid, as iron by sulphuric acid, or mechanically by rubbing the surface with sand paper. Even by these means alone the metals are rendered much more efficient; but to take advantage of this principle to the fullest extent, I cover platinum with finely divided black powder of platinum, by galvanic means; that is, I place the platinum as the copper is placed in a Daniell's battery; but instead of employing sulphate of copper in the outer vessel, I use a small quantity of nitro-muriate of platinum, so that the finely divided metal is thrown down on the sheet platinum, previously roughened by sand paper. In this way it was also placed on palladium, silver (roughened by nitric acid), plated copper, iron of every sort, and on charcoal, with the same good result; but no other metal was found to answer for its reception. The metal generally employed is silver, because of its cheapness, and its not undergoing any alteration. But whatever metal be used, the principle is the same, viz. the affording a surface to which the hydrogen shall not adhere, but from which it shall be evolved; and the infinity of the points which are presented by such a surface as above described, appears to be the cause of this excellent result. The preparation of the silver is now made a separate branch of a trade, and the platinized metal can now be bought ready for use; but for those who desire to perform this operation, a brief description is here added.

"The metal to be prepared should be of a thickness sufficient to carry the current electricity, and should be roughened, either by sand paper, as in the case of platinum or palladium, or when silver is employed, by brushing it over with a little strong nitric acid, so that a frosted appearance is obtained. The silver is then washed, and placed in a vessel with dilute sulphuric acid, to which a few drops of nitro-muriate of platinum are added. A porous tube is then placed in this vessel, with a few drops of diluted sulphuric acid; into this the zinc is put Contact being made, the platinum will in a few seconds be thrown down upon the surface of the silver, as a black metallic powder The operation is now completed, and the platinized metal ready for use However, iron, when thus prepared, is as effectual as silver, and may be sometimes employed with advantage. With this metal, all that is required is to rub a little nitro muriate of platinum over it, and an immediate deposit of the black powder takes place

"The liquid generally adopted to excite this battery, is a mixture of one part, by measure, of sulphuric acid, and seven of water, which will be found amply strong for all purposes Where we desire greater intensity we can obtain it by the addition of a few drops of nitric acid, but if too much be used it will attack the silver When however, platinized platina is employed, the nitric acid may be used with impunity The electro-metallurgist will find it advisable to use dilute sulphuric acid, containing only $\frac{1}{15}$th of the pure acid

"Numerous enquiries have been made as to what arrangement is best suited to this battery, but this must depend upon the purpose for which it is employed For the student's laboratory, the Wollaston trough of twelve cells appears to be best adapted and it should be so constructed, that any number of cells may be employed, independently of the others as they may be required The silver being the most expensive metal, the zinc should completely surround it so that the whole of the silver may be brought into action When a battery is required to continue in action for a very long time, as for days or even weeks, a larger vessel, to contain more dilute acid, must be used

"When we desire to employ a battery for manufacturing purposes it might be as well in some cases to remove the sulphate of zinc as soon as formed, by means of a syphon tube passing to the bottom of the vessel, while fresh acid is continually supplied at the top, but this is not generally necessary For these purposes the battery should be so constructed that any of the zinc plates, when worn out can be readily replaced There are many other forms which may be adopted, is the circular, with the zinc outside, or it may be used as a tumbler battery

"The characteristic of this battery is the great quantity of electricity produced, and its simplicity, moreover it requires but very little trouble in its manipulation The zinc seldom demands amalgamation as that will generally last till the metal is dissolved

"In using this battery it is important that no salt of copper, lead, or other base metal be dropped into the exciting fluid, as by that means the silver would become coated therewith, the plain consequence being that a surface of copper instead of that of the finely divided platinum is presented to the fluid From a want of knowledge of this fact, in some who have used the battery, I have seen the negative metal covered with copper, which finally becoming oxidated, rendered the platinum useless

"Such is a brief view of the three batteries now in use Professor Daniell's excellent invention being distinguished by its constancy, Mr. Grove's powerful battery, by its intensity, and my own, by the quantity of electricity developed, and by its simplicity Neither of these can be regarded as a perfect galvanic battery, for each wants some of the properties of the others, it is to be hoped therefore, that every attention will be given to the further improvement of these valuable instruments, until the good properties of each are combined in one. Which of the three is at present to be preferred, must depend upon the purpose for which it is required, and the choice must of course be left to the operator. For my own part it affords me much pleasure to see that the platinized silver battery has fully answered the expectations which I formed of it. By some it has been too much extolled, by others too much blamed It has been the subject of experiments not appertaining to it, such as comparing its intense effects when quantity is its characteristic. Notwithstanding the mis-statements on both sides, it has fully stood the test of time, and has been employed by the public in a manner which I had not even hoped The reason they prefer it for general and especially for manufacturing purposes appears to be, that it does not require the use of porous tubes, nor of the strong acids, and that it does not give off poisonous fumes. It will continue in active operation for two, three, or more days, when a sufficiency of acid is supplied to it. The zinc frequently demands but one amalgamation; and the time required either for setting it in action or for maintaining its operation, is comparatively not worth a thought, and lastly, the expense of working it is reduced to the lowest possible amount, being exactly proportionate to the power obtained.

*(To be continued)*

## NEW MODE OF TRACKING ON CANALS.

It will be interesting to our scientific readers to learn that steam-stugs, with screw propellers, have now been successfully introduced on the Union Canal An experiment with one of these steamers took place a few days ago, under the superintendance of the Company's able manager R Ellis, Esq, in the presence of their chairman, Col M'Donald, Messrs Maxwell, M'Lagan, Burns, L'Amy and Tennant, directors, Mr Shaw, manager for the Duke of Hamilton, Mr Crichton, manager of the Forth and Clyde Canal, Mr Glennie, manager of Monkland Canal; Captain Yuill, R N., together with a number of other gentlemen interested in the result The boats are the first of the kind introduced into Scotland They are built of iron by Messrs. John Reid and Co, of Port-Glasgow; and the engines, screw-propellors, &c, are fitted up by Mr. William Napier, sen., engineer, Glasgow. The engines which were much admired, are on the upright principle. They communicate their power to the screws placed on each side of the bow, and by a very nice arrangement of wheels with wooden and iron teeth (in order to prevent noise and vibration), they are driven at a great speed without creating any of that surge or wash on the banks which has hitherto formed the chief objection to the use of steamers on canals The result of the experiment gave great satisfaction to all present; and, independently of the gain in point of speed, it is calculated that there will be a considerable saving in expense, compared with the ordinary mode of tracking by horses. The steam-boat had attached to her, six very large scows deeply laden, but it is capable of towing double the number without any material diminution of speed The scows to be tracked are connected together by rods having a parallel movement, and all under the control of the steersman on board the steamer, so that the necessity of a separate rudder and steersman for each scow is avoided—the whole train moving along with a steady and uniform motion. After the company had been thoroughly satisfied as to the practicability and success of the scheme, which there is every prospect of being very generally adopted, they adjourned to the Star and Garter Inn at Linlithgow, where the Directors handsomely entertained them at dinner. The evening was spent in a rational and agreeable manner, the various scientific gentlemen present expressing themselves highly delighted with the experiment they had witnessed.

## BOTTLE AND HALF MEN AND VENTILATION.

Some years ago, about fifty members of one of the Royal Society Clubs at Edinburgh, dined in an apartment I had constructed, where, though illuminated by gas, the products of its combustion were essentially excluded, as they were all removed by a ventilating tube connected with, but concealed in, the drop of the gothic pendant in which the central lights were placed. Large quantities of a mild atmosphere was constantly supplied, and passed in quick succession through the apartment throughout the whole evening, the effect being varied from time to time by infusing odoriferous materials, so that the air should imitate successively that of a lavender field, or an orange grove, &c. Nothing very special was noticed, during the time of dinner by the Members; but Mr. Barry, of the British Hotel, who provided the dinner, and who, from the members of the club being frequently in the habit of dining at his rooms, was familiar with their constitutions, showed the committee that three times the amount of wines had been taken than was usually consumed by the same party in a room lighted by gas, but not ventilated—that he had been surprised to observe that gentlemen whose usual allowance was two glasses, took, without hesitation, as much as half a bottle—that those who were in the habit of taking half a bottle, took a bottle and a half, and that, in short, he had been compelled twice to send hackney-coaches for additional supplies during dinner, though he had provided a larger supply than usual, considering the circumstances under which the members met. Minute inquiries afterwards assured me, that no headache nor other injurious consequences had followed this meeting, nor was any of the members aware, at the moment, they had partaken more heartily than usual, till Mr. Barry showed them what had taken place. The meeting included individuals of all ages, and of extreme variety of occupations, among whom there were judges and members of Parliament, medical men and members of the bar, naval and military officers, whose different ages varied as much as their very various professional occupations.

## THE IRON MANUFACTURE.

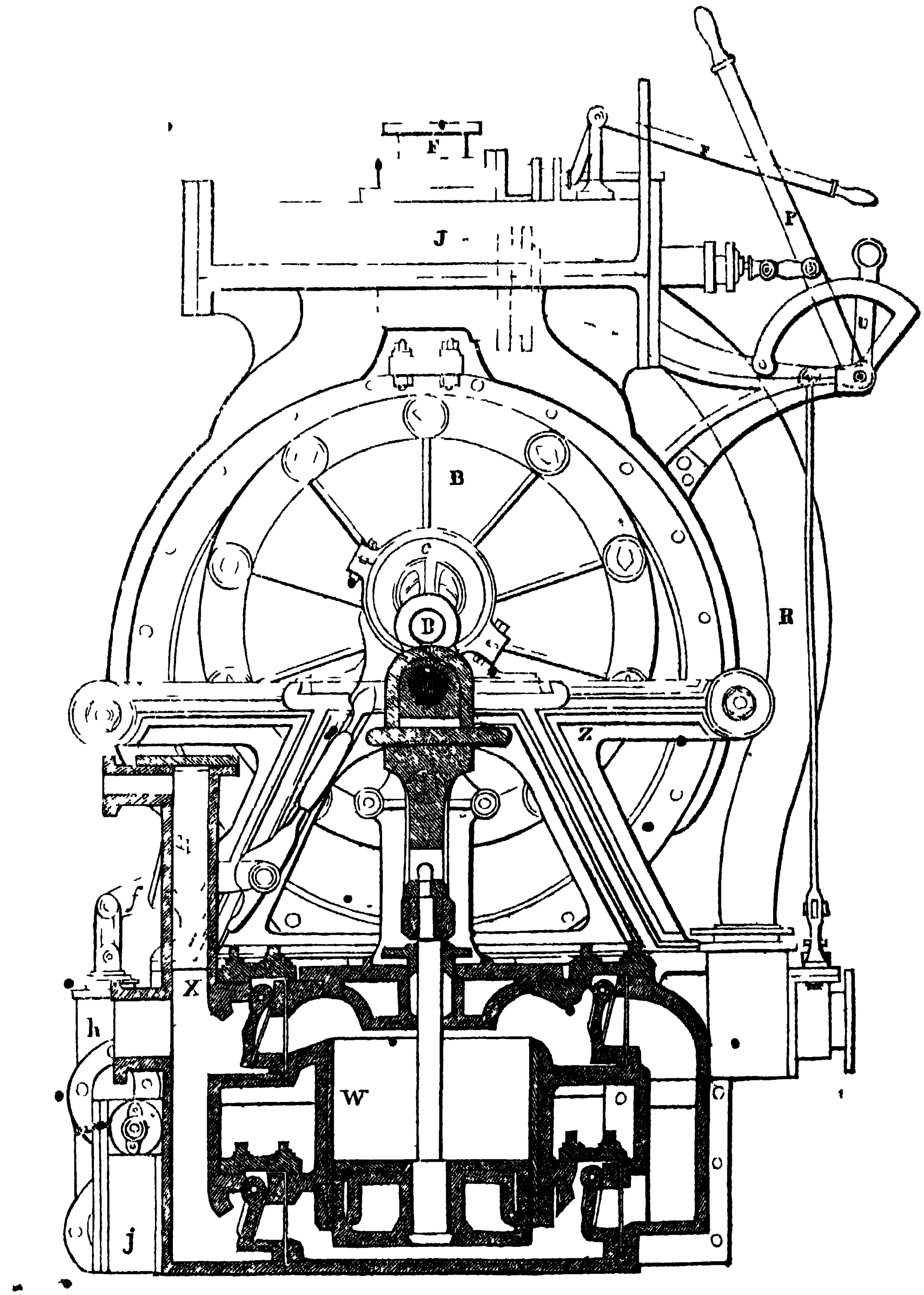
The attention of the iron-masters has been attracted to a process of considerable importance lately introduced into their manufacture. The application of electricity, to supersede several of the expensive processes, has, it is stated, been tried in the Welch and Derbyshire furnaces with satisfactory results. It appears that the costly fuel and labour required for the purification of the ore from sulphur, phos-[illegible] and such subtle elements, create its high [illegible] value; and these being all electro-negative, have induced the new process, whereby the impure stream of metal after flowing from the blast is in its moment of consolidation subjected to a powerful voltaic battery, which so disengages the impure components that in the process of puddling they are readily extracted. The London blacksmiths, it is stated, have tested this iron after a single reheating, and pronounce it equal to the best metal in the market. By the same process an experiment was tried by Dr. Ure, by whom a soft rod of iron was held in contact with a moderate red heat, and that gentleman is understood to have stated that in a few hours the metal was converted into steel. Should these facts prove what they seem, they are calculated to affect most seriously this important branch of our trade.

## VARIETIES.

*Frictional Electricity.*—From the facts observed by M. Peltier, it follows that pressure and swiftness are uninfluential on the effects produced; and that the quantity of electricity is in proportion to the swiftness, whatever the pressure is. In the explanation which this philosopher has given of facts observed, he has deducted the electricity which recombines at the very source where it is liberated, when no obstacle to this recomposition is present. It is for want of having made allowance for this recomposition that other persons have been equally led into error in the explanations they have given of the phenomena produced in the liberation of electricity by friction; in fact, the following considerations ought never to be lost sight of:—First, when the decomposition of the two electricities by friction is brought about more rapidly than the recomposition, the electric tension increases. Second, if the recomposition is made in an appreciable space of time, the faster we turn, the higher will the maximum tension arise. It is very evident that, when we turn rapidly, a certain point is attained at which the tension of the liberated electricity is such that a portion of the two electricities combines, notwithstanding the bad conductibility of the bodies rubbed; the same will be the case in proportion as the intensity increases. Hence, there must be a certain maximum intensity, which cannot be passed, seeing that the two electricities always recombine on contact, the friction not being so instantaneous, that the separation of the two bodies can be effected in an infinitely small space of time. Whence we may comprehend that the disengagement of electricity is independent of the pressure, and of the swiftness of the friction.

*Solid Carbonic Acid.*—M. Thilorier found that when a slender stream is allowed to issue from a jet into the air, the cold produced by the instantaneous evaporation of a portion is sufficient to *freeze the remainder*, which falls like snow. By receiving the jet of acid into a round box, furnished with perforated wooden handles, this strange snow-like solid carbonic acid can be collected in any quantity and examined. It is comparatively permanent, and but slowly passed into the state of gas, from its exceedingly low temperature and bad conducting power for heat. If lightly touched it may be handled without inconvenience, but if pressed upon the skin causes painful disorganization. The solid acid is insoluble in water, but mixes easily with ether.

*Powder to destroy Flies.*—Mix together white arsenic 1 part; white sugar 30 parts; and rose pink 1 part. It should be carefully kept from children, and should be marked *poison* if put away in pape




BORRIE'S PATENT REVOLVING STEAM ENGINE.

## BORRIE'S PATENT REVOLVING STEAM ENGINE.

The following account of the Borrie's Patent Revolving Steam Engine, is taken from the *Engineer's Journal*.

A, is the foundation plate, to which all the parts of the engine are directly or indirectly attached. B, is the external cylinder fixed to the foundation plate. C, is a smaller cylinder, revolving within the external one, on a shaft D, whose centre is placed so far above that of the external cylinder, that their circumferences may touch one another at the upper point; thus the fire with coal or coke; the fire grate; the hearth leading to the flue or chimney; the vessel or matter to be heated, being placed at *e*. The shaft *a*, is covered with a plate, so constructed as to regulate a current of air, which is allowed to descend the shaft *a*, and pass through the upper stratum of coal simultaneously with a current of air which is admitted at the botton of the shaft and allowed to pass upwards through the fire, which currents meet and pass off with the products of combustion over the hearth to the chimney. The patentee states that it will be desirable to build upon, and over the hearth, a number of arches at convenient distances from each other, under which the flame passes. The second improvement consists in the application of inverted vessels (which the inventor denominates "preservers") fixed at or near the bottom of the boiler or pan, whether the same be open at the top or closed.

There are plates of iron rivetted or otherwise fixed to the sides of the boiler, and extending to within about one-eighth or one-fourth of an inch from the bottom of the boiler. Thus the steam generated within the preserver, that is, between the plate and the side of the boiler, cannot escape above the surface of the water line, but is retained between the boiler and the plate until by its "tension" or elasticity it is forced downwards, and underneath the edge of space between them gradually increases to the lower point *h*; (the shaft D, passes through steam tight stuffing boxes in the cylinder ends, and revolves in bearings on frames, which are firmly bolted to the foundation plate, and stayed to the cylinder) Two sliding pistons, consisting each of two arms, are connected together by four rods passing over the shaft, their breadth is equal to that of the outer cylinder, and their joint length over their extremities is necessarily somewhat less than its diameter, owing to the eccentricity of the revolving cylinder; these pistons slide freely at right angles to one another, through passages made in the circumference of the revolving cylinder, their sliding motion being caused by the pressure of one of their extremities on the ascending side of the outer cylinder through which they slide; as their length is always slightly varying during the course of a revolution, the difference is made up by metallic packing placed between the two thicknesses of plates, of which the arms of the pistons are composed, the packing is pressed by springs towards the sides and circumference of the outer cylinder, and will be understood by referring to the annexed drawing. There are metallic packings, (in the passages in the inner cylinder, through which the pistons slide,) which are pressed on the flat surfaces of the pistons by springs, and prevent the steam passing to the interior. There are also two steel rollers at the inside of the packings, which are pressed up to the flat sides of the pistons by screws; these are for the purpose of diminishing the friction of their sliding motion. These rollers would not be necessary excepting in large engines. The rim of the inner cylinder is made to project into metallic packing boxes in the cylinder ends, thus the steam is entirely prevented from passing into the interior of the inner cylinder; a packing box is also placed at the point of contact to prevent the steam passing to either side. It will therefore be understood, that the steam only acts on the projecting part of the sliding pistons, between the inner and outer cylinders.

The steam in coming from the boiler through the steam pipe F, has first to pass a slide, which is worked by a handle; it is used for regulating the speed of the engine, and also for stopping it, when required: after passing the above slide it enters the steam tight jacket J, the bottom of which is the slide face having four cylinder ports, and an eduction port on it; a slide worked by a handle P, passes over these ports for the purpose of reversing the motion of the engine: there are two ports on the slide, one of which, (in the position the slide is shown on the drawing) is open to the steam port; the one port is closed, and two ports M and K, are open to the eduction port, so that when the slide is in this position, the engine will necessarily move in the direction indicated, and the steam will act at the opposite side of the cylinder and consequently the motion be reversed.

It will here be observed that the lower cylinder ports, are *never* used for admitting steam, but only for leading off the eduction; the object in placing them so low in the cylinder is to allow the vacuum to act upon the pistons sooner; it will be kept in mind then, that in whatever direction the shaft revolves, the steam is always admitted at one of the upper ports, and the eduction led off at its opposite lower and upper ports. All these ports where they are lead into the cylinder, are divided into bridges placed diagonally across them so that the pistons may pass freely over them.

From the relative position of the two cylinders, the distance between their circumferences gradually increase from contact at the upper point, to the greatest distance at the lower point, (which in this case is one-sixth of the diameter of the external cylinder, but may be varied according to circumstances,) it will be seen that in whatever direction the engine revolves, the area of that part of the pistons which is acted on by steam and vacuum, gradually increases, so that the principal of expansion is carried out to its fullest extent without the aid of expansion valves and gear.

The steam passing through the eduction passage is conducted by the eduction pipe to the condenser; the inspection slide, placed at the lower end of the eduction pipe, conducts the water up the pipe, so as to act fully on the steam in passing downwards; it is worked by a lever and rod connected to the handle U, which is placed in proximity with the other starting handles. W, is the air pump, which is a double acting one, with the interior arrangement of its valves, &c.; it has a metallic packed piston which is worked from the main shaft by a crank and connecting rod, and the piston rod is kept parallel by two slide guides bolted on the air pump cover. X, is the hot well and the discharge passage.

The pumps are worked from the main shaft by an eccentric, connected by a rod and lever to a rocking shaft, on which are keyed two levers, which are connected by rods to the pumps, one pump is intended for the bilge water (supposing this to be a marine engine), and the pump *h*, for feeding the boilers, the latter has its valve chest *j*, bolted on the hot well.

Among the advantages which render this improved steam engine so peculiarly well adapted for locomotive and marine purposes, may be mentioned the following, viz.;—Small cost of construction, great economy of fuel, the space occupied by it is very little in proportion to its power, and also its comparative lightness, the weight of the engine being only about 2 cwt., per horse power, and that of the boilers only about 2¾ cwt. per horse power, so that the whole weight will only be about one half of the lightest engine hitherto constructed.

The revolution of one piston is divided into thirty-two equal parts. The external cylinder is three feet six inch diameter, and 1 foot 6 inch long inside, and the greatest distance between it and the internal cylinder, is 7 inches. The steam is supposed to be at a pressure of 30 lb. on the square inch, above the atmosphere, and the vacuum to be equal to 12 lb. on the square inch, the shaft making 50 revolutions per minute.

## SWIMMING.

The weight of the human body is very nearly equal to that of its own bulk of water; its magnitude, however, is subject to a small variation, caused by the action of breathing; when the lungs are inflated, the volume of the body is greater than after they collapse. It is true that in this case the weight of the body as well as its magnitude, strictly speaking, undergoes an increase; but the change of weight is comparatively small, being that of a few grains of air, which are alternately inspired and breathed out. The change of volumes produces, however, a sensible effect when the body is immersed in the liquid.

When the chest is inflated with air by drawing in the breath, the body is somewhat lighter than its own bulk of water; and, if it be immersed in that liquid, it will displace its own weight before total immersion takes place. If the head be presented upwards and inclined backwards, so as to keep the mouth and nose in the highest possible position relatively to the remainder of the body, a person may float with about half the head above water when the chest is filled with air; but when he breathes out, his lungs collapse, and the bulk of his chest is diminished; his weight, however, remaining the same, he must sink deeper in order to displace his own weight of water. A living body floating on water is, therefore, in a state of continual oscillation, alternately rising and sinking: this effect is increased by the inertia of the body; for when it descends it will not cease to sink exactly at that depth at which it displaces its own weight of water, but it will continue to move with the velocity it has acquired until the increasing weight of the water displaced forces it to return upward: its alternate ascent is similarly increased. This effect may be observed by pressing a piece of cork in water to a greater depth than that at which it naturally floats; an oscillation will ensue which will continue for some time.

Hence arises one of the difficulties which are found in floating on water; for, in the alternate sinking of the body, the mouth and nostrils may be so choaked as to intercept the breathing; a slight action of the hands or feet is therefore necessary to resist the tendency to sink after each expiration from the chest.

The lighter the body is in relation to its magnitude, the more easily will it float, and a greater portion of the head will remain above the surface. As the weights of all human bodies do not bear the same proportion to their bulk, the skill of the swimmer is not always to be estimated by his success: some of the constituent parts of the human body are heavier, while others are lighter, bulk for bulk, than water. Those persons in whom the quantity of the latter bear a greater proportion to the former will swim with a proportionate facility.

Sea water has a greater buoyancy than fresh water, being relatively heavier; and hence it is commonly said to be much easier to swim in the sea than in a river: this effect, however, appears to be greatly exaggerated. A cubic foot of fresh water weighs about 1000 ounces; and the same bulk of sea water weighs 1028 ounces; the weight, therefore, of the latter exceeds the former by only 28 parts in 1000. The force exerted by sea water to support the body exceeds that exerted by fresh water by about one thirty-sixth part of the whole force of the latter.

It has been proved that in whatever position a body floats on a liquid, the same bulk must be immersed; it follows, therefore, that if a person floating raise his hand above the surface of the water, an equal portion of his head must sink. Hence the danger arising to persons drowning is increased by the involuntary effort by which they stretch out their arms.

The bodies of some animals are much lighter than their own bulk of water. Many species of birds, such as ducks, geese, swans, and water fowl generally, present examples of this. The feathers with which they are covered contribute much to their buoyancy; and, in many instances, a very small portion of their body will displace a quantity of water equal to their weight.

Fishes have a power of changing their bulk by the distension of an air vessel with which they are provided; they can thus at will displace a greater or lesser quantity of water. When they enlarge their bulk, so as to displace more water than their own weight, they rise to the surface; and when, on the other hand, they contract their dimensions, so as to displace less water than their own weight, they sink to the bottom.

When a human body is first drowned, the air being expelled from the lungs, it is heavier, bulk for bulk, than water; and, therefore, remains at the bottom. The process of decomposition subsequently produces gases, by which the body is swelled and increased in bulk so much, that it displaces more water than is equal to its own weight. and therefore rises to the surface. When the vessels, containing the gases thus generated, burst, the body will again contract its dimensions and sink.—*Lardner.*

## CULTIVATION OF PEPPER.

Among the various productions of the southern districts of Malabar, is the pepper vine; it is a staple commodity at Ajengo, and grows on a beautiful vine, which, incapable of supporting itself, entwines round poles prepared for it; or, as is more common in the the Travancore plantations, the pepper vines are planted near mango, and other trees of straight, high stems; which being stripped of the lower branches, the vine embraces the trunk, covering it with elegant festoons and rich branches of fruit, in the picturesque style of the Campagna Felice. The mango and jac trees are generally used for this purpose; few pepper gardens contain more than eight or ten trees. The vines are planted near the trunk, and led to it while young; the stem is tough, knotty, and strong. Some begin to bear in the fourth year, others not till the sixth; they are in perfection about the ninth or tenth year, and continue bearing as many years longer, if in a congenial soil; from that period the vine gradually decays, and a new soil is then prepared for a considerable depth round the tree, for the reception of fresh shoots from flourishing vines. The leaf of the pepper plant is large, and of a bright green; the blossoms appear in June, soon after the commencement of the rains. They are small, of a greenish-white; succeeded by bunches of green berries, which turn brown and hard as they ripen: the pepper is gathered in February, and has the same appearance as when sent to Europe. The flavour of pepper is more or less communicated to the fruit of the tree which supports it; a circumstance not at all relished by the proprietor, as many mangoes naturally taste strong of turpentine, and are not improved by the additional pungency of pepper. Assiduity and cleanliness are essentially necessary in a pepper garden; not a weed is permitted to grow; the produce, however, amply compensates for the trouble; for although the Ajengo pepper is not so much esteemed as that produced at Onore and Carwar, it is sold, on an average, at eighty rupees a candy; five hundred and sixty pounds English weight. It is treason to destroy a pepper vine in Travancore, where the king monopolizes that branch of commerce; but permits the merchants of Anjengo to have a free trade with his subjects in cassia, coir, cables, and cordage, made from the outer husk of the cocoa-nut.

## ON THE ADAPTATION OF SUSPENSION BRIDGES FOR RAILWAYS

BY G. L. SHIRLEY.

*For the Magazine of Science.*

In making a few remarks on this subject, it is my intention to confine myself to Bridges over which the Railway passes. Every person who has been accustomed to read Scientific Works, would have heard of the Suspension Bridge of Captain Samuel Brown, and must be acquainted to a certain extent with their principle of construction. Now owing to the great weight which are conveyed on Railways, it is necessary that a Bridge should present the three following essential properties:—

1. Perfect rigidity.
2. Strength to carry the load required.
3. And should be formed of such materials which possess the greatest durability.

First. It should possess perfect rigidity. Every person who has been engaged in Engineering pursuits, will have found that this cannot be attained in a Suspension Bridge, and it is at once evident to the most superficial observer, that a chain passing over two pieces and hanging down by its own weight in the centre, would be subject to vibrations by the application of a small force. To shew how essential this property is, I will cite two or three examples, which are not only interesting but useful as practical occurrences to the Engineer. It must be in the recollection of most of your readers, that not long ago an accident occurred to the Menai Suspension Bridge, erected under the superintendance of the late celebrated Mr. Thomas Telford, which was severely injured during a gale of wind. The most plausible explanation of this occurrence, which was first propounded by Professor Cowper, and which seems to be gaining ground, is, that the wind catching the *regular intervals* of the vibration of the Bridge, that is, the wind keeping time with the vibrations caused them to increase, till at last the Bridge was overthrown. It is from precisely the same reasons that trees are uprooted from the ground; the famous chain pier at Brighton met with a similar accident. The experiment may be easily tried by manual exertion, by merely continually pushing yourself against the chains of a bridge, and if you succeed in catching the intervals of vibration, a considerable shaking on the bridge will soon be experienced. Now a train of carriages or waggons with an engine attached, when going over a Suspension Bridge would produce a similar series of vibrations, and would therefore have the same tendency only to a greater extent of overthrowing the structure, and this is carried out by experience. A Suspension Bridge on Captain Brown's principle was erected across the river Tees, to carry the Stockton and Darlington Railway, and when finished it was found quite impracticable for the traffic and carriages to pass over it, and in fact it assumed the shape of a cone, the apex being in the centre of the bridge, so that gearing was obliged to be resorted to in order to prop it up, rendering it a complete wooden structure, before it was safe for the carriages and traffic to pass over it, so that the case as carried out in practice is impracticable.

The Second property, viz. "That the bridge should possess sufficient strength to carry the load required," follows immediately from what has been stated, and it is unnecessary to dwell further on this subject.

As regards the Third statement, I would mention that wood possesses vast less durability than iron or stone, especially when exposed alternately to wet and dry weather; and though very little of this material is used in a Suspension Bridge, still it is a matter that cannot be over looked. The cross joists and covering may however be of iron, but this only adds to the expense in the first instance, and is a method that as far I am aware of is never used.

There is however another kind of Suspension Bridge on the principle of Mr. George Stephenson, in which cast iron girders are suspended from wrought iron tension bars placed in the same place as the former. This principle has been used in the Northern and Eastern, and Blackwall Railways, and has been found to answer to a certain extent where the space is not large, but where it is beyond a certain limit, the girders must be made very large to possess a sufficiency of strength. Though such a bridge may be to a certain extent rigid, yet it is not sufficiently so for an engine of 10 tons weight, and it is far from being as durable a mode of constructing as might be adopted.

The conclusion therefore which I have arrived at, and which seems to have been carried out by practice, is, that Suspension Bridges are inapplicable for Railways, and it will be found that nothing eventually answers so well as a substantial stone structure, which may at all times be depended upon, and the cost of a bridge of the latter description would be less, in localities where stone is abundant than Mr.

Stephenson's plan, and even in districts where stone is scarce, the cost of keeping the girders, &c. in repair, would eventually be more than a stone structure, and by having one of the latter description, a good solid bridge may always be insured.

*Durham.*

*To the Editor of the Magazine of Science.*

SIR,

My attention has been called to a notice in your valuable Publication Vol. VI., No, 270, of a patent taken out by me, viz. "An Improved Lining for Walls of Houses," and with the exception of the first sentence, "They consist in covering Walls with a lining of Cotton or other Fabric, coated at the back with a solution of caoutchouc," (this is of course what I do patent,) all that follows in reference to the proper application is erroneous.

It will however be unnecessary to occupy your columns with a description of the patented process, as parties requiring to use the Lining may obtain every information of the Patentee.

I am, Sir,

Your obedient Servant,

JOHN COLLARD DRAKE.

London,

19, *Elm Tree Road, St. John's Wood.*

## FOUNTAINS.

THE great beauty of these additions to a garden, and the comparatively small cost, render it surprising to us that they are not more generally employed. There are few situations in which there are the requisites for a Fountain without some artificial contrivance. It is certain that there must be a head of water somewhere considerably above the level, and this must be conveyed to the design by means of a pipe underground, or at least out of sight, but what if we inform our readers that at a place of some note, where there were at least half a dozen ornamental fountains, all there was to make them play their put was a water-butt, which was filled with rain when there was enough of it, and was filled by a common force pump when there was much dry weather. In such a case as this there must be some economy of water observed. The fountains only played when there was somebody to look at them, because they required a man constantly at work while they did play, though every one was turned off and on at pleasure. The description of the various modes of supplying a fountain would occupy a volume, but there is one worth noticing, especially for its adaptation wherever there is a flow of water: suppose a brook, for instance, comes through premises, and the highest part of that brook was only three feet above the lowest part where it runs off; by the application of a water-ram, a simple and useful contrivance, water can be raised to ninety feet high, so that it is only necessary to find a place, or form a place strong enough to hold a head of water, and by the means of this ram a continuous supply may be had at the full height without manual labour. It is thus described:—

"The Ram, which was invented about 300 years ago, is a machine for raising water to any given height, by means of the momentum of a stream of water flowing through a pipe, the passage of the pipe being stopped by a valve, which is raised by the stream as soon as its motion becomes sufficiently rapid, the whole column of water concentrates on the valve, and acts as a single solid, so that it must resist any pressure. It is a matter of astonishment that a machine possessing so many advantages as the water Ram, (the price of which is from £8 upwards) is not in more general use, when its utility is considered. There is not more than 300 of them in use."

By means of this very simple apparatus, you may raise the water from a cistern, where it is laid on in the lower part of the premises, to fill vats or tanks at the top of the house, and a small pipe conveyed down, out of sight, through any device in a garden, will play a jet of very considerable power and height. By the same contrivance a reservoir or pond on the top of a hill may be filled from a running stream at the lowest part of a valley, and at any distance; we, therefore, are a little astonished, that ornaments so very well calculated to embellish even the finest garden should be so neglected. This brings us to the consideration of the defunct fountains in Bushy Park; we may be told about the expense of repairing, the difficulty of the job, and fifty other objections which can be urged against putting the fountain in order; but we deny the right of any government to allow the public edifices and grounds to remain out of repair. If the fountain and pond are not to be kept in order, let them be destroyed, but it is discreditable to see a noble design, calculated to enhance the beauty of a popular drive, allowed to stand as a memento of neglect in a government, which can expend, somehow or other, something like fifty millions per annum, but which is two parsimonious to keep up, in working order, one of the handsomest objects about the Hampton Court Palace.—*From the Gardener,*

## GUNPOWDER.

*(Continued from page 181.)*

Instead of melting, separately, sulphurs of different shades, we shall obtain a better result by first filling up the pot to half its capacity, with the greenish-coloured article, putting over this layer one quarter volume of the deep yellow, and filling it to the brim with the brown-coloured. The fire must be extinguished as soon as the yellow is fused. The pot must then be closely covered for some time; after which the lighter impurities will be found on the surface in a black froth, which is skimmed off, and the heavier ones sink to the bottom. The sulphur itself must be left in the pot for ten or twelve hours, after which it is laded out into the crystallizing boxes or casks.

Distillation affords a more complete and very economical means of purifying sulphur, which was first introduced into the French gunpowder establishments, when their importation of the best Italian and Sicilian sulphur was obstructed by the British navy. Here the sulphur need not come over slowly in a rare vapour, and be deposited in a pulverulent form called flowers; for the only object of the refiner is to bring over the whole of the pure sulphur into his condensing chamber, and to leave all its crudities in the body of the still. Hence a strong fire is applied to elevate a denser mass of vapours, of a yellowish colour, which passing over into the condenser, are deposited in a liquid state on its bottom, whilst only a few lighter particles attach themselves to the upper and lateral surfaces. The refiner must therefore give to the heat in this operation very considerable intensity; and, at some height above the edge of the boiler, he should provide an inclined plane, which may let the first ebullition of the sulphur overflow into a safety recipient. The condensing chamber should be hot enough to maintain the distilled sulphur in a fluid state,—an object most readily procured by leading the pipes of several distilling pots into it; while the continuity of the operations is secured, by charging each of the stills alternately, or in succession. The heat of the receiver must be never so high as to bring the sulphur to a syrupy consistence, whereby its colour is darkened.

In the sublimation of sulphur, a pot containing about 4 cwt. can be worked off only once in twenty-four hours, from the requisite moderation of its temperature, and the precaution of an inclined plane, which restores to it the accidental ebullitions. But, by distillation, a pot containing fully 10 cwt. may complete one process in nine hours at most, with a very considerable saving of fuel. In the former plan of procedure, an interval must elapse between the successive charges; but in the latter, the operation must be continuous to prevent the apparatus from getting cooled; in sublimation, moreover, where communication of atmospheric air to the condensing chamber is indispensable, explosive combustions of the sulphurous vapours frequently occur, with a copious production of sulphurous acid, and correspondent waste of the sulphur; disadvantages from which the distillatory process is in a great measure exempt.

I shall here describe briefly the form and dimensions of the distilling apparatus employed at Marseilles in purifying sulphur for the national gunpowder works, which was found adequate to supply the the wants of Napoleon's great empire. This apparatus consists of only two still-pots of cast iron, formed like the large end of an egg, each about three feet in diameter, two feet deep, and nearly half an inch thick at the bottom, but much thinner above, with a horizontal ledge four inches broad. A pot of good cast iron is capable of distilling 1000 tons of sulphur before it is rendered unserviceable, by the action of the brimstone on its substance, aided by a strong red heat. The pot is covered in with a sloping roof of masonry, the upper ends of which abuts on the brickwork of the vaulted dome of condensation. A large door is formed in the masonry in front of the mouth of the pot, through which it is charged and cleared out; and between the roof-space over the pot, and the cavity of the vault, a large passage is opened. At the back of the pot a stone-step is raised to prevent the sulphur boiling over into the condenser. The vault is about ten feet wide within, and fourteen feet from the bottom up to the middle of the dome, which is perforated, and carries a chimney about twelve feet high, and twelve feet diameter inside.

As the dome is exposed to the expansive force of a strong heat, and to a very considerable pressure of gases and vapours, it must possess great solidity, and be therefore bound with iron straps. Between the still and the contiguous wall of the condensing chamber, a space must be left for the circulation of air; a precaution found by experience indispensable; for the contact of the furnaces would produce on the wall of the chamber such a heat as to make it crack and form crevices for the liquid sulphur to escape. The sides of the chamber are constructed of solid masonry, forty inches thick, surmounted by a brick dome, covered with a layer of stones. The floor is paved with tiles, and the walls are lined with them up to the springing of the dome; a square hole being left in one side, furnished with a strong iron door, at which the liquid sulphur is drawn off at proper intervals. In the roof of the vault are two valve holes covered with light plates of sheet-iron, which turn freely on hinges at one end, so as to give way readily to any sudden expansion from within, and thus prevent dangerous explosions.

As the chamber of condensation is an oblong square, terminating upwards in an oblong vault, it consists of a parallelopiped below, and semi-cylinder above, having the following dimensions:—

| | |
|---|---|
| Length of the parallelopiped . . | $16\frac{1}{2}$ feet. |
| Width . . . . . . | $10\frac{2}{3}$ |
| Height . . . . . . . . | $7\frac{1}{4}$ |
| Radius of the cylinder . . . | $5\frac{5}{6}$ |
| Height or length of semi-cylinder | $16\frac{1}{2}$ ,, |

Whenever the workmen has introduced into each pot its charge of ten or twelve hundred weight of crude sulphur, he closes the charging doors carefully with their iron plates and cross-bars, and lutes them tight with loam. He then kindles his fire, and makes the sulphur boil. One of his first duties (and the least neglect in its discharge may occasion serious accidents) is to inspect the roof-valves and to clean them, so that they may play freely and give way to any expulsive force from within. By means of a cord and chain, connected with a crank attached to the valves, he can, from time to time, ascertain their state, without mounting on the roof. It is found proper to work one of the pots a certain time before fire is applied to the other. The more steadily vapours of sulphur are to be seen to issue from the valves, the less atmospheric air can exist in the chamber, and therefore the less danger there is of combustion. But if the air be cold, with a sharp north wind, and if no vapours be escaping, the operator should stand on his guard, for in such circumstances a serious explosion may ensue.

As soon as both the boilers are in full work the air is expelled, the fumes cease, and every hazard is at an end. He should bend his whole attention to the cutting off all communication with the atmosphere, securing simply the mobility of the valves, and a steady vigour of distillation. The conclusion of the process is ascertained by introducing his sounding-rod into the pot, through a small orifice made for its passage in the wall. A new charge must then be given.

By the above process, well conducted, sulphurs are brought to the most perfect state of purity that the arts can require; while not above four parts in the hundred of the sulphur itself are consumed; the crude, incombustible residuum varying from five to eight parts, according to the nature of the raw material. But in the sublimation of sulphur, the frequent combustions inseparable from this operation carry the loss of weight in flowers to about twenty per cent.

The process by fusion, performed at some of the public works in this country, does not afford a return at all comparable with that of the above French process, though a much better article is operated upon in England. After two meltings of rough sulphur (as imported from Sicily or Italy), eighty-four per cent. is the maximum amount obtained, the average being probably under eighty; while the product is certainly inferior in quality to that by distillation.

3. *On the charcoal.*—Tender and light woods, capable of affording a friable and porous charcoal,

which burns rapidly away, leaving the smallest residuum of ashes, and containing therefore the largest proportion of carbon, ought to be preferred for charring in gunpowder-works.

After many trials made long ago, black dogwood came to be preferred to every plant for this purpose; but modern experiments have proved that many other woods afford an equally suitable charcoal. The woods of black alder, poplar, lime-tree, horse-chesnut, and chesnut-tree, were carbonized in exactly similar circumstances, and a similar gunpowder was made with each, which was proved by the same proof-mortar. The following results were obtained;

| | *Toises.* | *Feet.* |
|---|---|---|
| Poplar—mean range . . | 113 | 2 |
| Black alder . . . . . | 110 | 4 |
| Lime . . . . . . . . | 110 | 3 |
| Horse-chesnut . . . . | 110 | 3 |
| Chesnut-tree . . . . | 109 | |

By subsequent experiments confirmatory of the above, it has been further found that the willow presents the same advantages as the poplar, and that several shrubs, such as the hazel-nut, the spindle-tree, the dogberry, the elder tree, the common sallow, and some others, may be as advantageously employed. But whichever wood be used, we should always cut it when full of sap, and never after it is dead; we should choose branches not more than five or six years old, and strip them carefully, because the old branches and the bark contain a larger proportion of earthly constituents. The branches ought not to exceed three-quarters of an inch in thickness, and the larger ones should be divided lengthwise into four, so that their pith may be readily burned away.

Wood is commonly carbonized in this country into gunpowder-charcoal in cast-iron cylinders, with their axes laid horizontally, and built in brick-work, so that the flame of a furnace may circulate round them. One end of the cylinder is furnished with a door, for the introduction of the wood and the removal of the charcoal; the other end terminates in a pipe, connected with a worm-tub for condensing the pyroligneous acid, and giving vent to the carburetted hydrogen gases that are disengaged. Towards the end of the operation, the connexion of the cylinder with the pyroligneous acid cistern ought to be cut off, and a very free egress opened for the volatile matter, otherwise the charcoal is apt to get coated with a fuliginous varnish, and to be even penetrated with condensable matter, which materially injure its qualities.

In France, the wood is carbonized for the gunpowder works either in oblong vaulted ovens, or in pits, lined with brick-work or cylinders of strong sheet-iron. In either case, the heat is derived from the imperfect combustion of the wood itself to be charred. In general, the product in charcoal by the latter method is from 16 to 17 parts by weight from 100 of wood. The pit-process is supposed to afford a more productive return, and a better article; since the body of wood is much greater, and the fuliginous vapours are allowed a freer escape. The surface of a good charcoal should be smooth, but not glistening.

The charcoal is considered by the scientific manufacturers to be the ingredient most influential, by its fluctuating qualities, upon the composition of gunpowder; and, therefore, it ought always to be prepared under the vigilant and skilful eye of the director of the powder establishment. If it has been kept for some time, or quenched at first with water, it is unsuitable for the present purpose. Charcoal extinguished in a close vessel by exclusion of air, and afterwards exposed to the atmosphere, absorbs only from three to four per cent. of moisture, while red-hot charcoal quenched with water may lose by drying twenty-nine per cent. When the latter sort of charcoal is used for gunpowder, a deduction of weight must be made for the water present But charcoal which has remained long impregnated with moisture, constitutes a most detrimental ingredient of gunpowder.

[*To be continued.*]

## VENTILATION.

The following remarks are extracted from Dr. Reid's valuable Work on Ventilation.

It has pleased the Author of Nature so to constitute man, that his body is dependent on the materials with which he is surrounded for nourishment and support, and influenced by a number of agents which never cease to modify the tone of his constitution, throughout the whole period of his existence. They not only affect his animal frame, but, from the manner in which the living spirit is associated with the corporeal tenement in which it dwells, they equally influence his mental faculties. Their just operation is essential to all the functions of life; but their undue or unequal action, if not so extreme as to cause death, may lay the foundation of bad health, and give rise to morbid impressions unfavourable to the development of power, activity, and accuracy of thought and action. Among these, heat, light, and electricity, in all their changeful and fluctuating movements, are ever modifying his sensations; at times communicating a buoyancy, elasticity, and gaiety of feeling, which he can scarcely repress, while on other occasions he becomes the victim of the fatal influence which they produce upon his system.

But no agent exerts a more continuous power upon man than the atmosphere by which he is surrounded. There is nothing, perhaps, that presents a more wonderful combination of properties than is manifested in the endless variety of purposes which it serves, in respect to his own frame, as well as in reference to the general economy of nature. He depends upon it for the breath of life. It forms the great *pabulum vitæ*, to which all other nourishment is subordinate, and without which death immediately ensues. It is the medium of communicating to the eye the light that displays the visible creation to his view; it developes in the vital fluid that circulates in the body the warmth by which the living frame is animated; it is the medium of those vibrations, without which there would be no voice to cheer man in his present abode, no language, no melody, nor harmony of sounds; it conveys the fragrance of the most odoriferous and attractive flowers; it warns him equally, by their offensive impressions, of numerous sources of disease and danger. Ten thousand rays or undulations may pass through it from the regions of space, and from the varied objects at the surface of the earth, unfolding at every point of the horizon which the eye can command, the grandeur and variety of the works of creation; and still no jarring movement is permitted to disturb the innumerable intersecting paths through which they move, or to counteract the influence which they all individually impress upon the human frame.

Through the medium of the air, the purer water, evaporated from the surface of the land and of the ocean, is wafted to different regions, and returned again to fertilize the soil, and quench the sufferings of thirst.

Again, air promotes the disintegration of all organic matters, converting, ultimately, the dead and decaying remains of animal and vegetable life into gaseous or soluble products, a large portion of which becomes diffused through the atmosphere, and serves in the course of time for the support of new generations. Thus the very dust of the ground passes in an insensible form into the air, and is subsequently absorbed in the vicinity of the place where it may have been produced, or conveyed by aerial currents into distant lands, where it appears in a new shape, as it renews its position in the vegetable kingdom, affording, in this condition, materials which flourish for a time, and then become a subject of the same series of changes in never-ending cycles.

But the atmosphere is no less wonderful when viewed in the various changes which it effects in the animal and vegetable kingdom, than in the mild and genial movements which it presents on a summer's eve, or in the violent action which it assumes in the wind, the rain, and the tempest.

If we look to the movements of the air in the great theatre of the globe itself, we shall find it perpetually circulating between the equator and the poles, contributing much to moderate the extreme temperatures that would otherwise prevail in the torrid and polar regions, and diffusing, in all the minor streams into which it is thrown by local causes, a perpetual freshness and purity, by which the general ventilation of the different regions of the globe is maintained.

If we turn to man himself, nothing can afford a more useful lesson, from which we may draw the most important practical conclusions, than the examination of the relation which the human frame bears to the atmosphere by which it is surrounded. Not only does the air act continually wherever it presses upon the surface of the body; it is even brought into contact with the blood within the inmost recesses of the lungs, where its renovating action purifies this vital fluid before it returns to the heart, from which it circulates in a living stream to every part of the body, producing a never-ceasing circle of chemical changes, so long as there is life to sustain its movements. And, if we count the number of respirations made in a minute, they will be found in general to amount to twenty; so that, upon an average, we draw upon this great magazine, the atmosphere, for nourishment and support, no less than twelve hundred times every hour during the whole period of our existence.

Nor has nature been more profuse in its supply of that aerial fluid with which we are surrounded, than careful in the means adopted for its efficient application. The interior surface of the minute cells of the lungs has been calculated to present an area about twenty times greater than the surface of the body; while the sanguiferous system incessantly returns the vital fluid from every part of the frame to the heart as uniformly as it is propelled, that it may again be renovated by the free draught of air which is so greedily inhaled by the lungs.

The external surface of the body performs functions of great importance to the maintenance of a sound and strong constitution, though they may be interrupted to a greater extent for a time than the function of the lungs, without so immediately affecting life. The operation of insensible perspiration continues without ceasing its invisible agency, unless when urged by extreme heat or other causes, into inordinate action, or suppressed by some injurious influence that tells speedily upon the constitution. The whole surface of the body is in reality penetrated with a multitude of pores, through which the air exerts a similar agency to that which proceeds with greater energy in the lungs.

The continuity of the action of the air is sustained in the human frame by a process no less remarkable than the extent of the arrangements for securing its full and effective influence. Not only is a powerful apparatus brought into play, by the operation of the mechanism of the chest, and the effect it produces along with the heart and blood vessels, so as to sustain the circulation of the blood, by which, and all the varied movements connected with the function of respiration, the perfect aeration of the whole frame is effected; but these, in their turn, produce a degree of temperature in the living frame, superior, in general, to that of the atmosphere by which it is surrounded. From the change of equilibrium that necessarily ensues, the vitiated, warm, and light expanded air—expanded after it comes in contact with the living frame, whether rejected from the lungs or from contact with the body—continually gives way to the colder and denser atmosphere which presses it upwards by a slow and gentle movement; and this being heated in its turn, is followed, in endless succession, by a perpetually renewing current throughout the whole period of existence.

*(To be continued.)*

## VARIETIES.

*Wax Marble. For Leather Book Covers, &c.*—This marbling must be done on the foredge, before the back of the book is rounded, or becomes round, when in boards, and finished on the head and foot. Take bees' wax and dissolve it over the fire in an earthern vessel; take quills stripped of their feathers. and tie them together; dip the quill tops in the wax, and spot the edgé, with large and small spots: take a sponge charged with blue, green, or red, and smear over the edge; when done dash off the wax, and it will be marbled. This will be useful for stationery work, or for folios and quartos.

*Novel use of Ice in Ventilation.*—A course of experiments has been going on at the Hanover Square Rooms, with a view to their more complete ventilation. The process selected as the most complete is that of Mr. Day, who calls in to his aid the Archimedean screw, by which fresh air is forced into an apartment of any size without causing the slightest perceptible draught. On the last occasion of her Majesty's visit to these rooms, during the performance of the Ancient Concerts, and when attended by the King of Saxony, the Duke of Wellington, and other distinguished persons, this scientific process was tried, and although the atmosphere, externally was 69 to 70 degrees during the whole of the evening, that of the *salon* scarcely exceeded 70 degrees, although it was densely crowded and highly illuminated with gas. This novelty in the history of ventilation was effected by the air being passed through trays of ice. The comfort arising from so agreeable a temperature has determined the proprietors to resort to the same means on all similar occasions in future.

THE GYMNOTUS, OR ELECTRIC EEL.

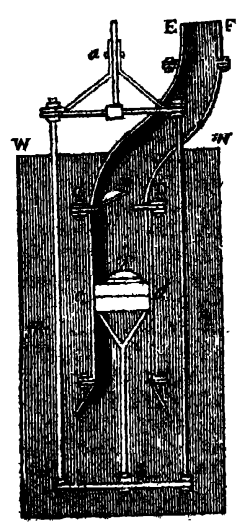



Fig. 1.

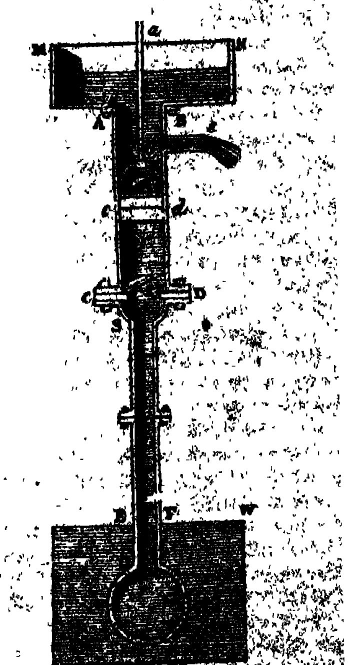



Fig. 2.

PLUMBING.

## THE GYMNOTUS, OR ELECTRIC EEL.

We present our readers with a representation of two fine specimens of the Gymnotus or Electric Eel, which are now exhibiting at the Gallery of Practical Science, in Adelaide Street, and the following account of this singular animal extracted from Mr. Noad's attractive work on Electricity, will we doubt not be read with interest.

The Gymnotus is a native of the warmer regions of America, and Africa, inhabiting large rivers, especially those of Surinam. In Africa it chiefly occurs in the branches of the Senegal. It is so named from the absence of the dorsal fin. In general aspect it very much resembles an eel,—the body is smooth, without scales; a long ventral fin extends from just behind the head, to the very extremity of the tail; around the mouth are many papillæ lodged in crypts, which are merely mucous glands. The mouth is armed with sharp teeth, and projecting into it are numerous fringes, which, from their vascularity, doubtless serve a purpose in respiration. The œsophagus is short, terminating in a capacious stomach with thick *rugose parietes*. The rest of the alimentary canal is short, doubled on itself, and terminates in the *cloaca*, which is situated in the mesial line, a few inches from the under jaw. The whole cavity of the abdomen is not more than seven inches long, and contained, in the female specimen examined by Mr. Letheby, besides the alimentary canal, ovaries filled with ova of a bright orange colour, the heart, the liver, and upper part of the air bladder. The rest of the animal is made up of the electrical organs and muscles of progression, together with an air sac, which runs beneath the spine the whole length of its body. The Gymnotus was first described by Richer, in 1677, and its anatomical structure by Mr. Hunter, in the 63rd and 65th volumes of the Philosophical Transactions. The electric organs consist of alternations of different substances, and are most abundantly supplied with nerves; their too frequent use is succeeded by debility and death. That these organs are not essential to the animals, is proved by their thriving after they have been removed.

By touching this fish with one hand a shock is felt in the fingers, wrist, and elbow. The hand of one person being held in water at the distance of three feet from the animal, upon a second person's irritating the eel, the former will receive a shock. Dr. Williamson placed a cat-fish in the same vessel of water with the eel, and then dipped his own hand in the water. The Gymnotus swam up to the fish, but turned away without offering any violence to it; it soon returned, and after regarding attentively the cat-fish for some seconds, gave it a shock, which made it turn up its belly, and continue motionless. The shock was perceptible to Dr. Williamson at the same time. Whenever fish that had been thus rendered motionless were removed to another vessel, they recovered.

In his Tableau Physique des Régiones Equinoriales, &c., Humboldt has given some curious details respecting the electrical eel, which inhabits the rivers and lakes of the low provinces of Venezuela and the Caraccas. It is met with most frequently in the stagnant pools, dispersed at intervals over the plains which extend from Oronooo to the Apuré. The old road near Uratica has even been abandoned on account of the danger experienced in crossing a ford, where the mules were, from the effects of the shocks, often paralyzed and drowned. Even the angler sometimes receives a stroke conveyed along his rod and line. These eels are about six feet in length, and occasion a highly painful sensation, more resembling the effect of a blow on the head, than the shock of a common electric discharge; a peculiarity of effect referable perhaps to a great quantity of electricity of small intensity. The following particulars given by Humboldt, and taken from the Edinburgh Review, vol. xvi. p. 250, are worth inserting:—

"The Indians entertain such a dread of the Gymnotus, and show so much reluctance to approach it when alive and active, that Humboldt found extreme difficulty in procuring a few to serve as the subjects of experiment. For this express purpose he stopped some days on his journey across the Llanos to the river Apuré, at the small town of Calaboze, in the neighbourhood of which he was informed they were very numerous. But though his landlord took the utmost pains to gratify his wish, he was constantly unsuccessful. At last he determined to proceed himself to the spot, and was conducted to a piece of shallow water, stagnant and muddy, but of the temperature of 79°, surrounded by a rich vegetation of the great Indian fig trees and the odoriferous sensitive plants. Here he soon witnessed a spectacle of the most novel and extraordinary kind. About thirty horses and mules were quickly collected from the adjacent savannahs, where they run half wild; these the Indians drove into the marsh. The gymnoti, roused from their slumbers by the noise and tumult, mount near the surface, and swimming like so many livid water-serpents, briskly pursue the intruders, and gliding under their bellies, discharge through them the most violent and repeated shocks. The horses, convulsed and terrified, their mane erect, and their eyes staring with pain and anguish, make unavailing struggles to escape. In less than five minutes two of them sunk under the water and were drowned. Victory seemed to declare for the eels; but their activity now began to relax; fatigued by such expense of nervous energy, they shot their electric discharges with less frequency and effect. The surviving horses gradually recovered from the shock, and became more composed and vigorous. In a quarter of an hour the gymnoti finally retired from the contest, and in such a state of languor and complete exhaustion, that they were easily drawn on shore by help of small harpoons fixed on cords."

It will not be uninteresting to repeat (V. 1. MS.) a brief account of some of the experiments made by Dr. Faraday with this fish, the results having afforded every proof of the identity of its power with common Electricity.

1st. *Shock*.—This was very powerful when one hand was placed on the body near the head, and the other near the tail. When the *dry* hands grasped metallic conductors in contact with the fish, scarcely any shock was felt; but when the hands were wetted, smart shocks were experienced,

2nd. *Galvanometer*.—A pair of collectors were thus constructed: a plate of copper eight inches long, by two inches and a half wide, was bent into a saddle shape, that it might pass over the fish, and inclose a certain extent of the back and sides, and a thick copper wire was brazed to it, to convey the electric force to the experimental apparatus; a jacket of sheet caoutchouc was put over the saddle, the edges projecting at the bottom and the ends; the ends were made to converge so as to fit in some degree the body of the fish, and the bottom edges were made to spring against any horizontal surface on which the saddles were placed. The part of the wire liable to be in the water was covered with caoutchouc.

By causing the fish to send a powerful discharge through these collectors, a galvanometer of no great delicacy being included in the circuit, deflection of the needle amounting to 30° was produced; the deflection was constantly in a given direction, the electric current being always from the anterior parts of the animal through the galvanometer wire to the posterior parts. The former were, therefore, for the time, externally positive, and the latter negative.

*Making a Magnet.*—When a little helix, containing twenty-two feet of silked wire wound on a quill, was put into the circuit, and an annealed steel needle placed in the helix, the needle became a magnet, and the direction of its polarity in every case indicated a current from the anterior to the posterior parts of the Gymnotus through the conductors used.

*Chemical Decomposition.*—Polar decomposition of iodide of potassium was obtained by moistening three or four folds of paper in the solution, placing them between a platinum plate and the end of a platinum wire connected respectively with the two saddle conductors. Whenever the wire was in conjunction with the conductor at the fore part of the Gymnotus, iodine appeared at its extremity; but when connected with the other conductor, none was evolved at the place on the paper where it before appeared. By this test Dr. Faraday compared the middle part of the fish with other portions before and behind it, and found that the conductor A, which being applied to the middle, was negative to the conductor B applied to the anterior parts, was, on the contrary, positive to it when B was applied to places near the tail. So that within certain limits the condition of the fish externally at the time of the shock appears to be such that any given part is negative to other parts anterior to it, and positive to such as are behind it.

*Evolution of Heat.*—The experiments were not decisive on this point, as might be expected, the instrument employed was a Harris's thermo-electrometer.

*Spark.*—The electric spark was first obtained in the following manner. A good magneto-electric coil, with a core of soft iron wire, had one extremity made fast to the end of one of the saddle collectors, and the other fixed to a new steel file; another file was made fast to the end of the other collector. One person then rubbed the point of one of these files over the face of the other, whilst another person put the collectors over the fish, and endeavoured to excite it to action. By the friction of the files contact was made, and broken very frequently; and the object was to catch the moment of the current through the wire and helix, and by breaking contact *during the current* to make the Electricity sensible as a spark. The spark was obtained four times. A revolving steel plate, cut *file-fashion* on its surface, was afterwards substituted for the lower file, and for the upper file wires of iron, copper, and silver, with all of which the spark was obtained.

In subsequent experiments the spark was obtained *directly* between fixed surfaces, the inductive coil being removed, and only short wires used. The apparatus employed was a glass globe, through the upper cap of which a copper wire, slightly bent at its lower extremity, and carrying a slip of gold leaf was passed; a similar wire terminating with a brass ball within the globe was passed through the lower cap. The gold leaf and brass ball were brought into all but actual contact, and when the wires were connected with the saddle collectors, and the fish provoked to discharge a current of Electricity, the gold leaf was attracted to the ball, and [illegible].

When the shock is strong, it is like that of a large Leyden battery charged to a low degree, or that of a good voltaic battery of perhaps one hundred or more pair of plates, of which the circuit is completed for a moment only; and great as is the force of a single discharge, the fish is able to give a double and even a triple shock, with scarcely a sensible interval of time. Dr. Faraday endeavoured to form some idea of the *quantity* of Electricity by connecting a large Leyden battery with two brass balls above three inches in diameter, placed seven inches apart in a tub of water, so that they may represent the parts of the Gymnotus to which the collectors had been applied; but to lower the intensity of the discharge, eight inches in length of thin wetted string were interposed elsewhere in the circuit, this being found necessary to prevent the easy occurrence of the spark at the ends of the collectors when they were applied to the water near to the balls, as they had been before to the fish. Being thus arranged, when the battery was strongly charged and discharged, and the hands put into the water near the balls, a shock was felt much resembling that from the fish; and though the experiments have no pretension to accuracy, yet as the tension could be in some degree imitated by reference to the more or less ready production of a spark, and after that, the shock be used to indicate whether the quantity was about the same, Dr. Faraday thought that it may be concluded that a single medium discharge of the fish was at least equal to the Electricity of a Leyden battery of fifteen jars containing 3500 square inches of glass coated on both sides, and charged to its highest degree.

Numerous other interesting experiments were made by Dr. Faraday with this fine specimen of the Gymnotus, from all of which it was rendered evident that all the water, and all the conducting matter around the fish, through which a discharge circuit can in any way be completed, is filled at the moment with circulating electric power, and this state might be easily represented by drawing the lines of inductive action upon it. In the case of a Gymnotus surrounded equally in all directions by water, these would resemble generally in disposition the magnetic curves of a magnet having the same straight or curved shape as the animal, *i. e.*, provided he in such cases employed, as may be expected, his four electric organs at once. That all the conducting matter around the fish is filled at the moment with circulating electric power, was proved by the fact, that a number of persons all dipping their hands at the same time into the tub, the diameter of which was forty-six inches, received a shock of greater or less intensity according as they were more or less favourably situated with regard to the direction of the current.

The Gymnotus can stun and kill fish which are in very various positions to its own body. Dr. Faraday describes the behaviour of the eel on one occasion when he saw it eat, as follows:—A live fish, about five inches in length, caught not half a minute before, was dropped into the tub. The Gymnotus instantly turned round in such a manner as to form a coil inclosing the fish, the latter representing a diameter across it: a shock passed, and there in an instant was the fish struck motionless, as if by lightning, in the midst of the water, its side floating to the light. The Gymnotus made a turn or two to look for its prey, which having found, he bolted, and then went searching about for more. Living as this animal does in the midst of such a good conductor as water, it seems at first surprising that it can sensibly electrify anything; but in fact it is the very conducting power of the water which favours and increases the shock by moistening the skin of the animal through which the Gymnotus discharges its *battery*. This is illustrated by the fate of a Gymnotus which had been caught and confined for the purpose of transmission to this country. Notwithstanding its wonderful powers, it was destroyed by a *water rat*, and when we consider the perfect manner in which the body of the rat is insulated, and that even when he dives beneath the water not a particle of the liquid adheres to him, we shall not feel surprised at the catastrophe.

The Gymnotus appears to be sensible when he has shocked an animal, being made conscious of it, probably, by the *mechanical impulse* he receives, caused by the spasms into which he is thrown. When Dr. Faraday touched him with his hands, he gave him shock after shock; but when he touched him with glass rods, or insulated conductors, he gave one or two shocks felt by others having their hands in at a distance, but then ceased to exert the influence, as if made aware it had not the desired effect. Again, when he was touched with the conductor several times for experiment on the galvanometer, &c., and appeared to be languid or indifferent, and not willing to give shocks, yet, being touched by the hands, they, by convulsive motion, informed him that a sensitive thing was present, and he as quickly showed his power and willingness to astonish the experimenter.

In these most wonderful animals then we behold the power of converting the *nervous* into the *electric* force. Is the converse of this possible? Possessing, as we do, an electric power far beyond that of the fish itself, is it irrational, or unphilosophical, to anticipate the time when we shall be able to reconvert the electric into the nervous force? Seebeck taught us how to commute heat into Electricity, and Peltier, more recently, has shown us how to convert the Electricity into heat. By Œrsted we were shown how to convert the electric into the magnetic force, and Faraday has the honour of having added the other member of the full relation, by re-acting back again and converting magnetic into electric forces.

The following are the experiments suggested by Faraday, as being rational in their performance and promising in anticipation.

1°. If a gymnotus or torpedo has been fatigued by frequent exertion of the electric organs, would the sending of currents of similar force to those he emits, or of other degrees of force, either continuously or intermittingly, in the same direction as those he sends forth, restore him his powers and strength more rapidly than if he were left to his natural repose?

2°. Would sending currents through, in the contrary direction, exhaust the animal rapidly?

3°. When, in the torpedo, a current is sent in the natural direction, *i. e.* from below upwards, through the organ on the other side into action? or if sent through in the contrary direction, will it produce the same, or any, effect on that organ?

4°. Will it do so if the nerves proceeding to the organ or organs be tied? and will it do so after the animal has been so far exhausted by previous shocks, as to be unable to throw the organ into action in any, or in a similar, degree of his own will?

It is for the physiologist to pursue this inquiry: to him it belongs to connect these two branches of physical philosophy, a minute acquaintance with practical anatomy being quite as indispensable as a thorough knowledge of the laws of Electricity. "Never, however," as Daniell observes, "was there a more tempting field of research, or higher reward offered for its successful cultivation, than that which is presented by *animal Electricity*."

In the autumn of 1839, Professor Schoenbein, of Bale went through a series of experiments with the London Gymnotus, and obtained results entirely in accordance with those just described. One fact, however, was observed during the decomposition of iodide of potassium, which greatly surprised those who witnessed it. At the instant when the paper, impregnated with the iodide, was put in communication with the fish, a visible spark was observed: this spark did not occur every time, but in an exceptionable manner, although the experiments were repeated in circumstances as similar as possible. "So far as I myself have been able to observe," says Schoenbein; "we never obtained a spark, either at the moment when we complete the circuit of a galvanic pile by means of an electrolytic body, or at the moment when this latter is put out of the action of the current. I dare not then express an opinion upon the nature and cause of the phenomenon just mentioned, especially as I fear to decide whether the spark really occurred at the opening of the circuit, or at the instant of its being closed."

In summing up some exceedingly interesting remarks on the electrical powers of the Gymnotus, Schoenbein declares it to be his opinion, that the true cause of the phenomena is still completely obscure, and must neither be sought for in the physical or chemical constitution, nor in a fixed organization of certain parts of the animal: but that there exists, without being able at present to determine how, an intimate connection between the vital actions dependent on the will of the fish, and the physical phenomena which these vital actions produce. Until we know more exactly the nature of Electricity, we shall be unable to detect this intimate relation which exists between electric and vital action, until we know whether Electricity is only a particular condition of what we call matter, or whether it arises from particular vibrations of the ether, or, in fine, whether like gravity it must be regarded as a primitive and specific force of nature. So long as we are without an exact idea of what Electricity is, the different modes of its development will, of course, be incomprehensible to us, and we shall scarcely be able to say anything upon the cause of animal Electricity, even though anatomists and physiologists should have very carefully studied the structure of the fish, and should have made us most intimately acquainted with all its fibres and its most minute nerves."

## PLUMBING.

THE lead generally used in roofing and guttering is from 7 to 12 lb. to the superficial foot, and great vigilance on the part of the architect is required, in these days of contracts, to see that his employer has the thickness, or, which is the same thing, the weight that has been contracted for. We do not think it necessary to describe at length the machinery of a water-closet. Every one knows that the principle on which it is formed is that of a head of water in a cistern placed above it, which by means of a lever attached to a valve in the cistern allows a body of water to rush down and wash the basin, whose valve is opened for the discharge of the soil at the same moment that the water is let down from the cistern. Various instruments for this purpose have been contrived and patented, but we are not aware of any better than those which are made by the late Mr. Bramah, almost as soon as the subject formed a matter of inquiry. The reader will obtain by an inspection of one a far better notion than words or diagrams can convey. As it is a branch of the plumber's trade to find and fix the pumps for the supply of water to a dwelling, we think it right to furnish a description of the two sorts commonly used, which are the *lifting*, and the *common pump*. *Fig.* 1. is a diagram of a lifting pump, in which C D is a short cylinder submerged in the well or other reservoir, whence the water is to be raised. In this cylinder a valve is placed at *x*, above which the pipe or tube CE is carried upwards as high as is requisite for the delivery of the water. In the cylinder a water-tight piston moves vertically, being worked by rod or frame work, as seen in the diagram. To this piston is fixed a valve at *v*, and the cylinder between the two valves is filled with water. When the piston is raised, the water between the valves being pressed upwards against the valve *x*, opens it, and is driven into the tube CE, from which, on the renewed descent of the piston, its return is intercepted by the valve *x*. The water follows the piston in its ascent by the hydrostatic pressure of the water in the reservoir outside the cylinder; and on the next descent of the piston the water will again pass through the valve *v*, and will be driven through the valve *x* on its next ascent.

It is manifest from inspection that the valve *x* relieves the valve *v* from the pressure of the column of water in the tube CE during the descent of the piston; for if the valve *v* were subject to that pressure during the descent of the piston, it could not be opened by the pressure of the water in the well, inasmuch as its level is necessarily below the level of the water in the pipe CE. The valve *v* prevents the return of the water through the piston during its ascent. In raising the piston a force is required sufficient to support the entire column of water from the valve *v* to the surface of the tube CE. To estimate this, we must take the weight of a column of water whose base is equal to the area of a section of the piston, and whose height is equal to that of the surface of the water above the valve *v* in the tube CE. Hence, after each stroke of the pump, the pressure on the piston and the force necessary to raise it, will be increased by the weight of a column of water whose base is the horizontal section of the piston, and its height equal to the increase which the elevation of the column in CE receives from the water driven through the valve *x*. In the figure *cd* is the piston, the bottom of whose rod is at *b*; *m* and *n* are rods which connect it with the upper part of the work, and W is the level of water in the well. The common, or, as it is usually called, *suction pump* (shown in *fig.* 2.), is nothing more than a large syringe connected with a tube whose lower extremity is plunged in the well from which the water is to be raised. The tube is called a *suction pipe* (SO), and its end in the well is represented by O, which, for the purpose of preventing the ascent of solid impurities, is pierced with holes like a strainer. At the upper end of this suction pipe is placed the valve *x* opening upwards. At this place the tube is connected with another, BC, which acts as a great syringe, and in which works a piston having a valve at *v*, also opening upwards. The piston is worked alternately upwards and downwards in common pumps by a lever called the *brake*, but it may be worked in many ways. In the figure, W is the level of the water; CD, the *flange*, where the lower valve is fixed, *cd*, the piston, *ab*, the piston rod, and MN, the cistern into which the water is raised and delivered by its gravity at the *nozle* of the pump *e*.

At the commencement of the operation the water in the suction tube stands at the same height as the water in the well, being equally subject to the atmospheric pressure; but as soon as the syringe BC exhausts the air by the upward and downward action of the piston *cd*, the pressure of the air in SO being diminished and rendered less than that on the surface of the water in the well, will rise in SO by the atmospheric pressure; and as the air becomes more completely exhausted in the column of water in tube SO below the valve *x*, so will its pressure on the surface of the column be diminished, and whilst that diminution goes on, the height of the column will increase.

If the air could be entirely withdrawn from the tube SO, and a perfect vacuum created beneath the valve *x*, similar to that existing above the mercury in a barometer, then the atmospheric pressure, acting with undiminished effect on the surface of water in the well, would, in the tube SO, sustain a column of water equal to a column of the same base and of the same height as the mercury in the barometer. Now, the specific gravity of mercury being $13\frac{1}{2}$ times greater than that of water, a force capable of sustaining a column of mercury 30 inches high, would sustain a column of water equal to 30 inches $\times 13\frac{1}{2} = 405$ inches $= 33\frac{9}{12}$ feet. But an absolute vacuum is never formed; and, moreover, in this country, as the barometric column varies between 28 and 31 inches in height, the valve *x* should on no account be more than 28 feet above the level of the water in the well, taking into consideration all the attendant circumstances. This is the construction and principle upon which the common household pump is formed, and in it no other aid is derived from atmospheric pressure than what we have already stated; hence the pump requires as much force to work it as, in general terms, is equal to the weight of all the water in it at any time, the atmospheric pressure affording no aid to the workman. The cistern at the top is placed for the purpose of affording an unintermitted discharge of the water by holding more than the whole accumulation of water, which is contrived to be greater than the spout or nozle will discharge.—*Gwilt.*

## SADDLES AND HARNESS.

Edward Banton, Walsall, Staffordshire, saddlers'-ironmonger; has lately patented the following improvements in saddles and horse harness.

The patentee makes seven distinct claims in this specification. The main feature of his improvement in saddles is the construction of the saddle tree in such a manner that the pummel may be removed, as it is fixed on by a pin and a spring, instead of being nailed on, as in the usual manner. The improvements in harness refer principally to the bit, which is so contrived that the mouth-piece may be detached from the cheeks, and fixed by screws in any position that may be required. There is a contrivance also for bringing down the nose-piece when the reins are pulled, and thus shutting the horse's mouth, and preventing the animal from running away. Another part of the invention refers to a plan for lengthening or shortening harness without buckles, by employing what the inventor terms a "metal trough," with holes pierced in it, into which holes studs fixed to the other parts of the harness drop, and are there kept firm. The patentee also claims a plan for enamelling both the leather and the metallic parts of harness for their preservation; but he does not very clearly state what part of the process is new, for the plan of enamelling, he admits, has been previously adopted.

## PNEUMATICS.

It has been stated, that the atmospheric pressure at the surface of the earth is capable of supporting a column of water thirty-four feet in height. It follows, therefore, that if our atmosphere were condensed to such a degree that its specific gravity would be equal to that of water, its height would be thirty-four feet. Now the specific gravity of a stratum of atmosphere contiguous to the surface is about 840 times less than the specific gravity of water; that is, a cubic inch of water weighs 840 times more than a cubic inch of air. If as we ascend in the atmosphere it continued to have the same density, then its height would be evidently 840 times the height of 34 feet, which would amount to 28,560 feet, or 5 miles and a quarter. It is obvious, therefore, that since even at a small elevation the density of the atmosphere is reduced to half its density at the surface, the whole height must be many times greater than this. The barometer in the balloon in which De Luc ascended fell to the height of twelve inches. Supposing the barometer at the surface to have stood at that time at 30 inches, it follows that he must have left three-fifths of the whole atmosphere below him. His elevation was upwards of 20,000 feet.

A column of pure mercury, whose base is a square inch, and whose height is 30 inches, weighs about 15 lb. avoirdupois. It follows, therefore, that when the barometer stands at 30 inches the atmosphere exerts a pressure on each square inch of the surface of the mercury in the cistern amounting to 15 lbs. Now it is the nature of a fluid to transmit pressure equally in every direction; and if the surface on which the atmosphere acts were presented to it laterally, obliquely, or downwards, still the pressure will be the same. Taking, therefore, the medium height of the barometric column at 30 inches, it follows that the pressure sustained by all bodies which exist at the surface of the earth exposed to our atmosphere are continually under this pressure, and that every square inch on their surface constantly sustains a force of about 15 pounds. Thus, the body of a man, the surface of which amounts to 2000 square inches, will sustain a pressure from the surrounding air to the enormous amount of 30,000 pounds.

It might at first view be expected that this great force to which all bodies are subject would produce manifest effects, so as to crush, compress, or break them, whereas we find bodies of most delicate texture unaffected by it. Thus a close bag, made of the finest silver paper, and partially filled with air, is apparently subject to no external force. Its sides do not collapse. This arises partly from the circumstance of the pressure on every side, and in every direction being equal, and, therefore, producing mechanical equilibrium. It is obvious that a body which is driven in every possible direction upwards and downwards, laterally and obliquely, with equal forces, will not move in any one direction; for to suppose such a motion would be to assume that the quantity of pressure in that direction exceeds the quantity of pressure in other directions. But still, though a body may not be driven in any direction by the atmospheric pressure, it may happen that its parts are crushed and compressed. We do not, however, find this to happen. This arises from the fact, that the elastic force of the air is equal to its pressure; and since the internal cavities of a body, such as the thin bag above mentioned, are filled with air, which is confined within them, that air has precisely the same tendency to swell the bag, and to keep the parts asunder, as the external pressure of the atmosphere has to make them collapse.

In the same manner we may account for the fact that animals move freely in the air without being sensible of the enormous pressure to which their bodies are subject. The internal parts of their bodies are filled with fluids, both in the liquid and gaseous states, which offer a pressure from within exactly equivalent to the external pressure of the air. This may be easily rendered manifest by applying to the skin the mouth of a close vessel, to which an exhausting syringe is attached. By this instrument, the air may be rarefied in the vessel, and the atmospheric pressure consequently partially removed from the skin. Immediately the force of the fluid from within will swell the skin, and cause it to be sucked into the glass. This experiment may be performed by the mouth on the flesh of the hand or arm. If the lips be applied to the flesh, and the breath drawn in so as to produce a partial vacuum in the mouth, the skin will be drawn or sucked into the mouth. This effect is owing, not to any force resident in the lips or the mouth drawing the skin in, but to the fact that the usual external pressure is removed, and that the pressure from within is suffered to prevail.

All cases of that class of effects which are commonly expressed by the word *suction* are accounted for in the same manner.

If a flat piece of moist leather be put in close contact with a heavy body, as a stone, it will be found to adhere to it with considerable force, and if a cord of sufficient length be attached to the centre of the leather, the stone may be raised by the cord. This effect arises from the exclusion of the air between the leather and the stone. The weight of the atmosphere presses their surfaces together with a force amounting to 15 pounds on every square inch of those surfaces in contact. If the weight of the stone be less than the number of pounds which would be expressed by multiplying the number of square inches in the surfaces of contact by 15, then the stone may be raised by the leather; but if the stone exceed this weight it will not suffer itself to be elevated by these means.

The power of flies and other insects to walk on ceilings and surfaces presented downwards, or upon smooth panes of glass in an upright position is said to depend on the formation of their feet. This is such that they act in the manner above described respecting the leather attached to a stone; the feet, in fact, act as suckers, excluding the air between them and the surface with which they are in contact, and the atmospheric pressure keeps the animal in its position. In the same manner the hydrostatic pressure attaches fishes to rocks.

The pressure and elasticity of the air are both exercised in the act of breathing. When we draw in the breath we first make an enlarged space in the chest. The pressure of the external atmosphere then forces air into this space so as to fill it. By a muscular action the lungs are next compressed so as to give this air a greater elasticity than the pressure of the external atmosphere. By the excess of this elasticity it is propelled, and escapes by the mouth and nose. It is obvious, therefore, that the air enters the lungs not by any direct act of these upon it, but by the weight of the atmosphere forcing it into an empty space, and that it is expired by the action of the lungs in compressing it.

The action of common bellows is precisely similar, except that the aperture at which the air is drawn in is different from that at which it is expelled. In the lower board of the bellows is a hole covered by a valve, consisting of a flat piece of stiff leather, movable on a hinge, and which lies on the hole, but is capable of being raised by a slight pressure. When the upper board of the bellows is raised, the internal cavity is suddenly enlarged, and the air contained in it is considerably rarefied. The pressure of the atmosphere forces in air at the nozle, but this being too small to allow its admission with sufficient ease and speed, the valve covering the hole is acted upon by the atmosphere and raised, and air rushes in through the large aperture under it. When the space between the boards is filled with air in its common state, the upper board is depressed, and the air confined in the bellows is suddenly condensed. The valve covering the hole is thus kept firmly closed, and the air has no escape except through the nozle, from which it issues with a force proportional to the pressure exerted on the upper board. A bellows, such as that in common domestic use, thus simply constructed, has an intermitting action, and blows by fits, its action being suspended while the upper board is being raised. In forges and large factories, in which fires are extensively used, it is found necessary to command a constant and unremitting stream of air, which may be conducted through the fuel so as to keep it in vivid combustion. This is effected by bellows with three boards, the centre board being fixed and furnished with a valve opening upwards, the lower board being moveable with a valve also opening upwards, and the upper board being under a continual pressure by weights acting upon it. When the lower board is let down, so that the chamber between it and the middle board is enlarged, the air included between these boards being rarefied, the external pressure of the atmosphere will open the valve in the lower board, and the chamber between the lower and middle boards will be filled with air in its common state. The lower board is now raised by the power which works the bellows, and the air between it and the middle board is condensed. It cannot escape through the lower valve, because it opens upwards. It acts, therefore, with a pressure proportional to the working power on the valve in the middle board, and it forces open this valve, which opens upwards. The air is thus driven from between the lower and middle boards into the chamber between the middle and upper boards. It cannot return from this chamber, because the valve in the middle board opens upwards. The upper boards being loaded with weights, it will be condensed while included in this chamber, and will issue from the nozle with a force proportionate to the weights. While the air is thus rushing from the nozle the lower board is let down and again drawn up, and a fresh supply of air is brought into the chamber between the upper and middle board. This air is introduced between the middle and upper board before the former supply has been exhausted, and by working the bellows with sufficient speed a large quantity of air will be collected in the upper chamber, so that the weights on the upper board will force a continual stream of air through the nozle.—*Lardner*.

## VENTILATION.

(*Continued from page 192.*)

Oxygen is the name of the principal element that comes into play in all the more peculiar effects produced by the action of the air on the living frame. It is perhaps the most interesting and important element which has been discovered. It forms one-fifth part of the air by measure, and is an agent equally singular for the extent of its distribution, and the important purposes which it serves in the general economy of the globe. It constitutes eight-ninths of the water of the globe by weight, and about one half of its more abundant solid contents, so far as has been ascertained. Few of the products of the animal and vegetable kingdoms do not contain it. No statement indeed is more literally true, than that it forms more than one-half of the materials of which the Author of Nature has created for the more immediate support of animal and vegetable life, and for affording the means of procuring artificial heat and light by combustion.

If we look practically to the action of the air upon the living frame, it is impossible to contemplate the extreme importance that must necessarily be attached to the supply of air in a pure form, as indicated by the complication and extent of the provisions that have been made for this purpose, without contrasting them with the comparative indifference that is, in general, entertained by man himself as to the proper exercise of the function of respiration.

The knowledge of the actual existence of that invisible and attenuated air by which man is so closely surrounded, is seldom realized with that convincing consciousness of its presence which is necessary to enable him to appreciate its influence on his system. Presenting nothing gross and tangible to the external senses, when he is defended from the more severe fluctuations of an outward atmosphere, a process of reflection becomes necessary to force this truth practically upon his attention. He may be said to have, in general, no believing faith in the real relation that subsists between his own frame and the air he breathes. He is, accordingly, comparatively indifferent as to the nature and quality of the air that he consumes. Present to him any grosser material such as he can eat or drink, and his sensibility may be exquisite; he will descant upon such matters indefinitely on many occasions, and spare neither pains nor expense to satisfy the demand of his appetite. But the quality of that finer, more ethereal and purer food, which has access directly and without any intervening digestive process to the living blood, is a matter of such comparative indifference, that he is too often content to breathe indefinitely the polluted atmosphere that may have previously visited a thousands lungs, so long as there is a sufficient infusion of fresh air to prevent absolute and immediate oppression, or to produce such marked effects as to awaken him more precisely to the actual position in which he is placed.

The standard of taste for fresh and pure atmospheric air even among those classes of society who have every luxury at command, must be considered at present as very much below what is required for health; and even where the want of it is felt and acknowledged, the amount of value placed upon it is so small and trifling, that the expense and trouble of providing proper channels for its supply are considered serious objections to its introduction. Hence, architectural arrangements have too often been considered independently of ventilation; protection from without, and stability and beauty of structure, are not the sole requisites for architectural perfection. The supply of a pure and wholesome atmosphere is essential in the adaptations required in each individual building; and so far as practical utility is taken into consideration, instead of placing the supply and regulation of air so much in the back ground, it ought, in reality, to form one of the primary features of every architectural structure in which a defence is offered from the external element. When the air is of inferior quality, the mental faculties are subdued and deteriorated in proportion as the body is oppressed by the vitiated atmosphere, pure air being not only essential for the proper development of the bodily frame, but also requisite for the due energy of the intellectual functions.

*(To be continued.)*

## CARBONIC ACID EXHALED FROM THE HUMAN BODY.

Professor Scharling, of Copenhagen, with the view of ascertaining the quantity of carbonic acid exhaled during the twenty-four hours, as well from the lungs as from the general surface of the body, undertook the following experiments on six individuals—viz., four males and two females. The subjects of experiment were confined in an air-tight box, wherein they were perfectly at their ease, being enabled to speak, eat, sleep or read, without inconvenience; a constant current of atmospheric air was admitted into the box, and the deteriorated gases abstracted by means of an air-pump. The air withdrawn was conducted into a proper arrangement of bottles, some containing sulphuric acid, others a solution of caustic potash. The quantity of carbonic acid, both previous to and subsequent to each operation, was carefully ascertained, by being received into three graduated tubes. The results were as follows;—

1st. The Professor himself, aged thirty-five years, exhaled 219 grammes during twenty-four hours, seven of which were spent in sleep. 2nd. A soldier, twenty-eight years of age, exhaled 239·728 grammes =8·45 oz. 3rd. A lad of sixteen, 224·379 grammes =7·9 oz. 4th. A young woman, aged nineteen, [illegible] grammes = 5·83 oz. 5th. A boy nine [illegible] and a half old, 133·126 grammes = 4·69 oz. [illegible] A girl of ten, 125·42 grammes = 4·42 oz. In the two last cases the period allotted to sleep was nine hours. From these experiments the Professor deduces that males exhale more carbonic acid than females, and children comparatively more than adults. He also finds that less of this gas is given off during the night than during the day; and that in certain cases of disease, which he does not specify, less carbonic acid is formed than during the healthy state. He is then induced to hope that attention to this point may ultimately throw some light on certain forms of disease. It will be interesting to compare these results with Liebig's views, as well as with the experiments which have recently emanated from the Academy of Sciences in Paris.—*Proceedings of the Chemical Society.*

## VARIETIES.

*Iron Dock Gates.*—Mr. James Leslie, lately read at the Institution of Civil Engineers, a description of the iron dock gates at Montrose harbour. These gates were described in great detail, giving all the dimensions of the several parts, which were fully shown by some elaborate drawings. The framing was of cast iron, covered on both sides with wrought iron plates three-eighths and five-sixteenths of an inch thick, rivetted on so as to be water-tight, and to render the gates buoyant, and partly to compensate for the weight of metal in them, which was about eighty-seven tons. The gates were fifty-five feet wide and twenty-two feet six inches deep, and were entirely composed of iron, except the bottom bars and the false mitres, which were of oak. The sluice valves were of iron without any brass on the faces, but the backs were covered with zinc plates, and the bolts had zinc nuts screwed over the iron ones, in order to check the oxidation of the iron by the galvanic action of the two metals.

*Washing Linen.*—The supply of water in Paris is nearly seven times what it was in 1816. Washerwomen have increased in number in the capital, and washing by soap is substituted for washing by ley. This is very injurious to the public health All river or spring water holds in solution carbonate of lime, which is decomposed by alkaline soap, and the result is a soap having for its base insoluble lime. This calcareous soap attaches itself to the linen, and the heat of the ironing melts and drives it into the article washed with it. It is to the presence of this calcareous soap that the bad smell of linen for which it is used is due. When cotton or linen cloth has undergone the process of washing with soap twenty times, it becomes impermeable. It is, in fact, the secret means employed for rendering all cloths impermeable; not, indeed, by soap washing them twenty times, but by saturating them with a calcareous soap produced by the dissolving of a soluble calcareous salt. But though it may be useful to render a cloth coat impermeable, to save the wearer from being wet by rain, it is prejudicial to health to wear next to the body that which will not absorb the perspiration. In this respect, the substitution of soap for ley must be injurious. There is, however, a very simple mode of avoiding this inconvenience; it is by putting into each litre of water used for washing, one or two grammes of potass, or soda, before dissolving the soap in it. By this, the calcareous soap will be precipitated, and the soap, meeting with no lime in the water, will not undergo any decomposition; consequently, no calcareous soap can remain in the linen. The use of soda or potass will not be at all expensive, because the alkali remains in the water, and contributes, with the soap, to the cleansing of the linen.—*La Presse.*

DENT'S DIPLEIDOSCOPE.

ILLUSTRATION OF THE SIMPLE MODE OF TAKING AN OBSERVATION WITH THE DIPLEIDOSCOPE.

## THE DIPLEIDOSCOPE.

An invention of a most useful kind, displaying a considerable portion of scientific research, has lately been brought before the public by Mr. Dent, the eminent Chronometer maker of the Strand. The invention consists of a small instrument for ascertaining the true time by means of the sun's rays. A pamphlet containing a very minute description of its use and application has been published by Mr. Dent, from which we extract the following preliminary remarks :—

"The time," in popular language, denotes a certain division of the day, calculated from the sun's appearing at its greatest or meridian altitude at any particular place.

When the sun has reached this altitnde, it is mid-day, or noon,

The day is divided into 24 parts, or hours, because that is the time occupied by the Earth in making one complete revolution round it axis.

In the course of this revolution, every part of the earth's surface must have been directly opposite to the sun; or, in language more scientifically correct, must have had the sun in the plane of its meridian: and the moment at which any particular place was thus directly opposite to the sun, was noon to the inhabitants of that place.

Hence it will be seen, that the word "noon" is a relative term, and that of any two places situate in different longitudes, noon will be earlier at the place which lies nearer to the east. If the distance be fifteen degrees of longitude, the difference will be one hour; and so more or less in proportion.

The revolution of the hands of the clock is intended to be a faithful index of the revolution of the earth on its axis; and, to a certain extent, so it is: but the imperfection of all human workmanship renders even the most exquisite machinery liable to error. This error can be corrected only by actual observation of the heavenly bodies.

These observations are continually being made by our principal astronomers at the different observatories; and the time is communicated to the public by means of a signal—*the falling of a large ball*, that may be seen from a considerable distance.

Chronometer-makers of any eminence have usually an observatory of their own, with the apparatus requisite for ascertaining the true time for themselves. The expense and labour attending such arrangements have hitherto placed it out of the power of the ordinary watch-maker to take his own astronomical observations; a difficulty which, at the trifling expense of two guineas, will be removed by the instrument in question.

The Dipleidoscope, or new patent meridian-instrument, will enable any person to obtain correct time with the greatest facility, by an observation either of the transit of the sun over the meridian by day, or of the transit of the stars by night. In the following explanation, howevever, it is intended, for the sake of consulting both brevity and simplicity, to confine the directions to solar observation.

This new instrument possesses great advantages over any other of similar correctness; it is exceedingly simple; it is not liable to get out of adjustment or repair, and it does not require any attention beyond that which is, of course, necessary in the first instance, viz.: that it be placed on a level surface, and in the meridian. The observations to be taken afterwards, can be made by any one, although previously unacquainted either with astronomical apparatus or practical astronomy; the instrument being as simple as a sun-dial, while it is infinitely more correct, since it gives the time to within a fraction of a second. The utility of possessing an indicator of this kind in addition to the most perfect timekeeper, must be evident; for, however excellent a clock or watch may be, experience shows how difficult it is to obtain exact time, *for lengthened periods*, by any mere mechanical contrivance. To remedy the defect of mechanism, it has been already remarked, that actual observation of the heavenly bodies becomes indispensable; as, without it, the best time-keeper cannot be implicitly depended upon for any considerable interval. On the importance of exactness in this essential matter, it is not necessary to enlarge: it will suffice merely to allude to the inconvenience of missing a railway train. An advantage also not to be overlooked, is the gratification of knowing, especially in remote parts of the country, that you are in possession of the true time; information which is now not easily to be obtained: for it is notorious on what uncertain contingencies the regulation of the parish clock, in many of our rural districts, continually depends;—such as the passing of some public vehicle, or the announcement of the guard of a mail-coach.

Perhaps, then, it is not saying too much to affirm, that a Dipleidoscope should be placed in all country Personages, as well as in Railway stations, and Government establishments, both at home and abroad.

*(To be continued.)*

## GUNPOWDER.

*(Continued from page 191.)*

4. *On Mixing the Constituents and forming the Powder.*—The three ingredients thus prepared are ready for manufacturing into gunpowder. They are, 1. Separately ground to a fine powder, which is passed through sorted silk sieves or bolting machines; 2. They are mixed together in the proper proportions, which we shall afterwards discuss; 3. The composition is then sent to the gunpowder mill, which consists of two edge-stones of a calcareous kind, turning by means of a horizontal shaft, on a bed-stone of the same nature; incapable of affording sparks by collison with steel, as sand-stones would do. On this bed-stone the composition is spread, and moistened with as small a quantity of water as will, in conjunction with the weight of the revolving stones, bring it into a proper body of cake, but by no means into a pasty state. The line of contact of the rolling edge-stone is constantly preceded by a hard copper scraper, which goes round with the wheel, regularly collecting the caking mass, and bringing it into the track of the stone. From 50 to 60 pounds of cake are usually worked at one operation, under each millstone. When the mass has been thoroughly kneaded and incorporated, it is sent to the corning-house, where a separate mill is employed to form the cake into grains or corns. Here it is first pressed into a hard firm mass, then broken into small lumps; after which the corning process is performed, by placing these lumps in sieves, on each of which is laid a disc or flat cake of lignum vitæ. The sieves are made of parchment skins, or of copper, perforated with a multitude of round holes. Several such sieves are fixed in a frame, which, by proper machinery, has such a motion given to it as to make the lignum vitæ runner in each sieve

move about with considerable velocity, so as to break down the lumps of the cake, and force its substance through the holes, in grains of certain sizes. These granular particles are afterwards separated from the finer dust by proper sieves and *reels*.

The corned powder must now be hardened, and its rougher angles removed, by causing it to revolve in a close reel or cask turning rapidly round its axis. This vessel resembles somewhat a barrel-churn, and is frequently furnished inside with square bars parallel to its axis, to aid the polish by attrition.

The gunpowder is finally dried, which is now done generally with a steam heat, or in some places by transmitting a current of air, previously heated in another chamber, over canvas shelves, covered with damp grains.

5. *On the proportion of the Constituents.*—A very extensive suite of experiments, to determine the proportions of the constituents for producing the best gunpowder, was made at the Essonne works, by a commission of French chemists and artillerists, in 1791.

Powders in the five following proportions were prepared :

| | Nitre. | Charcoal. | Sulphur. | |
|---|---|---|---|---|
| 1 | 76 | 14 | 10 | Gunpowder of Bâle. |
| 2 | 76 | 12 | 12 | Gunpowder works of Grenelle. |
| 3 | 76 | 15 | 9 | M. Guyton de Morveau. |
| 4 | 77·32 | 13·14 | 9·24 | Idem. |
| 5 | 77·5 | 15 | 7·5 | M. Riffault. |

The result of more than two hundred discharges with the proof-mortar shewed that the first and third gunpowders were the strongest; and the commissioners in consequence recommended the adoption of the third proportions. But a few years thereafter it was thought proper to substitute the first set of proportions, which had been found equal in force to the other, as they would have a better keeping quality, from containing a little more sulphur and less charcoal. More recently still, so strongly impressed have the French government been with the high value of durability in gunpowders, that they have returned to their ancient dosage of 75 nitre, 12½ charcoal, and 12½ sulphur. In this mixture, the proportion of the substance powerfully absorbent of moisture, viz. the charcoal, is still further reduced, and replaced by the sulphur, or the conservative ingredient.

If we inquire how the maximum gaseous volume is to be produced from the chemical reaction of the elements of nitre on charcoal and sulphur, we shall find it to be by the generation of carbonic oxide and sulphurous acid, with the disengagement of nitrogen. This will lead us to the following proportions of these constituents :—

| | Hydrogen = 1. | Per cent. |
|---|---|---|
| 1 prime equivalent of nitre .. | 102 | 75·00 |
| 1 ,, sulphur | 16 | 11·77 |
| 3 ,, charcoal | 18 | 13·23 |
| | 136 | 100·00 |

The nitre contains five primes of oxygen, of which three, combining with the three of charcoal, will furnish three of carbonic oxide gas, while the remaining two will convert the one prime of sulphur into sulphurous acid gas. The single prime of nitrogen is, therefore, in this view, disengaged alone.

The gaseous volume, on this supposition, evolved from 136 grains of gunpowder, equivalent in bulk to 75¼ grains of water, or to three-tenths of a cubic inch, will be, at the atmospheric temperature, as follows :—

| | Grains. | | Cubic Inches. |
|---|---|---|---|
| Carbonic oxide .. .. | 41 | = | 141·6 |
| Sulphurous acid .. .. | 32 | = | 47·2 |
| Nitrogen .. .. .. | 14 | = | 47·4 |
| | | | 236·2 |

being an expansion of one volume into 787·3. But as the temperature of the gases at the instant of their combustive formation must be incandescent, this volume may be safely estimated at three times the above amount, or considerably upwards of two thousand times the bulk of the explosive solid.

But this theoretical account of the gases developed does not well accord with the experimental products usually assigned, though these are probably not altogether exact. Much carbonic acid is said to be disengaged, a large quantity of nitrogen, a little oxide of carbon, *steam of water*, with *carburetted and sulphuretted hydrogen*. From experiments to be presently detailed, I am convinced that the amount of these latter products printed in italics must be very inconsiderable indeed, and unworthy of ranking in the calculation; for, in fact, fresh gunpowder does not contain above one per cent. of water, and can therefore yield little hydrogenated matter. Nor is the hydrogen in the carbon of any consequence.

It is obvious that the more sulphur is present, the more of the dense sulphurous acid will be generated, and the less forcibly explosive will be the gunpowder. This is sufficiently confirmed by the trials at Essonne, where the gunpowder that contained 12 of sulphur and 12 of charcoal in 100 parts, did not throw the proof-shell so far as that which contained only 9 of sulphur and 15 of charcoal. The conservative property is, however, so capital, especially for the supply of our remote colonies and for humid climates, that it justifies a slight sacrifice of strength, which at any rate may be compensated by a small addition of charge.

*Table of Composition of different Gunpowders.*

| | Nitre | Charcoal | Sulph. |
|---|---|---|---|
| Royal Mills at Waltham Abbey | 75 | 15 | 10 |
| France, national establishment | 75 | 12·5 | 12·5 |
| French, for sportsmen .. .. | 78 | 12 | 10 |
| French, for mining .. .. | 65 | 15 | 20 |
| United States of America .. | 75 | 12·5 | 12.5 |
| Prussia .. .. .. .. .. | 75 | 13·5 | 11·5 |
| Russia .. .. .. .. .. | 73·78 | 13·59 | 12·63 |
| Austria (*Musquet*) .. .. | 72 | 17 | 16 |
| Spain .. .. .. .. .. | 76·47 | 10·78 | 12·75 |
| Sweden .. .. .. .. .. | 76 | 15 | 9 |
| Switzerland (a round powder) | 76 | 14 | 10 |
| Chinese .. .. .. .. | 75 | 14·4 | 9·9 |
| Theoretical proportions (as above) .. .. .. .. | 75 | 13·23 | 11·77 |

6. *On the Chemical Examinations of Gunpowders.*—I have treated five different samples: 1. The government powder made at Waltham Abbey; 2. Glass gunpowder made by John Hall, Dartford; 3. The treble strong gunpowder of Charles Lawrence and Son; 4. The Dartford gunpowder of Pigou and Wilks; 5. Superfine treble strong gunpowder of

Curtis and Harvey. The first is coarse-grained, the others are all of considerable fineness. The specific gravity of each was taken in oil of turpentine: that of the first and last three was exactly the same, being 1·80; that of the second was 1·793, all being reduced to water as unity.

The above density for specimen first, may be calculated thus:—

75 parts of nitre, specific gravity .. 2 000
15 parts of charcoal, specific gr. .. 1·154
10 parts of sulphur, specific gr. .. 2·000

The volume of these constituents is 5·55, (the volume of their weight of water being 100;) by which if their weight 100 be divided, the quotient is 1·80.

The specific gravity of the first and second of the above powders, including the interstices of their grains, after being well shaken down in a phial, is 1·02. This is a curious result, as the size of the grains is extremely different. That of Pigou and Wilks similarly tried is only 0·99; that of the Battle powder is 1·03; and that of Curtis and Harvey is nearly 1·05. Gunpowders thus appear to have nearly the same weight as water, under an equal bulk; so that an imperial gallon will hold from 10 pounds to 10 pounds and a half, as above shown.

The quantities of water which 100 grains of each part with on a steam bath, and absorb when placed for 24 hours under a moistened receiver standing in water, are as follows:—

100 grains of Waltham Abbey, lose 1·1 by steam heat, gain 0·8 over water.
100 grains of Hall, lose 0·5 by steam heat, gain 2.2 over water.
100 grains of Lawrence, lose 1·0 by steam heat, gain 1·1 over water.
100 grains of Pigou and Wilks, lose 0·6 by steam heat, gain 2·2 over water.
100 grains of Curtis and Harvey, lose 0·9 by steam heat, gain 1·7 over water.

Thus we perceive that the large-grained government powder resists the hygrometric influence better than the others; among which, however, Lawrence's rank nearly as high. These two are therefore relatively the best keeping gunpowders of the series.

The process most commonly practised in the analysis of gunpowder seems to be tolerably exact. The nitre is first separated by hot distilled water, evaporated and weighed. A minute loss of salt may be counted on, from its known volatility with boiling water. I have evaporated always on a steam bath. It is probable that a small portion of the lighter and looser constituent of gunpowder, the carbon, flies off in the operations of corning and dusting. Hence, analysis may show a small deficit of charcoal below the synthetic proportions originally mixed. The residuum of charcoal and sulphur left on the double filter paper, being well dried by the heat of ordinary steam, was estimated, as usual, by the difference of weight of the inner and outer papers. This residuum was cleared off into a platina capsule with a tooth-brush, and digested in a dilute solution of potash at a boiling temperature. Three parts of potash are fully sufficient to dissolve out one of sulphur. When the above solution is thrown on a filter, and washed first with a very dilute solution of potash boiling hot, then with boiling water, and afterwards dried, the carbon will remain; the weight of which deducted from that of the mixed powder, will show the amount of sulphur.

[*To be continued*]

## THE DAGUERREOTYPE PROCESS.

At a late meeting of the Paris Academy of Sciences, M. Daguerre communicated an improved process for the purpose of taking portraits, the ordinary mode of preparing the plates not being found sufficient to enable the operator to obtain good impressions. The improvement made by M. Daguerre requires a rather complicated process, but it is a very regular one, and has one decided advantage, for the artist is now enabled to have a good stock of plates on hand, as the new preparation will remain for a long time in a perfectly fit state for use. The new substances, of which M. Daguerre makes use, are an acqueous solution of bi-chlorure of gold. The process is as follows:—The plate is polished with sublimate and tripoli, and then red oxide of iron, until a fine black is obtained; it is now placed in the horizontal plane, and the solution of cayanure previously made hot by the lamp is poured over it. The mercury deposits itself, and forms a white coating. The plate is allowed to cool a little, and after having poured off the liquid, it is dried by the usual process of cotton and rouge. The white coating deposited by the mercury is now to be polished. With a ball (*tampon*) of cotton saturated with oil and rouge, this coating is rubbed just sufficiently for the plate to be of a fine black. This being done, the plate is again placed upon the horizontal plane, and the solution of gold and platina is poured over it. The plate is to be heated, and then left to cool; and the liquid having been poured off, the plate is dried by means of cotton and rouge. In doing this, care must be had that the plate be merely dried, not polished. On this metallic varnish, M. Daguerre has succeeded in taking some very fine impressions of the human figure which were exhibited.

## OPAL.

Amongst the mineralogical treasures of South Australia, Opal has been discovered in abundance Subsequent to the discoveries in the western hemisphere, the secondary gems have gradually become less valuable in Europe: but their recent cheapness has occasioned an introduction for purposes of usefulness infinitely more extensive than the ancient collectors of gems ever dreamt of. Opal has, in fact, partially superceded ivory in the Sheffield and Birmingham manufactories for knife and fork handles, as well as for caskets and other toilet furniture. Opal is found to resist the effects of climate perfectly, and to this important quality, in addition to its beauty of appearance, may be attributed the fact that it is at present so much in [illegible]ries.

## EXPERIMENTS WITH STARCH.

BY E. A. SCARLING.

Berzelius says, "That paste is not to be considered as a solution of starch in water, but merely as a swelling of the particles in water, which they absorb; and again give up, if laid on a porous mass having a greater affinity for water." The winter of 1840 being very severe at Copenhagen, many articles of food were frozen, and confirmed the truth of Berzelius' assertion in my mind. According to Vogel's statement, I expected a portion of the starch to be thrown down in the form of powder from a frozen solution on thawing; but I observed that this result is not obtained in a quantity of sago soup which was casually exposed to the frost. The whole of it was separated into two portions, *viz.* a spongy coagulum and a clear solution. The firm portion I removed with my hands, pressed it out, and obtained a spongy mass, which imbibed water like sponge; under the microscope it appeared to consist of small capsules; when dried it resembled horn; whereas common starch, boiled to paste and frozen, yielded, when dry, a mass resembling wetted paper dried by pressure; a spongy appearance was only obtained when the starch had been boiled for a lengthened period in water. The filtered solution contained starch in large quantity, as was readily proved by iodine. The spongy mass was washed with water until the water expressed gave no further traces of starch with iodine; but on boiling it and exposing it again to frost the clear solution was again rendered blue by iodine, and the same result was obtained on repeating the experiment several times. Thus it would appear that the capsules of starch may be gradually chemically dissolved by continued boiling. Elementary analysis of starch separated by freezing a solution, gave the same result as the analysis of common starch.

---

*To the Editor of the Magazine of Science.*

SIR,

Thinking the following account of two phenomena of atmospheric electricity, which have fallen under my observation, might not be unacceptable to some of your readers, I have been induced to forward it:—

On Friday, July 26th, at 5, P.M., a dense cloud made its appearance in the East, and appeared to be rapidly coming over our town. I was, at the time mentioned, standing in the street, and at the distance of a quarter of a mile I observed several pillars of dust approaching, each, at the same time, whirling on its axis. At first I felt a little perplexed to account for this, as there did not appear to be any wind; I however quickly referred the phenomena to the attraction of the cloud. The pillars continued to advance with it, until a shower coming on terminated this interesting display of the electrical influence of the atmosphere.

On Sunday, the 8th instant, we had a most magnificent display of the electric fluid. In the evening I observed a collection of clouds in the south-west, and another in the east, these continued to increase until, at 8 o'clock, a most splendid display of the fluid took place. The storm, at that time, appeared to be raging at about eight or nine miles from the place where I stood. The lightning was very brilliant, so bright, indeed, as to illuminate every surrounding object. Some of the horizontal discharges, I am satisfied, from observations made at the time, passed through a stratum of air of six miles. Several vertical discharges likewise took place, and it was from one of these, from a cloud of a quarter of a mile distant, that I experienced a violent shock (the effect of an electric wave.) The blow was very severe, and much resembled the shock from a powerful battery passed from the feet to the shoulders. Two trees near the spot were singularly agitated, and a gentleman, residing near, informed me that his house was shaken from the top to the bottom. The discharge was accompanied by a hissing noise like a flock of geese.

I am, Sir, your obedient Servant,
JOSEPH EXALL.

*Tenterden, Kent, 13th September*, 1844.

## HINTS ON HEALTH.

AVOID excess of food as the principal source of dyspepsia. Five or six hours should elapse between meals. Commercial and professional men should avoid long fasting. Do not hurry from dinner to business—rest an hour afterwards. Never eat things out of season, nor much of dishes to which you are unaccustomed. Much liquid at dinner delays the digestion. Avoid intemperance. Water is the most wholesome beverage. Excess of fermented liquors is highly injurious. Useful exertion is indispensable to health and happiness. Muscular exercise, well regulated, is conducive to longevity. The sedentary should walk whenever they have an opportunity. Never continue exercise after it has become painful. Standing at a high desk to write, when fatigued with sitting, will be found highly beneficial to literary men. The constant use of soft stuffed seats is injurious. Rooms in which the sedentary are employed should be warmed by fires in open grates, which assist ventilation; not by steam, hot water, gas, or close stoves. Never stand or sit with your back to the fire. Mental excitement is one of the most prevalent causes of disease, producing dyspepsia, monomania, and insanity. Few things tend more to the preservation of health and the prolongation of life, than the maintenance of a calm, cheerful and contented state of mind, and the cultivation of feelings of affection. Mental inactivity is scarcely less injurious than excessive exercise, giving rise to hy . . .
In the choice of professions, the talents, disposition, and natural bent of the mind of the individual ought to be studied. Trips into the country to watering and sea bathing places are highly beneficial to those who live in towns. Tobacco injures digestion and relaxes the nerves.—*Curtis.*

## SPEED OF COMMUNICATION WITH INDIA.

UNTIL within the last ten years, the communication between England and India has been both slow and irregular. The establishment of a line of steam-vessels, reducing the distance by two-thirds, and conveying, not only mails, but passengers, from India to England, in little more than a month—this, following closely upon the renewal of the Charter, under which the country was thrown open to adventurers of every class—has increased, in an enormous degree, the amount of passengers and letters despatched to and from India; and by giving proportionate impetus to the local press, still further multiplied the sources of information thus thrown open to the mother country. The number of letters dispatched every month, by the Bombay steamers, exceeds thirty thousand; the number of printed papers ten thousand. Many of these letters and papers are delivered in London five weeks after they are despatched; and in little more than two months an answer to a letter sent from Bombay may be received at that place. This rapidity of communication, coupled with its certainty, is an extreme provocative to frequent correspondence, not only between parties engaged in business, but between private individuals. In former years a letter was four, five, six, perhaps seven months, on its way. "We are now," wrote Sir James Mackintosh, in 1805, "within five days of six months from the date of our last London paper;" and again in 1811, "seven months from the date of the last London News." If an answer were received within the year, the letter-writer thought himself fortunate. This was disheartening and repelling. Correspondence, even between intimate friends and dear relatives, soon flagged, fell off by degrees, and ere long ceased altogether. Parties in England, or in the interior of India, had no knowledge of the date of a vessel's departure—hence further delays. A letter was, perhaps, several weeks lying idle at the General Post-office, or in the *duftur-khana* of a Calcutta agent. After this long rest, it was probably despatched by a vessel, bound for several intermediate ports, and did not reach its destination, until other letters of a more recent date had been received. All this was vexatious in the highest degree, and as regular correspondence was out of the question, people soon began to meditate on the expediency of abandoning that, which was fraught with so much inconvenience and annoyance. The establishment of a regular steam communication between the two countries has remedied all this, and made every Englishman and Englishwomen, in the three presidencies, a periodical letter-writer.

The rapidity and regularity of the communication between the two countries induced, at the same time, a greater desire after Indian news. The number of local journals despatched to England was soon multiplied. A class of publications, unknown before, sprung up, and in a short time, acquired a strenuous vitality. Papers were prepared expressly for the overland Mail, containing a summary of the month's news, and issued on the morning of post-day. These were despatched, in large numbers, by Indian residents, to their friends at home. The British press soon began to perceive the importance of obtaining the earliest and most correct Indian intelligence. The leading morning journals secured the services of clever and experienced correspondents at Calcutta and Bombay. These writers despatched their letters, containing an abstract of the month's news, and the most interesting extracts, afforded by the Indian journals, to the care of an agent at Paris, whose business it was to forward the despatches to the coast by a special courier. Thus the French mail was often anticipated by several hours, second editions were published, and the Indian news, for the time, was even more talked of than the last partisan debate in Parliament, or the state of the poll at a pending election.

## IMPROVED FURNACES.

MR. DETMOLD, of the city of London, merchant, has lately patented certain improvements in the construction and arrangement of furnaces or fire-places, applicable to various useful purposes.

In furnaces employed in the different processes of the arts, and which depend for their supply of air for combustion upon the draught created by a high stack or chimney, a large proportion of the fuel is converted into combustible gases, which escape, unconsumed, out of the chimney: at certain times also, especially when the layer of fuel on the grate is very thin, a considerable portion of atmospheric air passes, undecomposed, through the fire-grate into the furnace, which, in the reverberatory furnaces employed in working metals, causes a portion of the metal that is worked in the furnace to become oxidised or wasted. The formation of combustible gases in the furnace, and the passing of undecomposed air through the grate, tend, each of them, to lower the temperature of the furnace. In addition to this, the cold or outer air is being continually drawn into the furnace through the door when open, and through every opening or crevice that may exist in the furnace; and this also tends to diminish the heat, while, at the same time, it increases the waste of the metal by oxidation.

To obviate these disadvantages, the following constructions and arrangements are adopted:—Firstly, the grate or fire-chamber of the improved furnaces is made deeper than the fire-chamber or grate of the furnaces now in general use, by which means a thick stratum of fuel is always upon the grate or fire-bars; thereby preventing the passage of undecomposed air through the grate into the interior of the furnace. In ordinary furnaces, the depth of the grate, that is, the distance between the grate-bars and the top of the fire-bridge, is generally from twelve to eighteen inches, and seldom exceeds two feet; but in the improved furnaces the depth of the grate is from three to five feet, according as the coal employed is more or less bituminous. When a caking or highly bituminous coal is used, the grate should not be less than three feet in depth; for a free-burning coal, four feet in depth; but for a very dry fuel, such as coke or anthracite coal, a depth of five feet will be found most advantageous.

Secondly, instead of relying upon the draught of a high chimney for the combustion of the fuel, a requisite supply of air is forced, by means of any ordinary blowing-machine, under the grate into the ash-pit, which is closed by an air-tight door: thus, the blast will cause the combustion of the lower stratum of coal immediately upon the grate, and the greater portion of the gas resulting from this combustion will be a combustible gas, namely, the carbonic oxide, which is invariably produced during the process of combustion when the temperature is very high, and when the proportion of carbon is in excess to that of oxygen. The portion of carbonic acid gas which is produced by the combustion of the lower stratum of fuel, immediately upon the fire-bars, will, in its passage upwards through the superincumbent mass of ignited fuel, absorb an additional dose of carbon, and will thereby also become converted into carbonic oxide. At the same time, the carbonaceous gases contained in the fuel, such as carburetted or bicarburetted hydrogen, will be evolved or distilled from the coal by the heat: thus, all the fuel in the fire-chamber (that is to say, all that is combustible in the fuel) is converted into combustible gases, which will pass together over the fire-bridge into the furnace.

The body of fuel in the fire-chamber, with the exception of the stratum resting immediately upon the grate or fire-bars, is never at a high temperature, as is ordinarily the case in furnaces, but is kept only at a red heat, which is quite sufficient to cause the formation of the combustible gases from the fuel.

Thirdly, the combustion of these gases is effected by forcing amidst them, in their passage over the fire-bridge, heated and compressed atmospheric air, supplied in numerous small streams; thereby causing a rapid and intimate combination of the oxygen of the air with the combustible gases, and consequently their perfect and immediate combustion, and a most intense temperature. The temperature of the compressed air may be regulated at will, by means of a damper, connected with the apparatus for heating the air.

The heat, thus produced from the fuel, is also more directly applied to the purposes required than in ordinary furnaces, in which the heat is produced by the partial combustion of the fuel upon the grate, and where the metals under operation derive their temperature merely from the flame in its passage through the main or working-chamber of the furnace: whereas, by these improvements, the temperature of the fuel in the fire-chamber, where the combustible gases are generated, is comparatively low, and their actual combustion, and the intense temperature resulting therefrom, is concentrated in the very spot where the metals are placed for operation, or where the greatest heat is required.

The loss of fuel, by the escape of combustible gases at the chimney, is thus avoided; as also the diminution of temperature, and the loss of metal by oxidation, from the effects of undecomposed air passing through the grate, or through the working-door, or any openings or crevices in the furnace, as the combustion of the gases, in the furnace, is effected under a greater pressure than that of the atmosphere without.

Furnaces of this improved construction, it is stated, may be employed with great advantages in the working of all kinds of metals, but they are of peculiar value in the different processes of the manufacture of iron.—*Newton's Journal.*

## VENTILATION.

(*Continued from page 200.*)

Till the discoveries of modern science revealed the nature and composition of atmospheric air, and the reciprocal action that ensues between it and the blood, the architect was, in respect to this question, like a traveller without a guide, and had no distinct appreciation of the position in which man is placed in respect to the atmospheric ocean in which he lives. And even where the facts now adverted to are known and recollected, still the rough and rude treatment to which the lungs are subjected, the vitiated atmosphere which they are so often called upon to inhale, and the transitions of atmospheric and artificial temperatures to which they are carelessly subjected, shew clearly how little the value of a mild and fresh atmosphere is practically appreciated; while the ravages of consumption, and the extended catalogue of evils accompanying diseases of the organs of respiration, point out the vast amount of misery that might be obviated, and of death that might be prevented, were the leading principles and practice of ventilation more generally understood.

A new era dawned upon this question when the constitution of atmospheric air was unfolded, the theory of respiration and combustion explained, the constituent elements of the corporeal frame traced more minutely in their varied movements in the living system, and the chemistry of the gases extended by the brilliant discoveries of the present age. The practical application to architecture of the truths then developed, appears to have been encompassed, however, with numerous difficulties, so that the most extreme variety of practice may still be observed, some depending upon the magnitude of the structure for the necessary supply of air, others looking to doors or windows, while, in a more limited number of examples, special channels are made for the admission of air. An unbounded field of investigation is opened in the endless varieties of adaptations required in the details for special structures, and the nature of the ventilating power which, under different circumstances, it may be most expedient to employ. Mere variety of practice is in itself unobjectionable, as the details of ventilation are necessarily as various as the details of architectural structure. The variety of estimates as to the amount of supply have always been a leading difficulty. Perhaps no buildings have been subjected to such numerous experiments as the Houses of Parliament, to which Sir Christopher Wren, the Marquis of Chabannes, Mr. Davies Gilbert, Sir Humphrey Davy, and many others, directed their attention; and it may afford some clue to the diversity of practice that has been prevalent, if it be remembered, that the area of discharge, provided by Sir Humphrey Davy, in the present House of Commons (at that time the House of Lords), was one foot; whereas at present it is fifty feet, and this is frequently worked by a power which renders it equivalent to several times that which would arise from any ordinary discharge.

It will be obvious indeed, that until a more general understanding shall have been entered into, as to the amount of air with which the system ought to be supplied, and the extent to which this should be placed under control, a reasonable expectation cannot be entertained that public buildings and private dwelling-houses will be much more systematically supplied with air than at present. This is the most important and primary question on which all other points depend. A false estimate as to the amount of supply required is an irreparable evil. So long as this difficulty is not specifically entered into, no suite of arrangements, however perfect in other respects, can be expected to give satisfaction. The simplicity of the arrangements required for ordinary purposes, and the difficulties connected with peculiar structures, where the architect, in indulging his professional taste, has too often taken an unbridled licence in excluding the necessary supply for the lungs, are so often imperfectly appreciated, that too frequently nothing whatever is attempted beyond the imperfect arrangements of doors and windows, any thing being considered good enough for ventilation, *i. e.* for the lungs.

But the progress of this question will necessarily be limited to a great extent, till the public shall acquire more information on those numerous matters connected with it which have attracted so much attention of late years. Until the great elementary truths of physical science shall be introduced as essential branches of education in schools and academies, among the humblest as well as in the highest walks of life, it cannot be expected that there will be that desirable appreciation of the value of a pure and wholesome atmosphere which must ever be one of the principal objects of all who desire to advance the cause of public health. The cloud must be removed that veils at present the true state of the case from the great mass of the community.

The number of individuals is comparatively small who are really aware of the magnitude of the evils arising from the respiration of air. It is not generally understood that in innumerable public and private assemblies, churches, theatres, schools, &c., an atmosphere is often breathed for hours continuously which is as foul and offensive, compared with the air that is congenial to the lungs, as the water of the Thames at London Bridge contrasted with a pure mountain spring. It is no exaggerated statement to affirm, that the greatest scourge with which this and so many other climates is affected, viz. consumption, owes it origin more to ignorance of the laws of health connected with the peculiarities of exposure to alterations of air and temperarure, an to the severity of local draughts, than to any disadvantages connected with the local state of the atmosphere which cannot be met with proper care and attention; that numerous other diseases, particularly catarrhs, rheumatisms, and pleurisies, often spring from this cause: that a deprecated tone of mental vigour, as well as of bodily health, may, in endless examples, be traced to the same cause; that the most deadly plagues that have ever appeared have been aggravated, if not caused, by want of cleanliness and ventilation, and that the ordinary typhoid fever of this country almost invariably originates under similar circumstances: that hospitals imperfectly ventilated have in some cases proved a curse instead of a blessing to the miserable patients who have been conveyed to them; that public establishments are known to the medical profession, where, at one time, from the same cause, no case of compound fracture ever recovered, few or none survived the amputation of a limb; mortification attacked every wound, however trivial, while the prostration of strength became so great, that men who had at first stood the severest operations without a murmur, subsequently cried like children at the slightest pain; and that cases have actually presented themselves where the apparently lifeless corpse, subdued and oppressed far more by the atmosphere with which it was surrounded, than by the disease to which it was supposed to have fallen a victim, has actually been known to revive after removal to the dead-room, a separate apartment, where the play of a wholesome atmosphere, flowing unrestrictedly upon it, revived the fading flame of life after it was to all appearance gone, and where health and strength were ultimately restored; that the practice in hospitals has been accompanied with the most decided reduction of mortality as the ventilation has been improved: that even in cities, generally, the mortality has regularly diminished as the external ventilation of the streets has been placed on a better and more systematic footing, by increased attention to cleanliness, and by affording free channels for the passage of air.

But, independent of the more serious and direct attacks of disease, there are numerous minor evils that often prey upon the constitution, where the air is of inferior quality. The long-continued action of vitiated air gradually undermines the tone and strength of the stomach; the appetite diminishes, and the citadel or mainspring of the constitution being thus enfeebled or destroyed, all the other powers of the system also gradually give way. This may be observed in numerous dwelling-houses, in many varieties of shops, offices, and counting-houses, and in various trades and sedentary occupations, where the natural wants of the system, a proper care as to regularity of diet and to exercise in the open air, are absorbed in attention to business. It would be well indeed were individuals so exposed, to pause and calculate, with a little of that keenness with which they enter upon their daily pursuits, the extent to which they are obliged to draw upon the capital of their constitution in labouring under the oppression which an inferior atmosphere always developes. Premature old age is indeed one of the most certain consequences of long exposure to a vitiated atmosphere, especially when it is accompanied by an over-anxious and harassing attention to business; and in various occupations, the short span of human life is abridged many years by this cause, independently of the low tone at which it often flows, and the endless discomfort and annoyance to which, in such cases, it is so often subjected.

Nor are the moral and intellectual faculties to be forgotten in considering the influence of a vitiated atmosphere, as the energy and tone of both is lowered and depressed by bad air: these are impaired as much at least as the corporeal functions, and, when not subdued by the mere force of the oppression to which they are subjected, are often forced into an unnatural state of excitement, equally incompatible with health, and with the sober exercise of the reasoning faculties.

Ventilation consists in the due and appropriate supply of air to any apartment, passage, or other cavity to which the external atmosphere has not free and unlimited access. It requires, accordingly, to be as various in different buildings as their architectural construction, the climate in which they are placed, the materials of which they are composed, the purposes to which they are applied, and the habits of the inmates by whom they are occupied. *External Ventilation* is a term frequently used to indicate the supply of air to streets, squares, courts, and alleys, or to any special situation or area not included by buildings, and the quality of air as dependent on any special circumstances by which it may be affected.

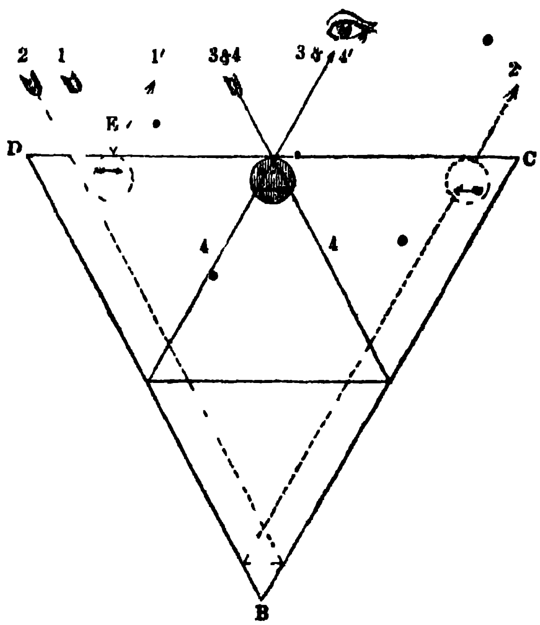
Much of the misunderstanding that prevails, too generally, in respect to ventilation, arises from the extreme diversity of standards which different individuals consider essential to their comfort. This evil is greatly aggravated by the different provision which is generally made for modifying the ventilation in unison with the variety of circumstances in which even the same constitution may be exposed. Ventilation requires, in all ordinary cases, to be varied from time to time, according to numerous circumstances, subject to perpetual fluctuation, which are noticed in the succeeding chapters.

*(To be continued.)*

## VARIETIES.

*Multiplication.*—If the human race, beginning from one pair, were to double once in 30 years, or if the excess of births over deaths were to double the population once in 30 years, then, at the end of 3,000 years, the population might be described as follows. Take men, women, and children, at an average height of four feet, and imagine a vast plain of the same surface as the whole earth and sea. Let each person be allowed one square foot to stand upon, and let the "surplus population," after the plain is full, stand upon the heads of the others, with others again upon their heads, and so on. The pile would extend to a height of 3688 times the distance from the earth to the sun; (sun's distance 95,000,000 of miles; earth's radius 3956 miles).

*Sympathetic Ink.*—1. A dilute solution of nitromuriate of cobalt. When heated, the writing performed with this ink assumes a fine green colour and disappears again when cooled. 2. An acetic solution of oxide of cobalt, to which add a little nitre. On exposing writing performed with the above to heat, it will assume a fine rose colour, which disappears on cooling. 3. Sal ammoniac, sulphate of copper, equal parts; water sufficient. This assumes a yellow colour when heated, and, like the preceding, disappears when cooled.




DENT'S DIPLEIDOSCOPE.

## THE DIPLEIDOSCOPE.

*(Continued from page 202.)*

### *Explanation of the Optical Construction of the Instrument.*

THE following explanation being designed for popular use, scientific language has been avoided, as much as may be. It is impossible, however, that a philosophical instrument can be made familiar to the general reader without some reference to philosophical principles, which the writer will therefore be excused from stating in this place, as an important and indispensable preliminary.

In the language of philosophy, the law which governs the transmission of light is, that the angle of the rays of incidence is equal to the angle of the rays of reflection. In other words, supposing the rays of light proceeding from an object to fall upon a reflecting plane, the eye of the observer must, in order to see the reflected image, be placed at precisely the same angle with regard to the plane, as the rays proceeding from the object to the plane. The rays falling upon the plane from the object are styled "the rays of incidence;" as the rays again proceeding from the plane to the eye are termed the "rays of reflection."

Keeping this law or principle in view, let us next consider the construction of the reflecting planes of the instrument in question.

There are three reflecting planes, D C, D B, and B C. fig. 1. Suppose D C to be so divided that the ray, No. 1, falling on D C, at E, will be re-reflected to the eye at 1′, and the image of the sun will appear to advance in the direction from D towards C. The ray, No. 2, passing through D C, is reflected from C B, impinges on D B, and reaches the eye in the direction 2′. The image of the sun thus formed will appear to move from C towards D, because it has been *twice* reflected, and thus the two images will *approach* each other. Suppose the ray No. 1 to have advanced to the position No. 3, and the ray No. 2 to the position No. 4; it will then be evident that their reflected rays will be in the same direction 3′ and 4′, and, therefore, that the two images of the sun coincide, as shown by the arrows being in the position of crossing each other, and indicating the instant of apparent noon; as the rays continue to advance, the images, having passed over each other, will, of course, be seen to separate.

The following familiar illustration is introduced to further explain the optical construction. When the sun is about setting, it is not uncommon to see the sun's rays so reflected from the windows of a whole range of houses, as to convey the idea of a public illumination. While some portions of the sun's rays are thus reflected, other portions pass through the glass into the rooms. The rays thus transmitted (the rays of *incidence*, as they were styled above) may be thrown at pleasure in any direction consistent with the range of the sun, by a person within the room, having a looking-glass in his hand: exactly as children produce what they call a *Jack o' lantern*. Now if, instead of throwing the rays upon a non-reflecting object (such as the wall, &c.), he were to transfer them to another looking-glass, they would be again reflected from this latter glass. Supposing these two looking-glasses to be placed at an angle of less than 90°, in a manner corresponding with the position of the two silvered planes seen in the instrument, and also shown in the diagram at D B, B C, he can reflect the sun's rays again out of the window. Now, if we imagine the window to represent the outer reflector of the meridian-instrument, its construction is, by this process, completely exemplified. To proceed a little further; it is evident, that the angle and situation of the two looking-glasses could be so arranged as to direct the rays of the sun through any particular pane of the window; so that a person standing without, in a proper position, would see, in addition to the sun's rays reflected from the *outer* surface of the pane, the rays of incidence that has passed through the window, and were thus reflected from the double mirror. One of the luminous objects (the flash or glare of the sun) so produced, would be reflected from the surface of the window, and would be a *single* reflection; while the rays of incidence, which had passed through the window, and undergone a *double* reflection by means of the *two* mirrors would, on being thrown back by the mirrors through the window, move in a direction contrary to that taken by the single reflection from the surface of the window-pane. Hence, any one of the heavenly bodies, subjected to the eye by a process of the above description, would not appear as two distinct objects, but those objects would be seen to approximate and cross each other in an *opposite* course: a desideratum being hereby secured which increases the power of the instrument in a double ratio, and renders it proportionably preferable to any other that has been hitherto employed.

It may not be amiss to add, that the experimenter who is desirous of making the observation with the utmost possible accuracy, may, after protecting his eye with a darkened glass, employ a telescope to magnify the object in the field of view.

*(To be continued.)*

## ELECTRO METALLURGY.

*(Continued from page 183.)*

### *On the Properties of Galvanic Batteries.*

"After describing the various forms of the galvanic battery, we are led to consider the effects which they produce, for these are called the galvanic effects; and the theoretical principle which causes them is termed galvanism.

"The sign of a battery in action, is the change going on in each cell of the battery itself. In Daniells's battery it is evinced by a deposit of copper on the negative metal; in Grove's battery, by the evolution of nitrous fumes, and in mine by an evolution of hydrogen. These several actions mark exactly the quantity of current passing; but in the two former batteries, no accurate measure can be readily made, although in the latter, the hydrogen may be collected in one of the cells by means of a glass jar, and the quantity thus exactly ascertained.

"This property in my battery is of extreme value to the mechanic and experimentalist, for he can tell at once by the hissing of the hydrogen, whether the connections are all correctly made, and what amount of current is passing, a fact of no small importance when applied to the electrotype.

"The next phenomenon which a battery displays is the power of heating wires of sufficient size to carry the current readily; and by this, the most infusible metals, as platinum, palladium, gold, copper, iron, and steel, may be instantaneously melted. The size of the wires melted, will depend upon the quantity of electricity developed, while the length will depend upon the intensity of the current.

"Mr. Snow Harris has ingeniously taken advantage of this property to make an instrument for measuring the voltaic current. It consists of a fine wire passed through a delicate air thermometer, and the expansion of air shows the degree to which the wire is heated. This instrument is a valueless test, unless both thick and thin wires be used in two experiments, for otherwise but one property of the battery is estimated.

"The next property which a battery displays, is its power of igniting metallic or charcoal points, when joined to two ends of the battery, and held so that they barely touch, a light is then exhibited equal in brilliancy to that of a little sun. This has been called the spark, and much controversy has taken place among the learned at what distance the spark will pass. Some have asserted that it will pass through some distance; Jacobi, however, considered the distance to be extremely small; but M. Gassio, with that liberality of spirit which alone is a sure test of a man's devotion to science, fitted up 100 series of Professor Daniell's largest batteries, but with them, by the most delicate micrometer, he could not discover that the spark would pass at any appreciable distance, on the contrary this large battery would remain quite inert if the poles were separated by the distance of the thinnest film of paper. In a late number of the Philosophical Magazine, Mr. Crosse has revived the enquiry by stating, that by a very extensive series of water batteries, in his own possession, he has succeeded in obtaining the spark at a short distance. He proposes to enlarge his battery to 1000 cells, in order fully to determine this point.

"The spark seems principally to depend upon a combustion of fine particles of metal, and, when charcoal or hard gas coke is used, upon little points of it flying from one pole to another, so that one pole wastes away, and the other increases till the flame becomes quite encased in a carbonaceous matter. This has always been a serious obstacle to the adaptation of this brilliant arc of flame to practical purposes. The phenomenon of the spark requires intensity for its production. A series of Grove's batteries is best suited for this purpose. Professor Wheatstone, by most ingenious experiments, determined, that the duration of the spark did not last for the one-millionth part of a second.

"The next property evinced by the galvanic battery, is its power of charging a Leyden jar; but this is a property of little importance, and requires great intensity. An extensive series of batteries must be used to effect this object.

"Depending upon the same causes as the last is the shock; which is a convulsive twitching in the muscles from the intensity of the battery. This singular effect requires generally a series. It is felt only when contact is made or broken; but if a cut exists in the finger, a small series will illustrate this property.

"When we desire to exhibit the effect of the shock upon a dead animal, a pin ought to be run through the skin at the head, and another at the hind-leg; every time the poles of a battery are connected or disconnected with these, strong convulsions will take place. If the upper lip be touched with a piece of zinc, and the under part of the tongue with a piece of platinum, or vice versa, a flash of light will be perceived when they are connected, whether the eyelids be open or closed. No explanation can be given of this singular phenomenon. All these phenomena are termed the physiological effects.

"A galvanic battery has the power of producing certain effects which are called magnetic effects, and the supposed principle of magnetism. To describe the term magnetism would be impossible, like galvanism, or electricity, because we are only cognizant of it by its properties. There are but two metals capable of being magnetic, and these are nickel and iron. The identity of magnetism and electricity has, like all other branches of philosophy, received many important additions from the indefatigable Faraday; but although magnetism is fraught with interest, it will be foreign to the purpose of this work to enter farther into its important details, than to illustrate the effects of galvanism.

"The voltaic current, passing at right angles to a piece of iron, from which it is separated by any non-conducting substance, induces in it the properties which are termed magnetic; for if another piece of iron be now held to it, it will be attracted. The more frequently the same current passes round the iron, the greater will be the power; and for this purpose it is usual to twist wire covered either with silk or cotton round the iron, in order that the same current may pass at the right angles in a greater number of times. When the current ceases, from the connection with the battery being broken, a difference according to the nature of the iron is observed: for if it be the pure malleable soft iron, all magnetism immediately ceases; hence, iron, so situated is termed a temporary magnet; but if hard steel is used for the experiment, the magnetism indeed is not so very powerful, but it continues for a very long period; hence in this state it is called a permanent magnet.

"A permanent magnet if suspended in such a way that it can vibrate, has one of its poles turned to the north pole of the earth, the other to the south pole; but if a galvanic current be passed round this permanent magnet, in the direction of its axis, the magnet will be instantly deflected at right angles from the current, and upon this principle, an instrument has been constructed called the galvanometer.

"The direction in which the needle is deflected, is best remembered by a little device which Professor Daniell describes in his lectures; for by supposing that we ourselves are the conducting wires, and the electric current passes from our head to our heels while we are looking at the magnet, the north pole will be turned to our right hand. This ingenious device is applicable to every position, provided we are either above, or underneath the plane of the needle.

"Galvanometers are differently constructed, according to the delicacy of the experiments for which they are required. In general it is sufficient to use a needle centered as if it were to be used for a mariner's compass, and a long covered wire is to be passed alternately over and under it, in the direction of the long axis. The two ends of the wire may be connected to mercury cups, to afford a ready means to unite them with the poles of the battery.

"A much more delicate form of galvanometer is constructed by using two needles, so suspended, that the north pole of one is over the south pole of the other.

"The polarities are thus neutralized, and no longer under the influence of the earth's magnetism. In this state they are called astatic, and are generally suspended by the finest fibre of silk, so that the slightest voltaic current will act upon them.

"It is advisable to allow one needle to have a slight preponderance, in order that the long vibration may not be troublesome. An instrument like this is only necessary for the most minute experiments.

"Another form is termed the tortion galvanometer, because a resistance is afforded by the twisting of an elastic substance. By this we are enabled to appreciate differences in slight currents.

"However useful the instrument may be for all small currents, large quantities of electricity are seldom measured by magnetic effects; but I believe that the right use of the magnet is a very important addition to our instruments for measuring galvanic currents. To estimate the quantity of electricity in any voltaic current, a piece of soft iron is to be bent in the form of a horseshoe, and a good sized covered copper wire is to be wound round it, the two ends being left free for conuection with the battery. A piece of soft iron with a hook attached to it is to be used for the keeper, and the weight which this sustains indicates the amount of electricity.

This instrument is only valuable for comparative experiments; as different results will always be obtained by different magnets, because the quality of iron is found materially to influence the results; but if the same magnet be used, and the wire of sufficient dimensions, and of moderate length, there will be scarcely any appreciable resistance offered to the current; and the relative quantity of electricity evolved, independently of its intensity, can be accurately ascertained.

"Temporary magnets are too frequently made with very thin covered wire, and even great lengths employed. Now in this case, the amount of magnetism induced by any current, ceases to be an exact measure of the quantity of electricity passing, because intensity is required to overcome the resistance afforded to the passage of the current from the wires; and it is from this cause that electro-magnetic engines, possessing, as they do, several magnets, and very often thin wires, require several cells before the current passes at all.

"To give a comparative estimate of the value of this test of the quantity of electricity evolved, and that of whereby the power is estimated by decomposition, perhaps is premature, till the latter mode is fully entered into, but as the magnet requires but little intensity, and that entirely depending upon the size of the wires, it is apparent that one cell of each combination, or form of battery, will suffice for the experiment; if however, the decomposition of water be taken as the test, a sufficient number of cells must be employed, to overcome the resistance; and thus, if many combinations are made the subject of experiment, it will be attended with great cost.

*(To be continued.)*

## PROPOSED SUBSTITUTE FOR CHIMNEYS.

The British and Foreign Review for July contains the following communication; "Dr. Arnott has recently invented an air-pump, with which it is proposed to supply a draft to furnaces that will supersede the necessity of funnels in steam-boats, and of the costly chimneys which now demand so great an outlay in the erection of engine-houses. This pump, when worked by a weight of one cwt., furnishes a draught equal to 100 cubic feet of air in a minute in an uncompressed state. A slight transfer of power from any engine would thus suffice to create a strong draught, which can be so directed as to cause the consumption of the smoke. As this simple and beautiful invention forms at the same time a powerful ventilator, we may expect from it a still greater reduction of the sufferings of sugar-boilers than the philanthropists ever contemplated."—It is to be regretted that the British and Foreign Review will venture to praise a scheme of the merits of which it is obviously incompetent to form a just opinion. Every engineer will only laugh at the announcement, for he will at once see that the project is neither new nor feasible. A pretty gigantic cylinder indeed it would be that would pump out the smoke of a steam vessel, the funnel-pipe of many of which is five feet in diameter. And then how well the pistons and valves would act when almost red hot! Besides, where would the smoke go when the vessel stopped? If, to obviate some of these objections, the air were to be forced into the ash-pit, instead of the smoke being drawn out of the chimney, the furnace door could not be opened to mend the fire while the engine was at work without the flame coming out in the fireman's face. If Dr. Arnott's physic be as bad as his mechanics, we should not like to have him for a doctor.

## VENTILATION.

*(Continued from page 208.)*

It will be sufficiently obvious, that due and appropriate ventilation, however simple it may be in individual cases, is, in reality, in many public buildings, a very large question, more particularly in complicated structures, and cannot be successfully studied without entering on a number of different subjects, among which the most important are the following:—

1. The general properties of gases.
2. The nature of atmospheric air, the changes to which it is subject, and the impurities with which it is apt to be contaminated.
3. The processes of respiration and transpiration, by which the air is brought into immediate action upon the living system, and the influence of these functions on atmospheric air.
4. The process of combustion, and the various modes of communicating artificial warmth to the air, as the open fire—the stove—steam and hot-water apparatus.
5. The deterioration of the atmosphere by artificial illumination; the effect produced by lamps and candles.
6. The nature of gas; the arrangements by which the strong objections to its more general introduction may be obviated.
7. The means of securing ventilation—natural ventilation—artificial ventilation—ventilation by fire——ventilation by mechanical power—the pump, the fanner, the screw, the bellows, the windmill ventilator, &c.

In special cases, particularly in manufactories where noxious products are evolved, unless their nature, and the manner of disposing of them, be understood, no certain results can be anticipated from the mode in which they are treated.

It will also be remarked that the nature and amount of ventilation must be modified by the extent of space to which it is applied, the numbers that may be crowded together, and the rapidity and extent of alternations to which they may be subject. In the House of Commons, where the number fluctuates continually, provision is required for 800 at one time, and in a few minutes afterwards for fifty or sixty only, or even a much smaller number, which, in a short time, may be as rapidly increased as it was diminished.

Again, the system of ventilation adopted frequently requires peculiar modifications from the particular circumstances in which it is applied, more especially in mines, ships, steamboats, transports, manufactories, prisons, hospitals, schools, theatres, refreshment-rooms, courts of law, hotels, dwelling-houses, coaches, stables, tunnels, and, in short, under all circumstances where the air is specially affected either by the individuals present, or the nature of the materials to which it may be exposed.

The necessity of ventilation to man arises from the structure of the human frame, its relation to the air with which it is surrounded, and the manner in which air generally is affected by respiration and transpiration — by many natural operations — by many of the products both of the animal and vegetable kingdom, and innumerable operations of art. These tend to vitiate the air and render it unwholesome by the evolution of noxious products, or by withdrawing that peculiar principle—oxygen—on which its power of supporting life more pre-eminently depends.

When the external atmosphere is pure, and the system free from disease, the air feels light and elastic, respiration is performed unconsciously, the mental faculties are serene, the bodily strength great, the appetite good, and the sleep calm and refreshing.

But when the air is of inferior quality, the respiration becomes uncomfortable, and often anxious or oppressive, the strength begins to fail, the general tone of the system is depressed, the power of the bodily or mental exertions becomes impaired, the sleep anxious and uncertain, and, in extreme cases, where the air has been vitiated to a great extent, death rapidly ensues. In more minute proportions, impurities in the air produce an endless variety of discomfort and disease, sometimes inducing a sense of languor or debility that may be barely recognised; while, on other occasions, they undermine the constitution by a slow and insiduous action, which is too often accompanied by a permanent loss of health.

Purity and freshness are still more essential in the supply of atmospheric air for respiration than in that of ordinary aliments, as the air undergoes no special chemical preparation before it acts upon the system, but is transferred at once to the cells of the lungs, and there it is almost directly brought into contact with the blood, nothing intervening between them except a minute portion of the most attenuated membrane, which does not prevent their tendency to affect each other.

The principal object of ventilation being to supply pure air for respiration, it may be well for the reader to familiarize himself with some of the leading facts mentioned in the following paragraphs. The standard of quantities assumed is the means of varied observation by different experimenters. Few results, however, are more various than the number of cubic inches of air respired by different individuals at the same period, or by the same individual at different periods, and hence great diversity may be expected in the result of the analysis of expired air, according as it is diluted largely with air from the mouth or nostrils, or obtained by a forced effort from the lungs after that in the larger air-passages shall have been expelled.

The pure air received into the lungs is always diluted with the air already there, before it acts upon the blood in the cells.

The inhabitants of London, amounting in number to two millions, respire, every minute, 370,370 cubic feet, or 12¼ tons of air, and consequently require, for respiration alone, 6,650,000 tons per annum. Allowing, however, 10 cubic feet per minute to each individual for the supply of his various wants, the consumption amounts to 359,000,000 of tons annually, or nearly 1,000,000 of tons daily.

In a room, containing 1,000,000 cubic feet of air, there are assembled 10,000 persons. The whole of the air will have been respired in nine hours, while an adequate supply of ten cubic feet per minute to every person would necessitate a total change every ten minutes, or a supply of fresh air amounting to 6,000,000 of cubic feet, or 205 tons per hour.

In a room 12 feet square and 12 feet high, containing, therefore, 1728 cubic feet of air, there are ten persons who respire the whole air in the room in 15½ hours, and require a complete change every seventeen minutes in order to supply them with 10 cubic feet per minute. Such a change might be effected by the ingress and egress of air through apertures, 1 square foot in area, at the rate of 100 feet per minute, or 1-?th mile per hour.

In the same manner, in a church, 80 feet long, 50 feet wide, and 40 feet high, containing therefore 160,000 cubic feet, there may be 1000 persons. For their supply there would be required a change every sixteen minutes, or about 20 tons of fresh air every hour.

One man during a life of 50 years makes 525,600,000 respirations, inspires 160·3 tons of air, consumes 18·57 tons of oxygen, discharges 19·8 tons of carbonic acid from his lungs, containing 5·475 tons of carbon, or about 80 times the weight of his own body (150 lb.). Were he allowed 10 cubic feet of air per minute, he would, during 50 years, have used nearly 900 tons.

The inhabitants of the earth, taken at one thousand millions, respire annually 3,327,000,000 of tons of air, and evolve 109½ millions of tons of carbon. The total weight of the atmosphere is about 5,261,000,000,000,000 of tons, so that it would require 1,580,000 years to elapse before the whole atmosphere could be respired by the human inhabitants of earth.

Of the atmosphere, seventy-eight per cent., or 4,103,600,000,000,000 tons are nitrogen, and 22 per cent. or 1,157,400,000,000,000 tons are oxygen. Of this quantity, there are annually consumed, by the human inhabitants of the globe, 371,550,000 tons of oxygen, so that it would require nearly 3,120,000 years for this supply to be exhausted, supposing respiration to be carried on till the last portions are consumed, did no principle exist by which it could be renovated. The quantity of carbon and moisture evolved every minute by one individual, by respiration alone, amounts to 3·27 grains of carbon, and 3·27 grains of watery vapour. From an assembly of 1000 persons there would, therefore, be evolved, in one hour, 38 lb. of carbon, and 27½ lb. of water.

The whole inhabitants of the earth discharge annually from their lungs, 107,000,000 tons of water, a quantity, which, if collected together, would form a sphere nearly 2000 feet in diameter.

The inhabitants of London, taken at 2,000,000, evolve annually, from their lungs, about 220,000 tons of carbon, and 215,000 tons of water.

At a sitting of the House of Commons on a very leading question, when 800 persons, members and strangers, are present for twelve hours, air is required for 11,520,000 respirations. :—

20 = respirations by one person in one minute.
60 = minutes per hour.

1200 = respirations per hour.
12 = hours of sitting.

14400 = respirations per twelve hours.
800 = number of members and strangers present.

11,520,000 = number of respirations made by 800 persons in twelve hours.

It has been found, that a man makes, on an average, 20 respirations per minute, and that at each respiration he inhales 16 cubic inches of air.

It may be assumed that he consumes oxygen amounting to 10 per cent. by volume, of the air inspired, and discharges about 7·8 per cent. of carbonic acid gas. The accordance of those numbers, with the mean of estimates given by the authorities cited, will appear from the annexed table.

| Authorities. | Oxygen consumed. | Carbonic Acid discharged. |
|---|---|---|
| Dr. Thomas | .. | 327 per cent. |
| Allan and Pepys | .. | 8.125 .. |
| Sir H. Davy | 9.876 per cent. | 875 .. |
| Lavoiser & Seguin | 12.940 .. | 4.205 .. |
| Menzies . . | 11.320 .. | .. |
| Coathupe and Liebig | .. | 7.750 |

On the whole it may be stated, that for 302 cubic inches of air inhaled per minute, there are consumed 32 cubic inches of oxygen, and there are discharged 25 cubic inches of carbonic acid gas.

*(To be continued).*

## GUNPOWDER.

*(Continued from page 204.)*

I have tried many other modes of estimating the sulphur in gunpowder more directly, but with little satisfaction in the results. When a platina capsule, containing gunpowder spread on its bottom, is floated in oil heated to 400 Fahrenheit, a brisk exhalation of sulphur fumes rises, but, at the end of several hours, the loss does not amount to more than one half of the sulphur present.

When gunpowder is digested with chlorate of potash and dilute muriatic acid, at a moderate heat in a retort, the sulphur is acidified; but this process is disagreeable and slow, and consumes much chlorate. The resulting sulphuric acid being tested by nitrate of baryta, indicates of course the quantity of sulphur in the gunpowder. A curious fact occurred to me in this experiment. After the sulphur and charcoal of the gunpowder had been quite acidified, I poured some solution of the baryta salt into the mixture, but no cloud of sulphate ensued. On evaporating to dryness, however, and redissolving it the nitrate of baryta became effective, and enabled me to estimate the sulphuric acid generated; which was of course ten for every four of the sulphur.

The acidification of the sulphur by nitric or nitro-muriatic is likewise a slow and unpleasant operation.

By digesting gunpowder with potash water, so as to convert its sulphur into a sulphuret, mixing this with nitre in great excess, drying and igniting, I had hoped to convert the sulphur readily into sulphuric acid. But on treating the fused mass with dilute nitric acid, more or less sulphurous acid was exhaled. This occurred even though chlorate of potash had been mixed with the nitre to aid the oxygenation.

It is probable, for reasons already assigned, that the proportions mixed by the manufacturers may differ slightly from the above.

The English sporting gunpowders have long been an object of desire and emulation in France. Their great superiority for fowling pieces over the product of the French national manufactories, is indisputable. Unwilling to ascribe this superiority to any genuine cause, M. Vergnaud, captain of French artillery, in a little work on fulminating powders lately published, asserts positively, that the English manufacturers of 'poudre de chasse' are guilty of the 'charlatanisme' of mixing fulminating mercury with it. To determine what truth was in this allegation, with regard at least to the above five celebrated gunpowders, I made the following experiments:

One grain of fulminating mercury, in crystalline particles, was mixed in water with 200 grains of the Waltham Abbey gunpowder, and the mixture was digested over a lamp with a very little muriatic acid. The filtered liquid gave manifest indications of the corrosive sublimate, into which fulminating mercury is instantly convertible by muriatic acid; for copper was quicksilvered by it; potash caused a white cloud in it that became yellow, and sulphuretted hydrogen gas separated a dirty yellow white precipitate of bisulphuret of mercury. When the Waltham Abbey powder was treated alone with dilute muriatic acid, no effect whatever was produced upon the filtered liquid by the sulphuretted hydrogen gas.

Two hundred grains of each of the above sporting gunpowders were treated precisely in the same way, but no trace of mercury was obtained by the severest tests.' Since by this process there is no doubt but one 10,000th part of fulminating mercury could be detected, we may conclude that Captain Vergnaud's charge is groundless. The superiority of our sporting gunpowders is due to the same cause as the superiority of our cotton fabrics —the care of our manufacturers in selecting the best materials, and their skill in combining them.

I shall join here some miscellaneous observations upon gunpowder.

In Bengal, mixing is performed by shutting up the ingredients in barrels, which are turned either by hand or machinery; each containing 50 lb. weight, or more, of small brass balls. They have ledges on the inside, which occasion the balls and composition to tumble and mingle together, so that the intermixture of the ingredients, after the process has been gone through, cannot fail to be complete. The operation is continued two or three hours; and I think it would be an improvement in Her Majesty's system of manufacture if this method of mixing were adopted.

In England two or three pints of water are used for a 42lb. charge: but the quantity is variable; both the temperature and the humidity of the atmosphere influence it.

Bramah's hydrostatic press, or a very strong wooden press working with a powerful screw, lever, and windlass, constitutes the description of mechanism by which density is imparted to gunpowder. The incorporated or mill-cake powder is laid on the bed, or follower of the press, and separated, at equal distances, by sheets of copper, so that when the operation is over, it comes out in large thin solid cakes, or strata, distinguished by the term press-cake. The milk-cake powder at Waltham Abbey, is submitted to a mean theoretic pressure of 70 to 55 tons per superficial foot.

Gunpowder should be thoroughly dried, but not by too high a degree of heat; that of 140° or 150° of Fahrenheit's thermometer is sufficient. It appears to be of no consequence whether it be tried by solar heat; by radiation from red-hot iron, as in the gloom-stove; or by a temperature raised by means of steam. Her Majesty's gunpowder is dried by the two last methods. The grain should not be suddenly exposed to the highest degree of heat, but gradually.

The method of trial best adapted to shew the real inherent strength and goodness of the gunpowder, appears to be an eight or ten-inch iron or brass mortar, with a truly spherical solid shot, having not more than one-tenth of an inch windage, and fired with a low charge. The eight-inch mortar, fired with two ounces of powder, is one of the established methods of proof of Her Majesty's works. Gunpowders that range equally in this mode of trial, may be depended on as being equally strong.

Another proof is by four drachms of powder laid in a small neat heap, on a clean polished, copper plate; which heap is fired at the apex, by a red-hot iron. The explosion should be sharp and quick, not tardy, nor lingering; it should produce a sudden concussion in the air, and the force and power of that concussion ought to be judged of by comparison with that produced by powder of known good quality. No sparks should fly off, nor should beads, or globules of alkaline residuum, be left on the copper. If the copper be left clean, *i. e.* without gross foulness, and no lights, *i. e.* sparks, be seen, the ingredients may be considered to have been carefully prepared, and the powder to have been well manipulated, particularly if pressed and glazed; but if the contrary be the result, there has been a want of skill or of carefulness manifested in the manufacture.

"Gunpowder," says Captain Bishop "explodes exactly at 600° of heat by Fahrenheit's thermometer; when gunpowder is exposed to 500° it alters its nature altogether; not only the whole of the moisture is driven off, but the saltpetre and sulphur are actually reduced to fusion, both of which liquify under the above degree. The powder on cooling, is found to have changed its colour from a gray to a deep black; the grain has become extremely indurated, and by exposure even to very moist air, it then suffers no alteration by imbibing moisture."

---

## PROFESSOR FARADAY ON HEAT.

When light falls on a polished opaque substance, it is reflected from it, or thrown off in an opposite direction, the angle of reflection being always equal to the angle at which it falls on the surface. If the body is transparent, the greater part of the light passes through it, and if the light falls angularly upon it, it is refracted, or bent from its course, and when the transparent substance is prism-shaped, the light is thrown completely in another direction. Such substances as ice and glass allow light to pass through, and refract it, but polished metals reflect, and do not allow it pass. The same facts have been observed with respect to heat, and although it cannot be seen in its passage, its transfer can be proved. When the hand is held towards a fire, heat is felt, which is due to its being radiated, or thrown equally, as from a centre, in all directions. The effects of radiated heat may be watched by using a red-hot ball, which will be found to give off heat equally in all directions, and will readily light a piece of phosphorus placed at a great distance below it. A flat mirror, held in the paths of the rays of heat, will reflect them, and the rays must thus be thrown on any required spot. If, instead of one mirror, 300 or 400 are employed, and so placed that the heat reflected from each should fall on the same spot, the effect of course is greatly augmented. A concave mirror may be considered as such an assemblage of myriads of flat mirrors, and its focus as the spot where their reflected heat is accumulated. With two parabolic reflectors, the effects of radiated and accumulated heat are very striking. A red-hot ball placed in the focus of one will fire combustibles held in the focus of the other, though they may be far apart, and ice produces in a similar manner, cooling effects.

The rays of heat and light are not hot, and it is an error in thought and word to call them so. The rays of heat are *heating* rays but not *hot* rays. This is beautifully illustrated by the experiments of Melloni, who found that various transparent substances allowed heat to pass through them in various proportions; that those bodies that allow it to pass freely through them do not become heated, and that those that stop the rays becomes heated exactly in that proportion. He placed a red-hot ball on a stand, and the two substances he wished to compare on opposite sides of it, and by a frame prevented any heat from passing excepting through the two bodies; beyond these he placed two pieces of metal with phosphorus on them, and by comparing the time it took to fire the phosphorus, he learnt the comparative freedom with which heat passed through the bodies experimented on. Through a piece of rock salt the heat passed with facility, but through glass it scarcely passed at all. Passing through the salt, it leaves it cold, but being stopped by the glass it makes it hot, thereby proving that when as rays it is not hot, but only when stopped, and then they lose their character as rays. In the same manner the rays from a luminous body are not light, until stopped by a solid body. If they were, the from the sun should be seen passing through up to the planets or the moon, but they give no l until stopped by them, and therefore are invisible.

When reflectors are used with the sun's rays, of course both the light and heat are reflected. Wood or paper held in the focus of a large reflector, are immediately fired by the sun's heat. The course of the rays travelling from the reflector to its focus is made beautifully evident by holding a smoking piece of paper underneath.

The rays of heat passed through a lens, are conveyed in a similar manner by refraction to a focus, but in this case the focus is on the opposite side to the source of heat. With the action of a burning glass every one is familiar, but it will now be seen that the property of refracting to a centre does not depend upon the nature of the body, but upon its transparency and shape; for ice, if melted on a hot tin mould, unless it is lens-shaped, acts equally well with glass. By it the sun's rays may be concentrated so as to burn paper and other combustibles, and yet the ice does not become melted. This could not be done with common heat, for instance, that from a fire, as ice will not allow its rays to pass, and stopping them, becomes melted. In Melloni's experiments on this subject he found that there were different kinds of rays of heat, just the same as there are different coloured rays of light, and that these rays were mixed in various proportions according to the source from whence they emanated. Thus some will pass through ice and salt, and not through glass. The rays of heat from the sun pass through almost every substance, whilst those from a common fire are stopped to a certain extent by almost every thing, and the substances themselves become heated. That no heat is produced until the rays are stopped, is seen by passing the sun's rays concentrated by a lens through a glass tube filled with ether, when no effect is produced; but put into it something which will stop the rays, such as a piece of black paper, and the ether is seen to boil immediately. The great effects produced by concentrating the sun's rays from a few feet on to one spot, gives a great idea of the immense quantity of heat which is continually being poured on this earth, and of the fearful effects were this heat withheld but for one season. These rays are not obstructed by the glass of the window, but allow it to pass on to carpets, &c., and heat them, but were they the same rays as from a fire, the effect would be very different.

The reception and emission of heat, though depending principally on the nature of the body, is found to be very generally influenced by the state and texture of the surface. Of two radiating bodies, for instance, tin canisters filled with hot water, one blackened or roughened on the surface will be found to get cold sooner than that which is left bright, one appearing like a good conductor, the other like a bad one, though the only difference is in the state of the surface: or the experiment may be varied by black-washing or white-washing only one side of the vessel; a thermometer will then indicate more heat being given off from that side than from the others. In the same way the reception of heat is affected by surface, those absorbing the best which radiate the best. The application of this principle to useful purposes is carried out to a great extent; for steam engines, and boilers, which are required to retain the heat, are kept bright, whilst those from which the heat is required to be delivered, as in warming buildings by hot water pipes, the surface is kept rough. In domestic economy the china teapot is now superseded by polished metal, which is found to keep the infusion hotter, and a difference even would be found whether a silver teapot were kept clean or dirty. Every substance is continually radiating heat to any other body near it which is colder than itself, and ice, even, will send out radient heat to solid carbonic acid. The emissive power is not always in proportion to the amount of heat, for the flame of a candle, though consisting of particles far hotter than a red-hot iron ball, does not radiate nearly so much heat as the latter. The power of a bright reflective surface to protect from radiant heat is well shown by placing a slip of gold leaf on a sheet of paper, and holding over it a red-hot ball; the uncovered paper is scorched, whilst the thin metal, itself an excellent conductor, entirely protects the paper below.

It has, then, been shown that bodies differ in their power of transmitting heat, some, like rock salt, transmitting it readily, or being an easy *dinthermal* body, whilst others, such as alum, transmit it but slightly, and that the rays of heat differ, depending upon the source from which they emanate, for the facility with which they penetrate transparent media; thereby confirming the probability of the analogy that Melloni has drawn between the various rays of light and those of heat.—*Engineer.*

## VARIETIES.

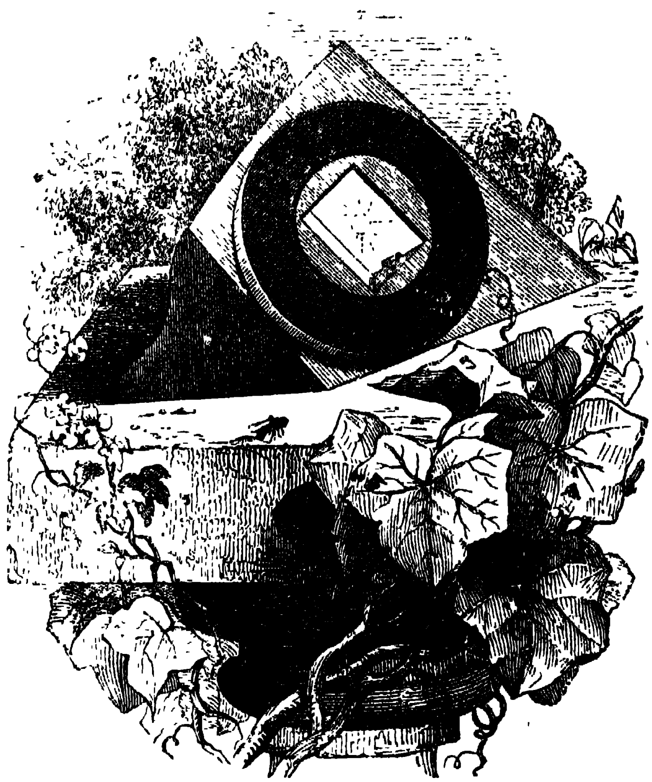
*Sparks Produced from Metal by Filing it.*—Take one part of antimony and melt it in a crucible, then add to it, by degrees, two parts of clean steel filings; mix and incorporate them well together by stirring them with an iron rod; when cold, put the mass into a vice, or fix it firmly in anything so that it will resist the action of a file; if a new rough file be now forcibly drawn across the mass, brilliant sparks make their appearance, of a white and red colour—the white sparks scintillate with a white flame, while the red fall extinguished.

*How to Test Spectacle Glasses.*—Hold one in each hand, placing their edges against each other, with their centres in a parallel line; now withdraw ten or twelve feet from the window, and observe the top and bottom bars of a square of glass; if they appear equal and uniform in all their parts, parallel to each other, and agreeing with the other squares in the window, then are they of the same radius; but if they do not match, the bars will appear disjointed, and higher or lower in one square than in the other.—*Cox's Spectacle Secrets.*

*Sting of Bees.*—Apply the blue-bag used by the washerwomen. Five minutes ago (and which induced me thus to address you) I was stung by one who tried several times before he could succeed. I applied the bag, and the pain ceased instantaneously. I have tried the same remedy for the sting of my bees, who made three distinct attacks before both, on myself and children, and always with the same result.—*F. G. C. in Gardeners' Chronicle.*

*Cement.*—A cement which gradually indulates to a stony consistence may be made by mixing twenty parts of clean river sand, two of litharge, and one of quicklime into a thin putty with linseed oil. The quicklime may be replaced with litharge. When this cement is applied to mend broken pieces of stone, as steps of stairs, it acquires after some time a stony hardness. A similar composition has been applied to coat our brick walls under the name of mastic.—*Dr. Ure.*

*Paper to Resist Humidity.*—This process, which is due to M. Eaglé, consists in plunging unsized paper once or twice into a clear solution of mastic in oil of turpentine, and drying it by a gentle heat. The paper without becoming transparent, has all the properties of writing-paper, and may be used for the same purposes. It is especially recommended for passports, workmen's books, legal papers, &c. When preserved for years it is free from injury, either by humidity, mice, or insects. It is further added that a solution of caoutchouc will produce even a still better effect.—*From the German.*



DENT'S DIPLEIDOSCOPE.

## THE DIPLEIDOSCOPE.

*(Continued from page 210.)*

### *Method of Placing the Dipleidoscope, and Directions for Testing.*

To illustrate and explain the method of placing the Dipleidoscope in the meridian, let us imagine a gentleman to reside at Dover. The longitude of his residence, in time, having been ascertained by reference to the ordnance-map, a good watch or chronometer, set to the time of the spot, is to be taken for the standard; and on the following day (or as soon after as the sun will permit), let us suppose the instrument is to be fixed. After it has been placed on a previously levelled surface, the following preparatory practice may be gone through, commencing about two hours before noon. Place the instrument on the unwrought end, with its two flat sides in the direction of the sun's rays: a sheet of paper may now be held nearly opposite the front glass, at about two feet distant (care being taken not to obstruct the rays of the sun from passing into the instrument), when the reflected image from the front glass will immediately be thrown upon the paper. The instrument should then be gently turned either to the right or left, until *another* similar image appear on the paper; these will mutually approach, until one is seen to cover the other, and they appear as one. If the observer then looks into the instrument (having the lowest side *a* (fig. 4) always towards him, and protecting his eye by means of the darkened glass), he will perceive the sun reflected in it, as one luminous circular object. The principal advantage derived from previously throwing the images on the paper is, that it indicates to the observer the direction in which he is to look into the instrument. By keeping his eye upon the sun, as exhibited in the glass, he will, after the interval of a few moments, perceive a *second* sun appear to pass away from the former:—these will presently be entirely detached, and two distinct suns will be seen. If he turn the instrument very gradually towards the west, the sun may be so separated as to re-approach, coincide, and separate again; and thus afford the opportunity of practising the complete observation before described. This experiment may be repeated at the pleasure of the observer, until he feels he has acquired the requisite skill for the permanent fixing of the Dipleidoscope; which, it needs hardly to be remarked, must be effected at apparent, or solar noon.

Before proceeding to the example intended to show the manner of placing the instrument in the meridian, it should be premised, that the twelve o'clock exhibited by the watch or chronometer designates what is called *mean* noon; so styled as to distinguished it from apparent noon. Between mean and apparent noon, there always exists a difference, *owing to the variations of the earth's motion in its course through the ecliptic*, together with the latter not coinciding with the plane of the equator. The provision made by astronomers to meet this inequality, and to convert apparent time into mean time, (by which latter clocks and watches are kept,) must be familiar to every one who is acquainted with the pages of an almanac. In the language of science, this reduction is called *equation of time;* and its application is indicated in the ordinary almanac by the phrase "clock fast," or "clock slow."

All the preparatory steps above alluded to, having been taken, the instrument is now to be permanently fixed; which process, for the clearer elucidation of the matter, we will suppose to take place on the 2nd of October. The criterion for determining the position of the Dipleidoscope is, that the two suns will be in coincidence, or appear as one, when the chronometer shows 11h.49m. 30·1s. It may be concluded that the instrument is then correctly in the meridian. If, however, on a subsequent trial, the chronometer, which we have taken as the standard for fixing the Dipleidoscope, makes the time shown by it too fast, the front glass must be moved, with great care and nicety, towards the east; if slow, with similar caution, towards the west.

There is also another plan for placing the instrument in the meridian, although not by any means so correct or so easy as the former. It is the usual method of erecting the ordinary sun-dial. Set a mariner's compass on the spot where the Dipleidoscope is to be fixed, and as soon as you have obtained the quantity due to the magnetic variation of the place, then suspend a plumb-line in the astronomical meridian. The compass is then to be removed, and the Dipleidoscope put down in its room. The apparently two plumb-lines, reflected in the instrument, must, by turning it gently round, be brought together, so as to coincide and appear as one.

A third and more perfect way of fixing the instrument may be derived from observation of the pole-star; but as this process involves some knowledge of practical astronomy, it is little adapted to general practice.

Having above detailed the method of fixing the Dipleidoscope in the meridian by means of the chronometer, &c. let us now proceed to describe the manner of testing its adjustment and give an example for taking the necessary observations.

In order to prove that the instrument is placed vertically, the observer must hang up a plumb-line, made of small white thread, at about two feet distant from the front glass, and move the line to the east or west, until the two lines reflected coincide in the field of vision. If the wind be high, so as to agitate the line, it will be requisite to immerse the plumb in a cup of water. Should the Dipleidoscope not be level, it will exhibit the images of the plumb-line diverging from each other, either at the top or bottom. To remedy this, a small piece of thin metal may be introduced under one of the sides which run parallel with the sun's rays, and it must be adjusted according to circumstances, until the images of the plumb-line become vertical. Correctness in this matter is of the utmost importance; for if the instrument did not stand vertically, the variation in the sun's altitude in summer and winter would occasion the Dipleidoscope to vary its indication of time.

The Dipleidoscope, when the level has been thus ascertained, must be firmly cemented.

*Directions for taking Observations*.—The instrument being supposed to be placed properly in the meridian, we may now go on to notice the manner of completing future observations. The reflection of two suns can be seen in the field of view for about ten minutes before their edges touch each other; and the complete observation consists in their movements being noted by the watch or chronometer at three separate times. First, at the contact or touching of the two limbs or edges; secondly, when the suns exactly coincide; and thirdly, when the edges separate.

But as the interposition of clouds may sometimes frustrate one or two of the observations, it becomes important to provide against such accidents. This is done by a calculation of the amount in time of the sun's semidiameter, with reference to the observation that happens to have been secured. If, for instance, the first observation be lost, and the second obtained, the loss is not of importance with regard to the second, as it is complete in itself;—the sun's place on the meridian being ascertained by the coincidence of the images. If the second observation be lost, and the first only obtained, *add* to the time then shown by the chronometer the amount of the sun's semidiameter. For those with whom strict astronomical precision is not so much an object, it is sufficient to say, that the quantity of 1 m. 7 s. may be used as the mean for the sun's semidiameter throughout the year. If both the first and second observations be lost, and the third only secured, *substract* from the quantity shown by the chronometer the sun's semidiameter, and the requisite time is obtained.

For the sake of example, the following observations are annexed:—

OBSERVATIONS.

1813. *October 2. Time shown by Watch or Chronometer.*

| | | H. | M. | S. |
|---|---|---|---|---|
| 1st observation | | 11 | 48 | 25·5 |
| 2nd ditto | | 11 | 49 | 30·1 |
| 3rd | | 11 | 50 | 34·7 |
| The first and third added together. | 2) | 23 | 39 | 0·2 |
| | Mean | 11 | 49 | 30·1 |

Further to illustrate the use of the above example, suppose the 2nd and 3rd observations to have been lost, and the 1st only secured: add 1 m. 4·6 s., the sun's semidiameter for October 2nd, and you have the same result as the centre, or the mean of all three observations, which is 11 h. 19 m. 30·1 s.

*Time shown by Watch or Chronometer.*

| | | H. | M. | S. |
|---|---|---|---|---|
| 1st observation | | 11 | 48 | 25·5 |
| 2nd ditto | | 11 | 49 | 30·1 |
| 4th ditto | | 11 | 50 | 34·7 |
| | 3) | 35 | 28 | 30·3 |
| Mean of the whole. | | 11 | 49 | 30·1 |

The above is all the calculation necessary to ascertain the time to within a fraction of a second. It is seen that, by adding the first and third observations together, and dividing by two, the mean result gives the same as the second observation, or time shown by the chronometer at the instant when the two suns coincided; and if we add all the three observations together and divide by three (according to the latter example), we then obtain, as the mean of the whole, 11h, 49 m. 90·1 s.; which result, we shall perceive by referring to Dent's equation-table for the 2nd of October, corresponds with the time there stated as that which should be indicated by the watch or chronometer, at apparent or solar noon, for that day. If the watch or chronometer show the time *less* than in the table, it is *too slow*; if more, it is too *fast*. The most perfect observations will always be obtained from the touching and separation of the sun's edges; as it is difficult, when taking the second observation, to determine the exact moment of coincidence.

While the advantage of the Dipleidoscope is such as not to be limited to many degrees of latitude necessary to observe the sun's highest and lowest altitude, and is of sufficient extent for all England and most parts of Europe, still, when the instrument is required for such low latitudes as India, it should be expressly stated, when the Dipleidoscope will be sent suitable for all places so near to the equator.

## VENTILATION.

(*Continued from page 208.*)

Having in a former number given Dr. Ried's "General Illustrations" on Ventilation, we resume our notice of this most important and valuable treatise on a subject of such vital interest to all classes of the community; and it were to be desired that a much larger share of attention should be given to the details; for "an honoured age of eighty, ninety, or a hundred years might then be expected become the average standard of human life, instead of the exception, as it is at present. Cities and country villages would emulate each other in showing a population whose health and strength would give grace and dignity to human nature. Some breathing time would be afforded for contemplation, and for the cultivation both of mind and body. A whole population passing through a hurried, a wretched, and an ephemeral existence, would not so frequently count its victims by thousands and tens of thousands who are often, with much truth, represented as being born only to die again, and every class of society would attain a higher standard or tone in all the great relations by which humanity is encircled.

"Results such as these could not spring from any single cause: the power of religion, the assistance of legislation, and the more general enlistment of all the sympathies of human nature, in favour of elevation of character, even among the humblest and most degraded of society, must engage more attention, as the most interesting and important of all occupations, independently of the mere alleviation of those physical wants and evils to which humanity is subject. Nor can any other measures be expected to penetrate into individual habitations or awaken that cordial understanding between different ranks of life, the interruption to which, wherever it occurs, must ever be considered one of the greatest misfortunes to which society is liable, from the extent to which it paralyses all efforts for amelioration."

So important does the author consider this subject, that he would make it a part of the general education of youth, and proposes to send teachers to the several schoolmasters, in order to make the science more generally understood; and we fully agree with him, that a few hundred pounds could not be expended more advantageously.

The association of proper means of communicating a knowledge of the great elementary truths of science, so far as they bear on the affairs of daily life, with the ordinary means of education is considered the principal desideratum for enabling more specific information to be acquired by all classes of society on the relation of the human frame to the external world, on the evils to which it is too often subjected, and on the advantages which would result from the adoption of measures by which they might be avoided; and if, for many years I have, at such leisure hours as my professional engagements permitted, given numerous courses on the chemistry of daily life to schoolmasters and young persons, such as I gave lately to a thousand teachers in Exeter Hall, under the sanction of the Committee of the Privy Council on Education, and joined with those who have advocated such measures, both in theory and practice, it has been from the conviction that it cannot otherwise be expected to attain those objects which the progress of science, as well as the wants of human nature, point out, by equally convincing evidence, as links of the great chain, unfolded by the natural progress of society.

I think I may now be permitted to say, that I have ascertained, by the courses referred to, and by numerous inquiries made in England, Scotland, and Ireland, that, were the question taken up on a great scale, an expense of from five to seven hundred pounds per annum, continued for a limited period, would soon enable missionary teachers to traverse the whole kingdom, and teach schoolmasters, who may not have had other opportunities, the great elementary truths that bear on health and length of life, enabling them not only to apply many of these in their own schools, but also to become the medium of introducing them to their pupils, and, through them, gradually to the whole community, were they to give familiar explanations, and simple experimental illustrations, once a week, of the facts which they would be taught. In the chemical department, the great barrier to such progress in some schools has been the attempt of the master to use complicated apparatus without adequate instruction. Let him content himself with plain apparatus, such as may be purchased for one or two pounds, or even with nothing more than a bottle, a bent tube, a few jars, and such materials as are every where accessible in civilized countries, and then, if a proper selection of experiments shall have been pointed out, he will find that he has the means of thousands of illustratious in which his pupils will delight—to which they will run from their play—and which will present endless topics of interesting conversation both at home and abroad.

And should any one say that I entertain too sanguine anticipations, or that this question is urged too strongly, I would reply, in the *first* place, that the views I have expressed do not exceed those realities which occasionally appear, notwithstanding the multiplied disadvantages with which they have been surrounded.

*Secondly*, An examination into the history of many cases of longevity, of health and strength, and of the influence of early training, where health was considered the primary object, has equally assured me that any calm and unbiassed enquiry will shew, that the expectations entertained are not unreasonable, but present a proper standard for aspiring to, though years or generations in some cases may elapse before they are attained, where the constitution may have been greatly impaired.

***Thirdly***, The scenes which I have witnessed during the last six-and-twenty years in chemical works in which I have been engaged, sometimes for many months continuously—in lanes, courts, and closes in Edinburgh, in which I attended to Dispensary practice while a student of medicine—in a fever hospital with 170 patients, where I resided during a severe epidemic — in numerous manufactories, mines, and ships—and in all classes of public buildings in this country, and on the continent—have impressed me more and more strongly, on each succeeding occasion, with the conviction that no other means would be at all adequate to cope with the magnitude of the evils it is desirable to remove, and to place measures for health on an extensive, consistent, economical, and practical basis.

The following extract is taken from a pamphlet on the study of Chemistry, in which the importance of conjoining the study of the alphabet of nature and of science, with the ordinary branches of education in elementary schools was advocated, in explaining the nature of the course given at Exeter Hall. The reader is referred to this pamphlet, if he should desire more minute statements than can be given here on this question.

The benefits arising from such a course would be—

I. A practical knowledge of some of the most important laws affecting health.

II. A practical knowledge of ventilation, and of the means, in many cases equally simple and economical, by which the more oppressive evils of a vitiated atmosphere may be removed.

III. A knowledge of the more important elements of which the material world is composed; of their actions upon each other, and upon the human frame. The key that would thus be given in daily life to the works of nature and the operations of art, would necessarily have the following advantages.—

1st. The lessons given, though few in number, would be equivalent to a great and extended course, when multiplied, after a few years, by the experience of daily life in those objects to which they are directed.

2nd. The knowledge they would impart being in reference to materials, the nature, use, and adaptation of which to various purposes, form the occupation of the great mass of mankind, great improvements in AGRICULTURE, ARCHITECTUR, MEDICINE, ENGINEERING, and in short, in every branch of Art or Science, would ensue, from the more extensive and familiar knowledge that would then be acquired, by all classes of society, in reference to the nature of the material world.

3rd. The standard of professional science among those more immediately occupied in professional pursuits would be advanced, as there would then be an opportunity of training the eye and the ear to observation, and the hand to manipulation, in early life; without these, however much the intellect may be trained, it is impossible to educate such accomplished observers, or such accurate experimenters in science. Elementary instruction in science has, in other respects also, become essential for young persons intended for professions where a knowledge of physical science is necessary; as, from the great progress now made in all its branches, it would be as impossible to expect the medical man, the engineer, the architect, the manufacturer, and all who are interested in science, to obtain that amount of information from the usual course of education which is now required, without some previous training in elementary schools, as it would be for any one to attain a proper rank as a scholar or a mathematician, were he never to enter upon the study of classics or mathematics, till he should join a university. Even now, in some professions, it is observed that the period of professional education is not adapted to the present state of science; and if elementary instruction, in some branches, at least, be not provided systematically in schools and academies, an extended period must be allotted to it at a future time, which would bear heavily on the means and resources of the advanced student. But if this course be omitted, college and university courses must be kept at a low par, compared with the ground they would take were professors not compelled, as they too often are, at present, to begin their courses with the most simple and elementary facts, which might be taught more advantageously before the pupils come to them.

The resources of the rich, the means of the poor, and the comforts of both would necessarily be increased, by the greater power that would be acquired in the production of agricultural and and manufactured articles, as by increased economy and comfort in their use.

It would give the pupils a new and more expanded view of the works of the Creator, and open to their notice innumerable sources of observation, which tend materially, in certain classes of society, to prevent the power of influence and dissipation, which, it is believed, is frequently commenced, not so much from the attractions it presents, as from individuals, having no other interesting means of occupation, when not engaged in their daily pursuits.

## ROSSE'S REFLECTING TELESCOPE.

At the great meeting of the British Association for the advancement of Science, held at York, on Thursday, September 26th, the Earl of Rosse described the construction of his gigantic Telescope, (for a view see No. 235). The following account of his Lordship's indefatigable exertions is extracted from "The Athenæum."

"Long before the hour of meeting, the room was crowded to suffocation, and many ladies, and even gentlemen, could not gain admittance. The address was illustrated by a model, with its supporting piers and galleries complete, and by a working model of the grinding and polishing machine.

"The Earl of Rosse commenced by stating, that the Council having intimated their opinion that some account of the experiments in which he had been engaged on the Reflecting Telescope would not be altogether devoid of interest, he would endeavour to describe, as briefly as possible, the manner in which he had attempted to accomplish the object in view, and the principal results obtained. When, about the year 1826, he first turned his attention to this subject, he considered that the knowledge of our own system might be almost considered complete. There were, no doubt, some portions of it, as the motions and distances of the satellites of Uranus, the masses of some of the planets, the rings of Saturn, and some others, which yet required elucidation, and would doubtless amply reward industrious research; but on the whole, he conceived that our ordinary instruments, aided by the nice contrivances for accurate measurement which the perfection of modern art had introduced, were amply competent to aid in this branch of research the many men of genius who were engaged in it. But a new and a most interesting field had been opened to the view, and partially explored, by the indefatigable zeal of the distinguished Herschel and his no less distinguished and accomplished son. The subject of double and multiple stars promised a rich harvest, if our instrumental powers could be enlarged to any considerable extent; and another field, no less promising, was that of nebulæ, of which some of those examined by the Herschels seemed to lay open to the contemplation of the astronomer regions in comparison with which our entire siderial sphere might be considered as a mathematical point. Now, in examining these, he did not mean to deny that accurate measurements were of much importance—indeed, of the very highest; but it must be obvious, that before we can measure, we must be rendered capable of seeing. Here, then, he found the strongest inducement to attempt to improve the instrument by which this was to be accomplished. Two objects required to be kept in view: first, to give the telescope sufficient aperture to secure a sufficiency of light; secondly, to increase to a sufficient extent the magnifying power. On these depended what might be called the optical power of the instrument, but particularly upon the former. For instance, the large telescope, of which a model stood before them, to be used effectually, must have a magnifying power of 300 times. Now, another instrument, very inferior in size, might have a much higher power, but, from the vast quantity of light which it collected into the image, objects in it became distinct which could not be at all seen by those of inferior aperture. The next question he had to determine was, whether he should attempt refractors or reflectors. Just at that time very large and very fine discs of the proper glass had been produced upon the Continent, and a strong hope was entertained of bringing the refracting telescope to a degree of perfection which had been hitherto rather hoped for than attained. But, upon a calm balancing of all the difficulties which opposed their construction, he determined to attempt the improvement of the Newtonian reflector, and that notwithstanding it was well known that an error of form of the reflector produced an error in the image more than five times as great as the same error in the refractor would produce. It was to the steps by which he attained this object that he was now about to direct the attention of the Section.

"Having concluded that upon the whole there was a better prospect of obtaining by reflection, rather than by refraction, the power which would be required for making any effectual progress in the re-examination of the nebulæ, the first experiments were undertaken, in the hope of obviating the difficulties which had previously prevented the application of the brilliant alloy which may be formed of tin and copper in proper proportions to the construction of large instruments. The manner in which the difficulty had been met, was, by adding an excessive proportion of copper to the alloy, but the mirror was no longer susceptible of a durable polish, and, when used, its powers declined rapidly. It appeared to me, therefore, to be an object so important to obtain a reflecting surface which would reflect the greatest quantity of light, and retain that property little diminished for a length of time, that numerous experiments were undertaken and perseveringly carried on. After a number of failures the difficulties appeared to be so great that I constructed three specula, where the basis of the mirror was an alloy of zinc and copper in the proportion of 1 zinc to 2·74 copper, which expands with changes of temperature in the same proportion as speculum metal. This was subsequently plated with speculum metal, in pieces of such size as we were enabled to cast sound. These specula were very light and stiff, and their performance upon the whole satisfactory; but they were affected by diffraction at the joinings of the plates; and although very brilliant and durable defining all objects well under high powers, except very large stars, still as the effect of diffraction was then perceptible they could not be considered as perfect instruments. In the course of the experiments carried on while these three specula were in progress, it was ascertained that the difficulty of casting large discs of brilliant speculum metal arose from the unequal contraction of the material which in the first instance, produced imperfections in the castings, and often, subsequently, their total destruction; and it appeared evident, that, if the fluid mass could be cooled throughout with perfect regularity, so that at every instant every portion should be of the same temperature, there would be no unequal contraction in the progress towards solidification, nor, subsequently, in the transition from a red heat to the temperature of the atmosphere. Although it was obvious that the process could not be managed so that the exact condition required should be fulfilled, still, by abstracting heat uniformly from one surface (the lower one), the temperature of the mass would be kept uniform in one direction, that is, horizontally; while in the vertical direction, it would vary in some degree as the distance from the cooling surface. These conditions being satisfied, we should likewise have a mass which would be free from flaws, and, when cool, would be free from sensible strain; nothing could be easier than to accomplish this, approximately, in practice; it would be only necessary to make one surface of the mould (the lower one) of iron of a good conducting material, while the remainder was of dry sand. On trial, this plan was perfectly successful; there was, however, a new, though not a very serious defect, which was immediately apparent—the speculum metal was cooled so rapidly that air-bubbles remained entangled between it and the iron surface; but the remedy immediately suggested itself, by making the iron surface porous, so as to suffer the air to escape; in fact, by forming it of plates of iron placed vertically side by side, the defect was altogether removed. It only then remained to secure the speculum from cooling unequally, and for that purpose it was sufficient to place it in an oven raised to a very low red heat, and there to leave it till cold, from one to three or four weeks, or perhaps longer, according to its size.

"The alloy which I consider the best, differs but little from that employed by Mr. Edwards: I omit the brass and arsenic, employing merely tin and copper in the atomic proportions, namely, one atom of tin to four atoms of copper, or, by weight, 58·9 to 126·4. As it was obviously impossible to cast large specula in earthen crucibles, the reverberatory furnace was tried; but the tin oxidized so rapidly, that the proportions in the alloy were uncertain; and after some abortive trials with cast-iron crucibles, it was found, that when the crucible is cast with the mouth up it is free from the minute pores through which the speculum metal would otherwise exude; and therefore such crucibles fully answered the purpose. It was very obvious that the published processes for grinding and polishing specula, being in a great measure dependent on manual dexterity, were uncertain, and not well suited to large specula; accordingly at an early period of these experiments, in 1827, a machine was contrived for the purpose, which has subsequently been improved, and by means of it a close approximation to the parabolic figure can be obtained with certainty; as it has been described in the Philosophical Transactions for 1840, it is unnecessary to do more than to point out the principle on which it acts. The speculum is made to revolve very slowly, while the polishing tool is drawn backwards and forwards by one eccentric or crank, and from side to side, slowly, by another. The polishing tool is connected with the eccentrics by a ring, which fits it loosely, so as to permit it to revolve, deriving its rotary motion from the speculum, but revolving much more slowly. It is counterpoised, so that it may be made sufficiently stiff, and yet press lightly on the speculum; the pressure being about one pound for every circular superficial foot. The motions of this machine are relatively so adjusted that the focal length of the speculum during the polishing process, or towards the lateral end of it, shall be gradually becoming slightly longer, and the figure will depend in a great measure upon the rapidity with which this increase in the focal length takes place. It will be evident that a surface, spherical originally, will cease to be so, if, while subjected to the action of the polisher, it is in a continual state of transition from a shorter to a longer focus; in fact, during no instant of time will it be actually spherical, but some curve, differing a little from the sphere, and which may be made to approach the parabola, provided it be possible in practice to give effect to certain conditions. An immense number of experiments, where the results were carefully registered, eventually established an empirical formula, which affords at present very good practical results, and may hereafter, perhaps, be considerably improved. In fact, when the stroke of the first eccentric is one-third the diameter of the speculum, and that of the eccentric is such as to produce a lateral motion of the bar which moves the polisher, measured on the edge of the tank, equal to ·27, the diameter of the speculum, or referred to the centre of the polisher, of 1·7, the figure will be nearly parabolic. The velocity and direction of the motions which produce the necessary friction being adjusted in due proportion by the arrangements of the machine, and the temperature of the speculum being kept uniform by the water in which it is immersed, there remains still other conditions, which are essential to the production of the required result. The process of polishing differs very essentially from that of grinding: in the latter, the powder employed runs loose between two hard surfaces, and may produce scratches possibly equal in depth to the size of the particles: in the polishing process the case is very different; there the particles of the powder lodge in the comparatively soft material of which the surface of the polishing tool is formed and as the portions projecting may bear a very small, proportion to the size of the particles themselves, the scratches necessarily will be diminished in the same proportion. The particles are forced thus to imbed themselves, in consequence of the extreme accuracy of contact between the surface of the polisher and the speculum. But as soon as this accurate contact ceases, the polishing process becomes but fine grinding. It is absolutely necessary, therefore, to secure this accuracy of contact during the whole process. If the surface of a polisher, of considerable dimensions, is covered with a thin coat of pitch, of sufficient hardness to polish a true surface, however accurately it may fit the speculum, it will very soon cease to do so, and the operation will fail. The reason is this, that particles of the polishing powder and abraded matter will collect in one place more than another, and as the pitch is not elastic, close contact throughout the surfaces will cease. By employing a coat of pitch, thicker in proportion as the diameter of the speculum is greater, there will be room for lateral expansion, and the prominence can therefore subside, and accurate contact still continue; however, accuracy of figure is thus, to a considerable extent, sacrificed. By thoroughly grooving a surface of pitch, provision may be made for lateral expansion contiguous to the spot where the undue collection of polishing powder may have taken place. But, in practice such grooves are inconvenient, being constantly liable to fill up: this evil is entirely obviated by grooving the polisher itself, and the smaller the portions of continuous surface, the thinner may be the stratum of pitch.

"There is another condition, which is also important, that the pitchy surface should be so hard as not to yield and abrade the softer portions of the metal faster than the harder. When the pitchy surface is unduly soft, this defect is carried so far that even the structure of the metal is made apparent. While, therefore, it is essential that the surface in contact with the speculum should be as hard as possible, consistent with its retaining the polishing powder, it is proper that there should be a yielding where necessary, or contact would not be observed. Both conditions can be satisfied by forming the surface of two layers of resinous matter of different degrees of hardness; the first may be of common pitch, adjusted to the proper consistence by the addition of spirits of turpentine, or rosin; and the other I prefer making of rosin, spirits of turpentine, and wheat flour, as hard as possible, consistent with its holding the polishing powder. The thickness of each layer need not be more than one-fortieth of an inch, provided no portion of continuous surface exceeds half an inch in diameter, the hard resinous compound, after it has been thoroughly fused, can be reduced to powder, and thus easily applied to the polisher, and incorporated with the subjacent layer, by instantaneous exposure to flame. A speculum of three feet diameter thus polished, has resolved several of the nebulæ, and in a considerable proportion of the others has shown new stars, or some other new feature."

In conclusion, Lord Rosse exhibited drawings of the nebulæ, as figured by Herschel. and also as they appeared in the telescope constructed by his Lordship.

Fig. 88 of Herschel, or 2 Messier, and 21 h. 23 m. —1° 34′ south, many of the stars into which it is reduced by his telescope, are as large as those of the first magnitude to the naked eye.

Fig. 81, Herschel, the bright nebula, near Tauri, figured by Herschel as perfectly elliptic and resolvable, but no stars seen, is seen in the telescope, with three feet aperture, as a rather oval cluster of stars, with projecting filaments of stars; some of these filaments extending considerably, so as to give something of the idea of a scorpion.

Fig. 29 of Herschel. The ring nebula of Lyra, shows in the three-feet telescope, seven stars, one triple. It is an annular cluster, with fringes, and the nebulous-looking centre in patches.

Fig. 45 of Herschel, a planetary nebula. is also seen as an annular cluster.

Fig. 26 of Herschel, the "Dumbell Nebula," is seen as an irregular cluster, or rather two in juxtaposition, and nothing of the exact elliptic termination of Herschel's figure.

Dr. Robinson and the Marquis of Northampton briefly addressed the Section.

## MAGNETIC ATTRACTION.

About the year 1818, Professor Barlow of Woolwich, turned his attention to the subject of magnetism, with a view principally of calculating the effect of ship's guns on the compass. In trying the effect of different iron bells, he was led to the curious facts —that there exists round every mass of iron, a circle inclined to the horizon, at an angle equal to the complement of the dip of the needle;—that the plane of the circle is a plane of no attraction upon a needle whose centre is in that plane;—that if we regard this circle as the magnetic equator, the tangent of the deviation of the needle from its north or south pole will be proportional to the rectangle of the sign of the double latitude, and cosine of the longitude;—that when the distance of the needle is variable, the tangent of deviation will be reciprocally proportional to the cube of the distance, and that, all things else being the same, the tangent of deviation will be proportional to the cubes of the diameters of the balls, or shells, whatever be their masses, provided their thickness exceeds a certain quantity. Mr. Barlow was, from these discoveries, enabled to invent a most ingenious method of correcting the error of the compass, arising from the attraction of all the iron on board ships. This source of error had been noticed by Mr. Wales, Mr. Downie in 1794, and by Captain Flinders; but it is to Mr. Bain that we owe the distinct establishment and explanation of this source of error. As a hollow shell of iron, about four pounds in weight, acts as powerfully at the same distance as a solid iron ball of two hundred pounds weight, Mr. Barlow happily conceived that a plate of five or six pounds weight might be made to represent and counteract the amount of the attraction of all the iron on board a vessel, and therefore leave the needle as free to obey the action of terrestrial magnetism as if there were no iron in the ship at all. After this ingenious contrivance had been submitted to the Admiralty, it was tried in every part of the world; and even in the regions which surround the magnetic pole, where the compass becomes useless, it never failed to indicate the true magnetic direction, when the connecting plate was properly applied. "Such an invention as this," says Captain Parry, "so sound in principle, so easy in application, and so universally beneficial in practice, needs no testimony of mine to establish its merits; but when I consider the many anxious days and sleepless nights which the uselessness of the compass in these seas had formerly occasioned me, I really should have esteemed it a kind of ingratitude to Mr. Barlow, as well as great injustice to so memorable a discovery, not to have stated my opinion of its merits, under circumstances so well calculated to put them to a satisfactory trial. "For this beautiful invention, the board of longitude conferred upon Mr. Barlow the highest reward of five hundred pounds: and the emperor of Russia, who was never inattentive to the interests of science, sent him a fine gold watch, and a rich dress chain, for the same contrivance.

## THE MAHOGANY TRADE.

The mahogany annually exported from Honduras by British settlers may be calculated at about sixty square-rigged vessels, at 120,000 feet each, value about 400,000*l.*; and the value of Guatemalian produce, such as indigo, cochineal, &c., exported, amounts to three times as much again. It is supposed that the sales of one commercial house at Belize average 15,000*l.* currency per month, which is one-twentieth part of what is sold, and would make the sales of British dry goods imported for the supply of that colony and Guatemala, at least 2,500,000*l.* currency, or about 1,500,000*l.* sterling.

The number of ships entered inwards and outwards during the last three years has averaged 100; their average tonnage being 20,000.

The inhabitants of Belize are dealers only in the raw material; the mahogany tables of their dwellings being manufactured in England, whilst the wood from which they were cut travels upwards of 15,000 miles before it reaches the spot of its ultimate destination, that being the same shore on which it grew. One of the largest of the logs ever imported into England was bought at Liverpool for 378*l.*, and was supposed to have returned to the manufacturer at least 1000*l.* If cut into veneers, 550*l.* of this sum would be paid in wages to British mechanics.

Not long since, Messrs. Broadwood, the distinguished piano-forte manufacturers, gave the enormous sum of 3,000*l.* for three logs of mahogany! These logs, the produce of a *single tree*, were each about fifteen feet long, and thirty-eight inches square; they were cut into veneers, of eight to an inch. The wood was particularly beautiful; capable of receiving the highest polish, and when polished, reflecting the light in the most varied manner, like the surface of a crystal; and from the wavy form of the pores, offering a different figure in whatever direction it was viewed.

Dealers in mahogany generally introduce an augur before buying a log; but, notwithstanding, they are seldom able to decide with much precision as to the quality of the wood: so that there is a good deal of lottery in the trade. The logs for which Messrs. Broadwood gave so high a price were brought to this country with a full knowledge of their superior worth.

The cutting of mahogany at Honduras takes place at two different seasons; after Christmas and towards Midsummer. The negroes employed in felling the trees are divided into groups of from ten to fifty. The trees are cut about twelve feet from the ground and are floated down the rivers.

## TESSELATED PAVEMENTS.

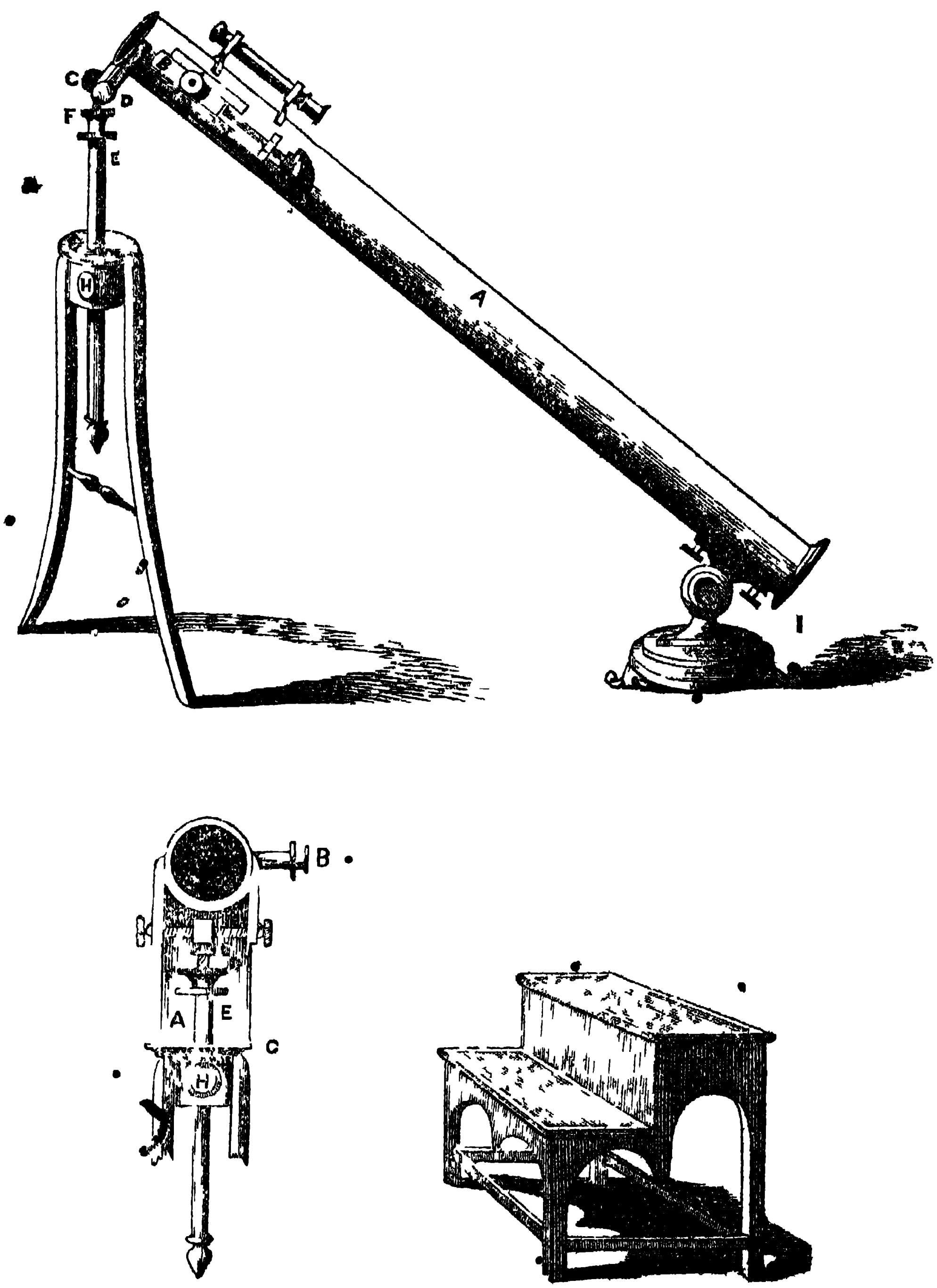
With all admirers of the arts and sciences, we hail with satisfaction the great improvements within the last few years in pavements, a subject so much neglected for many ages. Since the days of the Reformation our floors have been laid with little else than rude coarse flag-stones, raw boards, or at best, chequers of white and black marble, while the use of the handsome mosaics of the Romans, in the universal adaptation of classical models, seems to have been altogether overlooked, as well as the tesselated pavements of the middle ages, of which a fine remnant is concealed beneath a rush matting in front of the altar of Westminster Abbey, and a more perfect specimen still may be seen in Trinity Chapel, Canterbury Cathedral. At Great Malvern, Romsey, Winchester, Salisbury, Worcester, Rochester, and York, there are also fine specimens; but the Chapter House of Westminster Abbey, where a beautiful pavement in this style was carefully boarded over, when that building was fitted up as a record office, remains probably in greater peefection than any other extant in this country. Many of these are of great beauty; some consist of heraldic cognizances, others of figures, and others of very beautiful scrolls. They are probably as old as Edward III., who decorated the structure. Some of the first specimens of the revival of tesselated pavements may be seen in the Trinity Church and the Reform Club-house, London, and ere long Mr. Barry's good taste will be displayed in the adornment of the floors of the new Houses of Parliament with encaustic tiles. We trust that the example may not be lost sight of by those who have the superintendence of public edifices. They are also worthy the attention of architects for halls and passages even of very moderate-sized houses. Very ornamental, too, they would prove for hearths, mantle-pieces, &c. It has been thought that these payments, on account of their cost, would be restricted to the mansions of the wealthy; but as their merits are becoming more generally known, this opinion is seen to be founded on error, for although the first outlay is more costly than some, yet, in point of economy, they must be selected in preference to every other kind of flooring.—*Nottingham Review.*

## VARIETIES.

*A Product of the Action of Nitric Acid on Amber.* — On distilling pieces of amber with nitric acid, evaporating the solution obtained, and re-distilling and re-evaporating several times, small crystals of succinic acid are formed, which may be rendered pure by boiling with nitric acid and by re-crystallization. The contents of the receiver, in the first distillation are of a greenish-blue colour, which gradually disappears, and then the fluid is not to be distinguished from dilute nitric acid in flavour or appearance. If this acid be neutralized by a solution of caustic potash, it becomes hot; and when the acid odour has disappeared, a powerful smell of camphor is evolved. If the fluid when cool, be shaken with ether, and poured into a flask, where the ether may separate, and be drawn off by a syphon, a crystalline residue will be obtained on evaporation, which resembles the camphor of Laurus Camphora in all its physical qualities.—*From the German.*

*To make Copying Paper.*—Lay open your paper before the fire (clean white of large size), take the brush and cover it with the following varnish, then hang it up on the line, take another sheet, and repeat the operation until you have finished your quantity. If not clear enough, give each sheet another coat when dry.

Canada Balsam.
Turpentine; equal parts—mix.




TELESCOPES.

Birmingham, August 26, 1841.

*To the Editor of the Magazine of Science.*

SIR,

SOME two years since Mr. Sollitt, of Hull, sent an article to you on the Herschelian Telescope, with a promise of a further communication at some future time. I have been much disappointed at not having seen anything further from him, and have at length determined to trouble you with a few remarks on this beautiful, but much neglected, instrument, and if you find them worthy of insertion in your excellent Magazine I shall certainly continue to give you a few lines from time to time. The reflecting Telescope is a very superior instrument for Astronomical observation, and each form of it possesses certain advantages over others, and each has, consequently, its disadvantages. I certainly think that the most perfect form is the Newtonian; but I shall take them in the order of their invention, and shall endeavour to point out their peculiar merits and demerits.

*First, then, the Gregorian.*

This is (or I should rather say was) the most popular of all the reflecting Telescopes. The reason is at once obvious—it gives an exact image—is the most portable (with one exception, to be mentioned hereafter) of all the forms which have been invented, and for these reasons is, in addition to its being a powerful and perfect astronomical instrument, a most amusing companion, or, as Dr. Kitchener humorously observes, a capital

"Spying-glass to see a ship at sea,
"Geese on a green, or crows upon a tree."

The only objections to the Gregorian Telescope are, first, its magnifying powers are limited; you cannot use either very high or very low changes with good effect; secondly, you cannot use it either in or near the zenith without putting yourself into such a painful position as to destroy the accuracy of your observation on using a diagonal eye piece, which introduces reflection from another surface, its consequent loss of a great portion of light, and probably an inaccurate figure if your plane speculum is not ground and polished perfectly true.

The second Telescope we have to notice is the

*Cassegrainian,*

which is rather more portable than the Gregorian instrument as it is shorter than the before-mentioned Telescope, by twice the focal length of the small mirror. This is the only advantage that can be claimed for it, and it is more than counterbalanced by the inversion of the image—it has been repeatedly stated that the image is brighter in the Cassegrainian than the Gregorian; but experience does not confirm it. I have made a convex speculum to my 4-inch Gregorian, of exactly the same focal length as the concave, and I cannot perceive the least difference in the brightness of the image.

*The Newtonian*

is perhaps the best and most convenient of all the reflecting telescopes where its greater local length is not an objection, as from the eye-piece being inserted at a right angle to the axis of the tube you can observe with ease and comfort whatever part of the heavens your telescope may be directed to, a most essential thing as, if the body is in a constrained position, the attention must be divided and the observation not be so pleasing or accurate. Of course a finder is an essential part of a Newtonian telescope, without it you would find great difficulty in getting the object required into the field of view, especially with high powers.

*The Herschelian*

is a valuable instrument; its principal advantages are, first, it is requisite to have the speculum of considerable local length so that lenses of slight curvature give considerable magnifying power, consequently the image is brighter. Its second merit is, that if you are so fortunate as to obtain a speculum of good figure there is no error of figure or loss of light from a second reflection. This Telescope also requires a finder; the great disadvantage of the Herschelian Telescope is that you cannot use the micrometer with it, as the image being thrown obliquely on the eye-piece you cannot obtain their true position. The best plan is for those who are sufficiently fond of astronomy to induce them to go the expense, to have a Gregorian or Newtonian to use with a micrometer, and a *large* Herschelian to minutely examine the object with. I use a Newtonian of four inches aperture and an Herschelian of seven inches and seven feet six inches local length. These two instruments may be obtained mounted in a very effective manner for £35.

I have often heard the enquiry, why has the reflecting Telescope fell into disuse? and an erroneous impression has got abroad that they are inferior to the so called Achromatic Refractors, where Telescopes of small power are wanted. I would recommend every one to buy an Achromatic Refractor. If a Telescope of large size is wanted they must either be prepared to give an enormous price for an Achromatic or have a reflector, which latter instrument I should prefer even at the same price. Since the time of Short, Watson, &c., the reflecting Telescope has been but little attended to except by amateurs, and they cannot be expected to succeed so well as a person who devotes the whole of his time and manual labour to them. The few reflectors on hand at opticians generally are valued at prices as high or higher even than Achromatics of the same aperture would be charged. So long as this is the case, the reflector will not be used, as they are more liable to get out of adjustment than achromatics, and unless they can be obtained *equally good* at a *much lower price*, they will not be used as they were before the Achromatic Telescope became so common, by every one who wishes to examine the heavens. Many parties are deterred from having a Telescope because the stand is usually such an expensive item. I have contrived several very simple and effective ones. The drawing enclosed is one of them, which has been much approved by several eminent scientific gentlemen. The description follows—observe that the same letters of reference apply to each figure.

A—the tube of the Telescope.

B—the eye tube and its adjustment.

C—the screw which gives the Azimuth motion.

D—the screw which gives the vertical motion which works up and down the tube E by the nut F, and the tube E slides through a part of the hand G, and is elevated near the object when it is fixed by the screw H, and the adjustment completed by the screws C and D.

L—is the lower end of the stand, which has a vertical and horizontal motion which explain themselves.

Fig. 3—is a small set of steps, whose length is equal to the hind part thereof, and is used to elevate the fore or hind part of the telescope as you may

want zenith or high observation. It is the most steady stand I have ever met with; is cheap and neat, which are, I think, all very essential things. Should these general remarks be acceptable to you, I shall in my next enter more into particulars.

I am, most respectfully, your's,
CHARLES P. NEVILLE.

## THE YEW.

This tree is believed to be the most ancient in Great Britain; indeed, there appears reason to think that it is, of all European trees the one capable of attaining the greatest age; there are now individual examples in England respecting which no doubt can exist of their having been trees at the Christian era, and at least one that has considerably exceeded 3,000 years. This tree is in full health, and is perhaps the most ancient specimen of vegetation in Europe; it is also of remarkable magnitude, being about 27 feet in diameter. The yew is indigenous to Britain, grows naturally in many parts both of England and Scotland, and is hardy enough to endure the inclemencies of our severest seasons: it is most frequently grown as an ornamental shrub, and is valuable where sheltered by surrounding trees as an underwood, shooting up more rapidly and with a cleaner stem than when grown alone. Its dark foliage affords an advantageous contrast to trees of a livelier character; it has also much beauty of its own, being indeed considered by some as one of the most beautiful of our evergreens; during its growth, and till it is several hundred years old, it is of a broad, perfectly conical shape, but arrived at full maturity, its peaked summit begins then to decay, and it assumes gradually the round-headed form: its stem is of stout proportions, stiff and erect; its branches strike out horizontally, beginning very close to the ground; and both are round, being grooved or indented lengthwise. Its leaves are small, long and slender, of a needle form, and very close: it bears cones, also a scarlet, sweet, and glutinous berry, which incloses a small hard seed or nut, the kernel of which is not unwholesome; but the bark or wood of the tree itself would appear to be otherwise, for at Crediton, a farmer having cut down a yew-tree, and left two or three faggots lying where four bullocks had free access, and these having been for some time deprived of green fodder, they ate them with great avidity, and very soon died—the poison having, as it was proved, acted on the brain and nervous system, producing congestion in the membranes of the former, and other symtoms resembling apoplexy. The yew will grow in most soils, but it loves a sandy loam, and chalky situations are very favourable to its success; it is propagated by the seeds, sown in autumn as soon as ripe.

The gloomy associations connected with the yew, its qualifications for the adornment of places consecrated to solemnity, its ancient dedication to such purposes, its own sombre appearance, and the tardiness of its growth, conspire greatly against its cultivation, and leave it almost entirely to its old and appropriate haunt, the church-yard: the examples of ancient yews of great magnitude in such situations are numerous, and contain incontrovertible evidence of their having necessarily existed before either Roman or Christian had interrupted the sacrificial rites of Druidism; and a conclusion has therefore reasonably suggested itself, that this solemn evergreen was, from the suitableness of its shade, and its enduring nature, especially cultivated by the Druids in forming their sacred circles, and that the promulgators of Christianity, in superseding Druidical worship, erected their churches and set out their church-yards, in the very groves which they desired to consign to oblivion. Of the superstitious estimation in which it has been held, we read that dead bodies were covered "by shroud of white, stuck all with yew," and that, in some parts of England, to preserve them from putrefaction, they were rubbed over with an infusion of its leaves.

In olden times the wood of the yew was held in high estimation, as furnishing the material for the long bow, the pliant and trusty weapon of the hero of merry Sherwood; and which contributed so greatly to securing the splendid victories of Cressy, Poictiers and Agincourt; indeed, so highly was it esteemed, that statutes were enacted for its preservation, and for preventing the wood from being exported. It was also the law of the land that every man should have a bow made of it, or of some similar wood; the introduction of fire-arms, however, had the effect of deteriorating its value in a great measure, and the tree came in course of time to be regarded chiefly as an object of ornament; in which capacity, in the parks and lawns of our nobility, as well as in hedges, it was subjected to the vilest whims of fantastic imagery, being clipped into the most grotesque and ridiculous chimeras, vestiges of which are extant even at the present day. The wood is hard, compact in texture, fine and close in grain, elastic, susceptible of a very high polish, and unequalled in durability; it is, therefore, valuable and highly appropriate for the cabinet-maker's art, especially when cut into veneers, so as to bring out to advantage its veins and various shades of colour, which are very beautiful. It is also obviously desirable for axle-trees, but for which its scarcity must preclude its being made available.

## WADHAM'S GALVANIC CLOCK.

We extract the following communication from the *Electrical Magazine*:—"A galvanic clock, of a novel character, has lately been constructed for me by Mr. Wadham, a watchmaker, and most ingenious mechanician, which may probably be worthy of notice in your magazine.

"I am not aware that success has attended any of the various attempts hitherto made to construct a clock which should be a correct time keeper, (or at least *as wholly sustained* by the voltaic current. This is now accomplished. The "Electrical Clock," of Professor Wheatstone (an instrument peculiarly valuable to the practical astronomer), is rather a *time telegraph* than a clock, properly so called; but the new apparatus is wholly independent of any other clock:—once started, it works *per se*.

"I will endeavour to describe the mode in which this is effected. The power is derived from a small Smee's battery, a negative plate about five square inches); and this is economized probably to the utmost; for, as nearly as I can judge, it is hardly in action more than one hour out of every 20 or 24. The battery, therefore, lasts a considerable time. A single charge of diluted acid suffices for fourteen days, and the plates are then so little worn, that probably the same battery will serve for many weeks. The clock has the ordinary train of wheels, and is regulated by a balance wheel and spring from which the *escapement* is detached. It beats dead seconds. The second's hand is concentric with the hour and minute hands, and traverses the whole dial plate.

The clock is first put in motion *manually*, by moving a small lever. This, at the same moment, completes the galvanic circuit, and also gives tension to a coiled spring sufficient to set the train in motion. At this instant, the galvanic current begins to fulfil its office, which is to *continuate* the motion thus imparted. It is thus effected:—At the back of the clock is placed a modification of my impact, or vibrating contact breaker. On the same centre with the pallets, is a short arm or lever of ivory, which allows the closing circuit, *at the middle of the oscillations of the pallets*, but opens it in every other position. The peculiarity of this clock therefore, is, that the battery power is engaged for a minute fraction of every second, in *renovating the tension* of the before-mentioned spiral spring (occupying the main-spring in an ordinary clock) which originally gave motion to the clock train.

"But it not only maintains the power at first imparted, it accumulates it up to a certain point. Every time the armature is attracted by the electro-magnet, one tooth of a ratchet wheel is advanced, on the centre of which a pinion acting on the circumference of a wheel to whose centre the remontoire, or renovating spring is fixed. The other end of this spiral spring *acts against* but is *not fastened* to the interior circumference of the box containing it. Security is thus provided against overwinding the spring by any excess of galvanic power. The accumulation of power is thus obtained: the number of teeth in the ratchet wheel bears such a proportion to the rest of the movement, that at every revolution it gains a trifle on the original impulse given to the machine. Two or three advantages accrue from this provision. It makes it a matter of indifference if a few contacts are missed by the vibrating contact-breaker through the accidental presence of a particle of dust: it economises the battery, because under the accumulated power of the remontoire spring the vibrations of the balance, though isochronous, are more rapid, and the time of contact is thereby shortened: but principally the advantage is, that this accumulated power renders the clock for a short period *independent of the battery itself*. It continues to go correctly for above a minute after the battery is removed, affording hereby ample time to give a fresh charge of diluted acid, or to replace it by a fresh battery. The experience of about six week's action has been exceedingly satisfactory, and leaves perhaps little to be desired in the structure of an electrical clock."

F. LOCKEY.

## ROOFS.

The first obvious consideration in constructing a roof is the slope to be given to it, which depends on the climate against which it is to serve as a protection, and on the materials to be employed in covering it. In hot countries rain more rarely falls than in temperate ones; but when it comes, it descends very abundantly, which, added to the temperature of the air, makes it unnecessary to give a great slope to the roof, from which the water immediately runs, and the air dries it almost at the instant of the rain's cessation. In cold countries the rain is more searching, the air is more impregnated with moisture, and snow often lies for a long time on a roof; circumstances which require a greater proportional slope to it. Again, roofs covered with lead, zinc, or copper do not require so great a slope as those covered with tiles or slates.

Though among architects there does not appear to have been any fixed principle by which the slope should be determined, we find that in different climates suitable slopes have been adopted for similar materials. Thus in the southern parts of Europe we find the roofs very flat, whilst as we proceed into its northern parts the roofs acquire a very considerable elevation. We shall here transfer to our pages the notice of this subject in the *Encyclopedie Methodique*, which we consider extremely important and interesting, inasmuch as it shows that necessity was the parent of beauty in the inclination of the roofs of the ancients; and in the time of the middle ages it had some influence even in the production and development of the lancet arch.

The researches and observations made respecting the roofs of a great many ancient and modern buildings, situate in different countries, satisfy us that the slopes of roofs which have lasted best, are always proportioned to the temperature of the climate. Before entering into the consideration of any law for determining the slope of a roof, it will be proper to comprehend the meaning of the word climate as here introduced, which we shall use in the same way as it is understood by geographers. According to them, the climates of the globe are comprised under belts or bands, of unequal size, parallel to the equator. Of them there are 24 between the equator and the polar circle, each of half an hour; that is, the length of the longest day on a place situated at the beginning of the climate is always shorter by half an hour than that of the place situated at the extremity of the same climate, or at the beginning of the succeeding one, proceeding from the equator towards the polar circle. This difference in the length of the day, caused by the greater or less obliquity of the tropic with the horizon, is one reason of the different degrees of temperature of countries corresponding to the different climates. We are not, however, to assume that the temperature will be exactly the same for all places under the same climate, since there are many circumstances which tend to make a place more or less damp, in which cases the slope of the roof should rather have a relation to a more northern spot. In the roofs of the Continent covered with the hollow tile, as in the south of France for instance, less slope is required than with the Roman tiles, which are in sections alternately flat and circular; and these again require less slope than the common plain tile or slate. From the observations that have been made, we find that the slope of roofs covered with hollow tile, such as is used in the south of France, should be after the rate of three degrees for every climate, beginning from the equator and proceeding northward, and that when the Roman tile is used, an addition of three degrees should be made to such inclination; an addition of six degrees, if covered with slates; and of eight degrees, if covered with plain tiles. According to this law, a comparison of it with ancient buildings gives a remarkable corroboration of its value. Thus at Athens, situated about the middle of the sixth climate, the slope of a pediment would be about $16\frac{1}{2}°$; and that of the Parthenon is actually about 16°; that of the temple of Erectheus, $15\frac{1}{2}°$; of Thesus, 15°. In Rome, which is about one-third of the way up the seventh climate, the Roman tile requires an inclination of 22°. The actual slope of the pediment of Septimus Severus is 23°; those of the temples of Concord and Mars Ultor, 23½; of Fortuna Virilis and the Pantheon, 24°; and, of more modern date, the slope of the roof of St. Paolo fuori le mura was 13°.

"There is no article," says Ware in his *Body of Architecture*, "in the whole compass of the architect's employment that is more important or more worthy of a distinct consideration than the roof. The great caution is," continues our author, "that the roof be neither too massy nor too slight. Both extremes are to be avoided, for in architecture every extreme is to be shunned, but of the two the overweight of roof is more to be regarded than too much slightness. This part is intended not only to cover the building, but to press upon the walls, and by that bearing to unite and hold all together. This it will not be massy enough to perform if too little timber be employed, so that the extreme is to be shunned. But in practice the great and common error is on the other side; and he will do the most acceptable service to his profession, who shall show how to retrench and execute the same roof with a smaller quantity of timber; he will by this take off an unnecessary load from the walls, and a large and useless expense to the owner."—*Gwilt.*

## FIRE AT HAMBURGH.

A MEDAL has lately been struck by order of the authorities of Hamburgh, to commemorate the dreadful fire which took place there on Thursday, the 5th of May, 1814. It is struck out of the copper from the tower of the church dedicated to St. Peter in Hamburgh. On the obverse is a representation of St. Peter's Church as it existed before the fire, with an inscription, of which the following is a translation:—"The design of benevolent patrons accomplished the first building of this church in their life-time," or "The piety of our Forefathers built thee in their lifetime. 1342—1516."

The reverse represents the same church in ruins, as it appeared after the fire, and has this inscription:—"United powers (or public feeling) will worthily restore thee" (*i. e.* the ruin), to which is added, "Destroyed by fire on the 7th of May, 1812," and the artist's name, "Wilkins, Bremen."

As a specimen of die-sinking, it is beautiful and finished. If our information be correct, copies of the medal have been sent to those persons who took the most lively interest in, and most liberally relieved the sufferings of, the distressed inhabitants during their severe trials while destitute of home, food, and clothing.

St. Peter's Church was considered one of the finest specimens of ecclesiastical architecture in northern Germany. It was situated in the north-west corner of the cathedral place, and was built between the years 1139 and 1192. Its length was 225 feet, and its breadth 135 feet. The steeple, which was began in 1342, and finished in 1516, was 416 feet high. It had two chimes of bells, one of which was put in motion by the clock machinery, and played every half-hour; the other was played by means of keys at certain times of the day, and on particular occasions, by a person specially appointed for that purpose. Downes, in his "Letters from Mecklenburgh and Holstein," 1822, while describing Hamburgh, thus refers to these bells: "I was awakened by the sweetest of all sweet harmonies issuing from the belfry of one of the churches. It was neither ringing nor chiming, but a regular piece of composition, first and second."

The interior of the church was overloaded with monuments, paintings, carving, and stained windows. The subject of one of the oldest paintings was Hamburgh in the 15th century, in the foreground of which was represented the sacrilegious attempt of Heliodorus; it hung behind the pulpit, and had been there ever since 1554. In the nave hung portraits of Martin Luther and his friend Melancthon. Near the font was another painting of Hamburgh in 1250, on which might be perceived three churches, two convents, and St. George's Hospital. The altar-piece was painted by S. Bendixen, in 1814; it represented our Saviour appearing to Peter while performing his devotions.

The calamity which Hamburgh sustained by the awful fire in 1842, was unequalled in extent except by the fire of London: the heart of the town was reduced to a heap of ashes. Many years must elapse before the damage can be repaired, and the traces of it effaced. The conflagration broke out in the Deichstrasse, near the Elbe, on Thursday, May 5, from what cause is unknown, and raged until the following Sunday, in spite of all efforts to oppose it, spreading and widening as it spread, until it had involved in destruction two sides of the Alster Basin, levelling almost all the buildings, public and private, over an area of 18 acres, nearly in the form of a triangle, sweeping down 1,749 houses, 61 streets, besides courts and alleys, and even crossing the broad canal of the Alster. The attempts made to arrest the flames, when the engines had proved useless, were, first to pull down the houses; but in unroofing them, they readily caught fire from the sparks lodged in them; artillery was next employed to batter them down, but the balls only made holes in the walls, and passed through. Finally, the plan of blowing them up by gunpowder was resorted to, and this useful but dangerous task was executed by the English engineer Lindley, who fortunately for the town was present at the time, and understood the proper mode of proceeding. The first check was given to the fire by blowing up the Rathhaus, in whose cellars were deposited all the treasures of the state in silver bars. The churches of St. Peter, St. Nicholas, and St. Gertrude were speedily consumed. The New Exchange, though surrounded by the flames, by a miracle escaped almost uninjured. The sympathy caused by this event in all parts of the globe was proved by the voluntary subscription raised for the sufferers, amounting to 270,000*l.*, of which England contributed 41,000*l.*

Hamburgh will profit to a certain extent, by the calamity, in the improvements which will be introduced in laying out the new buildings, the widening of streets, the construction of sewers, and the filling up of some of the stagnant fleeths or ditches.

The plan of these improvements has been prepared by Mr. Lindley. A new and handsome Rathhaus is to be built at one side of a new square, fronting the Borse. Another improvement is the draining and conversion into a new quarter of the town of a low marshy tract on the right bank of the Elbe, called Hammerbroek. It has been intersected by canals, the water pumped out by a steam-engine, the surface raised four feet over a space of an English square mile.

A correspondent, in a letter dated Hamburgh, September 27, 1844, thus writes on the improvements now making in the city:—"Hamburgh is progressing daily; new streets continue to be marked out, and new buildings arise so rapidly, that it is necessary to perambulate the city frequently to keep up one's topographical knowledge. A custom prevails amongst the builders, on completion of the shell of any house, to give a kind of *fete* within it to the workmen employed. The building is hung over with flags and festoons, and a band of music is engaged for the occasion. The workpeople are plentifully regailed with the good things of this life; they eat and drink to the sound of the fiddle, bass viol, and sundry horns, and then begin their favourite waltz; the reel is not attempted until it is time to depart, and it is then the favourite dance of all as they wend their way through the streets homeward."—*Builder.*

## INFLUENCE OF THE FINE ARTS ON CIVILISATION.

The great object which we live for, is to enjoy the bounteous gifts of our *Creator:* the great object of civilisation is to enable us to do so, that we may die happy, convinced that we have not existed in vain, —but that, by the cultivation of the intellect we had sublimed our spirit, to irradiate the sphere we each revolved in. To extract as much pleasure as we can from existence, by regulating the sense through the mind, and so depart from the lower animals, and approximate the higher powers, ought to be, in my opinion, the result of civilisation; and, if I am right, then is art an integral portion of the means by which a people is civilised. In the wide and extended regions of nature, unlimited scope is afforded to the true *artist,* widely to direct the intellectual energies of his fellows; and I pity the man who, beyond the gaining of a livelihood, sees in art no greater object to exist for. Does not the landscape painter promote civilisation when he fixes on our souls for ever, the happy, happy, feelings a glorious landscape has charmed forth? When, by his soul-breathing imitation of the works of God, that which would otherwise have been transitory, is, by the magic of his pencil, recalled again and again to refresh the wearied mind with sweet remembrance of the purest and holiest sensations of our existence,—he is the medium of communication from nature up to nature's God! Does not the painter of the home and domestic subject promote civilisation, when he makes the rustic hearth, with all its honest joys, excite the envy of the rich, and preach contentment to the happier poor? Does not the great mind which grasps at historic art, promote civilization, when, by the positive realization of the deeds of man he brings the past to the present, to excite reflection to the future? Does not the sculptor promote civilisation, when joined to the aim of the latter, by the sublime purity of form, teeming of the pristine beauty of the sons of man, he creates visions of that time which may recur again, when nobler souls breathed in more glorious frames? Come forward, ye who would deny to art this power to instruct, and if the authors of the gentle and pleasing idea touch not your heart, look at that canvas, and at that, where terror and horror, and wrath, and rage, in blasted and angular forms, amid blackness and despair, strike and paralize the sense as with a thunderbolt,—the awful page of mortal woe, disclosed by *Michael Angelo,* and by *Hogarth*—and acknowledge the power of mighty art. And if you tremble at the visions of Titanic power, conjured up by the Italian, where even the blessed seemed saddened, and their beauty scorched by the reflection of gloomy suffering, turn to the *Englishman,* and in the brightness of virtue escape from the sadness of vice. And when you trace the course of the Idle and Industrious Apprentice, if you do not acknowledge the overwhelming power of art to teach, you must indeed be poor—no power exists to civilise you. Or if the wise man who lives to learn, will turn his eyes with me to where the heavenly power of beauty reigns supreme, where holy thought and love inspire the pencil of him who, by the suffrage of mankind, has gained the title of Divine, where the tenderest perceptions are stamped by the energy of goodness, and with a hand as firm as that of a giant, and in an outline animated by the soul of angel, *Raphael* draws your heart insensibly to a holy fervour by the beauty of form, and more nobly seeks to improve mankind by love, than sway the mind by terror—then surely, you must acknowledge all that art can do, from all that art has done. Is it no proof of the power of Art, that she can humanize the half-bruted peasant?—that the Italian feels her influences, and impresses the stranger on his soil, with involuntary respect—that he, the peasant, is alive to beauty, which but half inspires that stranger's mind; and would it not be glorious to art, if we could operate a charm on the sturdy ignorance of the peasant of *Great Britain,* and elevate him in the social chain by teaching him the beauty of the scenes he lives in; or by delineating the character of a country's pride—her yeomanry, make him most truly blest, because his lot is proved to be the happiest in the land—freed from the misery of inaction, his honest toil ensuring grateful rest, fitting him to fulfil his duty to his family, his country, and his God, by teaching him to extract happiness, from what he regarded formerly with sullen indifference!—*Park's Address to the Institutes of the Fine Arts,* 1844.

## TATTOOING.

The operation of tattooing is performed about the age of ten, and is very expeditiously managed by passing a needle and thread, the latter covered with lamp-black and oil, under the skin, according to a pattern previously marked out. Several stitches being thus taken at once, the thumb is pressed upon the part, while the thread is drawn through, by which means the colouring matter is retained, and a permanent dye of a blue tinge imparted to the skin. It is a painful as well as tedious process, especially as the needles are made of strips of whalebone. For those parts where a needle cannot conveniently be passed under the skin, the method by puncture is used.

Although the Esquimaux men do not practise tattooing, many of them pierce the lower part of the face for the purpose of introducing various kinds of ornaments. From Prince William's Sound to the Mackenzie, this custom is universally adopted; but, as far as our knowledge extends, it is confined within those limits. The lower lip, each corner of the mouth, and the septum of the nose, are the parts selected for the purpose; but it is more generally the fashion to pierce only the corners of the mouth, in which are placed labrets, formed with a double head like a stud, either made of ivory and blue beads, of ivory alone, or of different kinds of stone, as steatite, porphyry, or greenstone. The men of the Mackenzie, and the women of Chamisso Island, in addition, pierce the septum of the nose, through which they thrust the quill feathers of birds, or pieces of bone, or tubulose shells strung on stiff pieces of sinew. Both sexes at Prince William's Sound thus pierce the septum of the nose, but prefer the lower lip to the cheeks, and adopt two modes. The one consists in the under lip being slit or cut quite through, in the direction of the mouth, a little below the thick part. This incision, which is made even in children at the breast, is often above two inches long, and either by its natural retraction when the wound is fresh, or by the repetition of some artificial management, assumes the true shape of lips, and becomes so large as to admit of the passing of the tongue. This happened to be the case when the first person having this incision was seen by one of Captain Cook's party, who called out that the native had two mouths, which the immortal traveller observes it very much resembled. In this artificial mouth is placed a flat narrow ornament, made chiefly of a solid shell or bone, cut into little narrow pieces like small teeth, almost down to the bone or thickest part, which has a small projecting portion at each end to support it in the divided lips, the part cut then appearing outward. The other mode is merely to perforate the lower lip in several places, when the ornaments consist of as many distinct shelly studs, whose points are pushed through the perforation; the heads appear within the lip, as another row of teeth immediately under their own. Attached to the studs from below are suspended small strings of beads which hang down to the point of the chin. These are not removed so easily as the lip ornaments, which are at pleasure displaced and replaced with the tongue. The Esquimaux of the Mackenzie valued the labrets so highly, as to decline parting with them; while those of Prince William's and Kotzebue's Sound, gave them freely, regardless of the inconvenience of the saliva that flowed through the badly cicatrized orifice over the chin, but rather laughed when one revolted at the sight, and delighted in thrusting the tongue through the opening, at the same time that they winked the eyes. Nor are they particular what they substitute for the labrets. One man, we are informed by Captain Cook, appeared before him with two iron nails projecting from them, like prongs; and another endeavoured to make a large brass button answer the purpose of a labret. Through the septum of the nose, awls, and large cod fish hooks are thrust, and the women appropriate ear-rings and thimbles as decorations to their dress. the perforations are made at the age of manhood, by an incision sufficiently large to admit a quill, about half an inch below the corners of the mouth, which has the effect of depressing the under lip, and keeping the mouth open. The orifice is enlarged from year to year, until it reaches half an inch in diameter; and in more advanced years, is not unfrequently of a much larger size. Captain Beechy obtained from a native of Schismareff Inlet a finely polished jade that was three inches in length by an inch and a half in width. For some time after the operation has been performed, it is necessary to turn the cylindrical pieces of ivory frequently, that they may not adhere to the festering flesh. In time, this action becomes as habitual to them as that of turning the mustaches is to a Mussulman.

## WILSON'S SCANTLOMETER.

At the recent meeting of the British Association for the advancement of Science, a paper was read by Mr. J. Scott, Russell, F.R.S., one of the vice-presidents of this section. "On a New Scantlometer." Mr. Russell said this was a communication which had been sent in by Mr. Wilson, a gentleman of the architectural profession, and who unfortunately was not present. The scantlometer is the result of an attempt to meet a deficiency which exists as to the means of ascertaining the scantlings (or depths and thickness) of timbers used in buildings, and which is of this nature:—None but men of mathematical acquirements can calculate the exact depths, which, in a timber of a given thickness, is requisite for a given span, or the exact thickness necessary for one of a given depth to the same span, or the length which may just, with safety, be spanned by one or both of a given depth and thickness. And for those who have not the advantage of possessing this branch of education, there is but one way of acquiring the capability of determining questions of this description, namely, long experience and observation of what has been sufficient in similar cases. But of those who have occasion for such knowledge, the portion who have thus overcome the want of the more legitimate method is considerably the smaller; and the remainder, consisting, perhaps, chiefly of the rising generation of carpenters, but including also, in no small degree, men following the professions of architecture, and house surveying, have neither the one way nor the other of resolving, by themselves, the true requisites in these frequently recurring cases. It is mainly for the use of these, then, and also to obviate the necessity for calculation, to those who solve their questions by that means, that this contrivance is intended. This instrument has been invented for giving the scantlings of joists and rafters only, these having a relation to each other, and being of more frequent occurrence than the other timbers in carpentry, but for which similar provision can without difficulty be made. It consists of two diagrams or scales, both of which are generally wanted; the upper one comprehends timbers of the minimum thickness and maximum depth, embracing bearings up to 25 feet; the lower one gives equivalent scantlings from the minimum up to the maximum of thickness. The scantlings given had in view the joists of dwelling-house floors, and rafters carrying medium sized slating, the material fir, the distance asunder 12 inches, and the rate of weight sustained supposed to be similar in all cases, and diffused uniformly throughout. In the diagram which was exhibited, the base line of the upper scale shewed what should be the respective depths of level joints of the thickness of an inch and a half, for bearings, up to 25 feet, the concentric curves bringing the bearings which were set out on the right-hand boundary line, to measure on the scale of inches. The cradiating thread gave, on the same principle, the depths of sloping rafters of like thickness, to any pitch up to 60 degrees, the point of intersection with the concentric curves of bearing shewing the measure on the scale of inches produced upwards. It would be remarked, that the higher the pitch of the rafter, the less is its depth to the same bearing; the principle of this would at once be understood when it was remembered that the load being a downward pressure, the cross section of the timber was to be considered vertically, not at right angles to its inclination. The mode of using the lower scale was explained by an example. Suppose that in seeking the scantlings for a 16 foot rafter of the pitch of 25 degrees, to which the upper scale of inch-and-half thicknesses assigns a depth of 12½ inches, they wanted the thickness to be 2½ instead of 1½, it was quite necessary to slide the vertical scale of inches till 12½ coincided with the left-hand termination of the 16 foot curve, and they found that the intersection of the latter with 2½ inches of the scale at the top produced downwards, was at the level of 11 inches on the vertical scale, and which was the equivalent depth required,

Mr. Scott Russell said the description of this instrument was given in a simple and intelligent manner, and with perfect accuracy. For the purpose of ascertaining the scantlings of timbers this was an exceedingly practical and useful invention. It was, in fact, a mathematical calculation rendered mechanical, and whilst it would be found advantageous to those who were not mathematicians, it would also assist those who were, ascertaining whether their calculations were right.

The Chairman and Sir Thomas Deane also expressed their approval of the invention, the latter gentleman moving a vote of thanks to the author, which was carried by acclamation.

## NEW CEMENT FOR BUILDERS.

Mr. Austin, of Hatton Garden, has recently taken out a patent for "a new method of glueing or cementing certain materials for building and other purposes." The mode of manufacturing and applying it is thus described in the specification.—

"The cement used by the patentee is made by mixing India-rubber with cold naphtha, in the proportion of eight ounces of India-rubber cut into small pieces to each gallon of naphtha, stirring it from time to time until the India-rubber is dissolved; then to one part by weight of this mixture two parts of lac are added, and the whole is thoroughly blended together by the application of heat, accompanied with occasional stirring. When greater elasticity is required, a larger proportion of the India-rubber solution is used; if greater hardness is necessary, a larger proportion of lac is employed; and where the India-rubber would be liable to injury from great exposure and pressure, a much less proportion is used, and it is sometimes dispensed with altogether; asphalte, pitch, or resin, or other materials of that nature, may in some instances be substituted for the lac.

"The materials for building purposes to which this cement is applied are slate, tiles, stone, glass, and metal plates. When being used, the cement is kept in a heated state in a dish or vessel containing a narrow trough, termed a stamper, which slides up and down therein between guides; the slate or other material is brought to the heat of 150 degrees Fahr., and placed upon a dish, and the stamper being then raised, imprints or stamps a margin of cement thereon. The requisite margins of cement for forming overlapping joints being thus applied to the slate or other material, the cemented portions or margins are laid in contact with each other, and in a short time become firmly united, forming water-tight surfaces. Sometimes, to expedite the process, a coating of naphtha or other spirit that will act upon the cement, or a solution made by dissolving the cement in naphtha or other spirit, is applied to the cemented portions or margins. The cement may also be used for securing the above materials to the building as well as to each other.

"The patentee connects pieces of glass together with the above cement when making skylights, conservatories, frames for horticultural purposes, &c., he also cements slate, stone, metal, and manufactured clays and cements together, or to wood, or to woven and other fabrics, and woven or other fabrics to wood, for building and other purposes; he likewise cements pieces of leather together for making boots and shoes, and hose or pipes for fire-engines; also leather and cork together, or to wood, metal or woven or other fabrics, and woven or other fabrics to wood for the manufacture of trunks, portmanteaus, packing-cases, and other purposes. When joining these materials, the parts must be dry and free from dust, and should be warmed previous to receiving a coat of the cement, in order that it may not be chilled at the moment of application. If the joint is to be made at once, the parts must be expeditiously put together and pressed, as the cement rapidly loses its heat, and becomes solidified, but the junction may be effected at any subsequent period by the application of heat, or the spirit or solution before described."—*Newton's Journal.*

## VARIETIES.

*A New Mineral Manure.*—This rare and curious mineral phosphorite, proposed to be used as a manure, is thus adverted to by Professor Daubeny in a verbal account of the Natural History of Spain, which he recently submitted to the Ashmolean Society of Oxford. The clayslate at Lagrossan, near Truxillo, contains a vein of phosphorite, first noticed from its phosphorescent property by Bowles, and afterwards determined to consist of phosphate of lime by Prout. The latter chemist reported that entire hills were composed of it, and this erroneous statement becoming current, gave rise to the idea that it might be made available for manure, as a substitute for bones—the chief fertillising principle in which is the phosphate of lime. The mineral occurs, however, only in one solitary vein, which is indeed often as much as ten feet wide, and may be traced along the surface nearly two miles the vein is by no means a pure phosphate, but is largely intermingled with quartz and other rocky substances. Besides the phosphate of lime, it contains about 14 per cent. of floride of calcium, as if it were intended to provide a material which enters as a constituent into the bones of animals both of this and of a former age. The bones of the cow contain 55, of the horse 67, and of the sheep 70 per cent. of phosphate of lime, and as this material is derived from the food on which the animals live, it is indispensable that it be present in the soil in which the vegetables grow. Bone-dust, and other manures that yield phosphate of lime, are both expensive and limited in supply; hence the importance originally attached to the discovery of "entire hills" of phosphorite.

*Important Improvement in the Manufacture of Iron.*—Mr. Rogers, of Nantyglo, the discoverer of the black band, has, we understand, recently made an improvement in the manufacture of iron, by the discovery of a new "flux," which will almost entirely supersede the use of limestone, and diminish the general cost of making twenty per cent. The quality of the iron will be materially improved, and be the means of saving an immense quantity of coke.

*Fig. 1.*

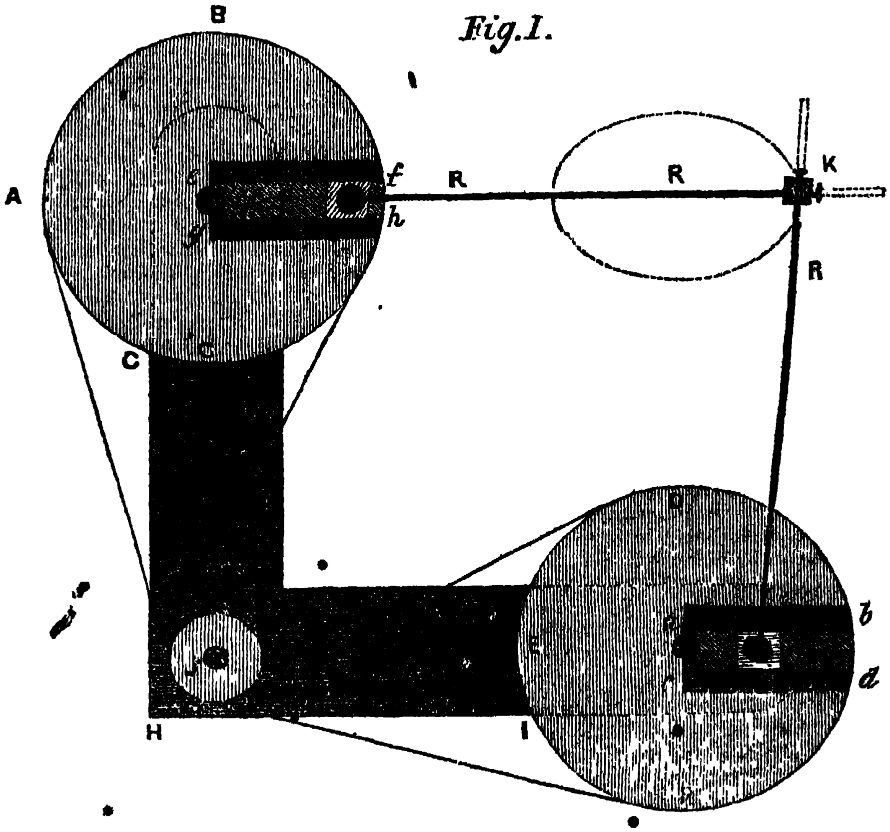
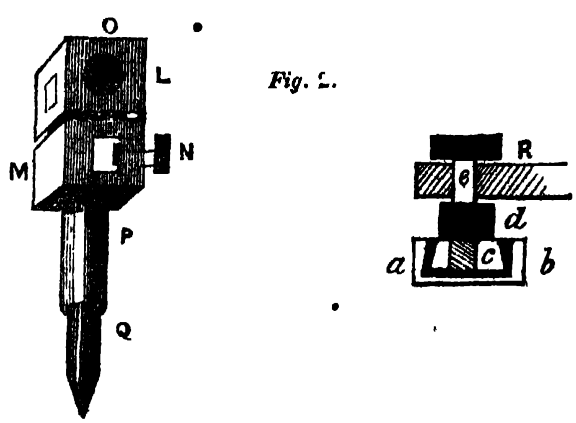



*Fig. 2.*




MACHINE FOR SKETCHING OVALS.

*To the Editor of the Magazine of Science.*

SIR.

HAVING invented a small machine for describing the figure of an oval on paper or other materials, by a simple combination of mechanism, and which can be made of wood at a trifling cost, I thought I could not do better than send it for insertion in your valuable and interesting Magazine, to which I have always been a Subscriber; this being the first I ever sent to any Magazine, by your inserting it, it may give that encouragement to my inventive faculties that most likely I may have again in a short time to trouble you with another communication.

Enclosed in this sheet you will find a rough drawing of the machine; the explanation is as follows:

The large wheels A B C and D E F are two inches in diameter, and each of them are mounted on a frame, G H I, whose width is one inch, depth one inch, and the length is regulated by the size of the wheels. Round each of the large wheels there is a small grove to admit a thin catgut cord, and round the small wheel, J (which can be made of a reasonable size), there are two grooves to allow the cord to pass twice over the surface on the same side. It is plainly to be seen that with the large wheels, both being of the same size, if one is turned the other must go round in the same line, and the small wheel carries the cord out of the way so that it does not interfere with the rods that form the oval; perhaps it would be better if, instead of being worked by a catgut, it were worked by a train of cog-wheels, which would not be apt to slip: on the wheel D E F there is a brass slot, whose sides are shown by A B C D; the inner edges are bevelled inwards, so as not to allow the brass slide B to come out, but to move easily from the edge of the wheel to the centre as required. The wheel A B C is fitted upon the hammer. The slot is shown by the letters E F G H. Fig. 3 explains the minute construction of the brass slides. A B is a section of the brass slot, and C is the slide which admits a pin E with a screw thread on the end of A, so as to fasten the slide on any part of the slot either nearer or farther from the centre of the wheel. D is a loose washer, so as to keep the lever R from injuring the thread of the screw. The lever R, which is shown in figure 1, has a hole drilled through the end of it, so as to allow the pin E to go through it, and then the line R will move easily about it. Both of the wheels are fitted up with these slides. Proceeding from the slides are two rods, one for each wheel, which rods terminate a little beyond the point K; this part is explained by figure 2. There are two pieces of square brass Z and M, which are connected, and yet more independent of one another; this is effected by a pivot or screw connecting them. Through the square piece of brass are two square holes so as to admit the rods R'R. These rods are fixed to the squares by screws O and N. From the bottom of the squares there is a hollow tube to fix in it a black lead to trace the figure. The rods R R are to be lengthened about two inches from the point where they meet, so that when the slide is put near the centre of the wheel, there will be sufficient hold at the junction K. We will now proceed to show the manner in which the machine is to be set, so as to describe any size of an oval, providing the diameter of the wheel will admit the size of the oval. To speak plainer, that is to say, if the long diameter of the oval had to be six inches, the wheel ought to be seven inches; and if the oval requires to be made larger, the wheel itself should be a trifle larger than the oval required. In the present drawing the wheel A B C is for forming the transverse diameter, and the wheel D E F the congugate diameter. The oval which I have described is one inch and an half, in its longest diameter, and, consequently, the slide is set half of that from the centre of the wheel, which is six-eighths of the radius; the short diameter of the oval is one inch, so the slide is set one inch and a half from the centre of the wheel; and whatever size of an oval is wanted, half of the diameters should be taken, and set on their respective wheels. The starting point is always at K, and the rod R R of the wheel A B C is put in a parallel line as near as can possibly be guessed; and then the other hand is allowed to take its chance as to what angle it may form with the other. If care is not taken in this respect, the oval will not be marked in a parellel position, I think from the explanation given you will be able to understand the principle of it. I do not follow the business of a mechanic, being the very opposite to it: but I am fond of passing my leisure hours in inventing, and no doubt you will think I have given a tedious detail of it; but you can shorten it at your will. All that I desire is to make you fully acquainted with the plan, leaving you to explain it in a far better manner than I am capable of. I am at present trying to form a similar machine to describe the parobolic; if I succeed I will forward it to you.

I am yours,

Very respectfully,

J. P. J.

---

## ON PAPER HANGINGS.

BY MR. COWTAN.

*Read before the Decorative Art Society on the 9th Instant.*

AMONG the many articles of British manufacture that lay claim to our attention, few are of more importance than that denominated "Paper Hanging," and few have received less of the requisite care and study. Not only is it of importance in a commercial point of view, but it must be considered in some sort as a vehicle for the advancement and encouragement of the fine arts of the country.

The art of ornamenting the walls of apartments has been in use from a very distant period; among the ancient Egyptians the pictorial representations on the walls of their tombs may lead us to suppose that their houses were decorated in a similar manner. Among the Greek settlers in the south of Italy decorating the interior of their houses was paid great attention to; and the ruins of Pompeii and Herculaneum attest that the art was highly cultivated there; some of these designs, though wanting in artistical skill, yet possesses remarkable brilliancy of colour. The houses of the rich patricians of Italy present numerous specimens of beautiful decoration; and the arabesques of Raffaell, and the rest of the Roman school, are perhaps the finest productions of this kind in the world.

Tapestries, as coverings to walls, were in great use for many centuries in Europe, and among the Eastern nations were known at a very remote period. Most tasteful and beautiful designs were employed in their manufacture; and the refined taste of Athens, and the talents of the first Italian artists, were called into requisition to furnish models from which to work these patterns; and those invaluable cartoons of Raffaell at Hampton Court, shew us how particular they were to procure the best designs and finest specimens of art to decorate and ornament their walls, a strong contrast with the character of taste of the present day, which is content with the productions of inferior artists whose taste and judgment have never been properly cultivated, and, except in some few instances, are totally deficient in those principles of true art which have been the study and direction of all who have arrived at excellence; and without a knowledge of these principles, no manufacture in which taste is required will ever reach even the length of mediocrity.

The capabilities of paper suggested the idea of applying it to the purposes of hangings for rooms, and though it has only been in use for little more than a century, it is nearly two hundred years since it was first applied to that purpose; and it has been used as a substitute for almost every other species of decoration. The varieties of subjects imitated in paper-hangings are very comprehensive, and successful attempts have been made to adapt them to the representation of architecture, sculpture, and painting, as well as arabesque designs, ornaments, and flowers. At first the aim seems to have been directed to imitations of tapestry, and to produce this, a material called flock was employed, a kind of woollen cloth chopped small with a machine, strewed lightly with the finger and thumb over the paper, on which a pattern had been previously drawn with fat oil or varnish, and the different colour and tints being carefully blended, an appearance of tapestry was thus obtained. This method is said to have first originated in England, and was invented by Jerome Langer, who obtained a patent for it during the reign of Charles I., dated May 1st, 1634. We find, however, according to an old French work that a manufacture of this kind was succeeded by his son, and who continued the business for fifty years after, with great success. Originally the material was of an extremely coarse description, and the flock projected considerably from the paper.

At Hampton Court specimens of the early productions may still be seen, mostly painted over in distemper, but the pattern can be distinctly traced. I have been enabled to procure a specimen of flock-paper which I am assured is not less than 110 years old; in this the surface is very coarse, although a great improvement upon the older fabrics.

In the reign of Queen Anne, paper-hangings were largely imported from China, and continue in fashion down to the present day. These hangings, though the outlines may be executed with stencils, are almost wholly done by hand, the colours of which are very rich and brilliant, exceeding in beauty almost anything we can produce in England. Dr. Ure states that the idea of paper-hanging was borrowed from the Chinese, among whom it has been practised from time immemorial. It is curious to observe how systematically the Chinese have adhered to the same patterns and devices to be seen among the earliest drawings of that remarkable people; we do not find the least advancement from the remotest period to the present time.

Mr. Jackson, a manufacturer of paper-hangings at Battersea, published in the year 1754, a work on the invention of chira scuro, and the application of it to paper-hanging, with prints in illustration. This book was probably used as a sort of advertisement of his own manufacture, and contained many just and well-sustained remarks, shewing a cultivated and well-directed taste. He proposed, instead of adhering to the old system (for it seems that paper-hanging had reached some degree of perfection even then), to employ subjects of more interest than the mere repetition of flowers and ornaments, which prevailed so much, that instead of being a principal, as they were, they should be merely an elegant auxiliary to designs of more dignified character; as, for instance, copies of the most celebrated classic subjects, statues, and landscapes; he remarks, "that the persons who could not purchase the statues themselves, might have these prints in their places, and thus gratify the taste of the possessor, which is not seen in the expense of the article, but in the selection."

In speaking of the vulgar and gaudy patterns frequently selected instead of tasteful and harmonious designs, he says, "Persons who prefer the unmeaning paper so generally met with to those done in this style, would prefer a fan to a picture of Raffaell, Carracchi, Guido, or Dominichino; and those who choose the Chinese manner ought to admire, in pursuit of the same taste, the crooked, disproportioned, and ugly, in preference to the straight, regular, and beautiful."

It is by this very means of ill-judgment in furnishing apartments that the true taste of the person is unthinkingly betrayed; those little and seemingly distant things offer the clue which leads to discovering the whole mind, and undoes, perhaps, all that character of being a true judge of the polite arts, which they are so fond of establishing. It seems impossible that any mind truly formed can, without distaste, be capable of letting such objects in upon it through the eye; where the internal senses are well-proportioned and just, these monstrous objects of the external must be displeasing and offensive. In that breast where the softer sensations of humanity are in any particular degree, the love of beauty generally accompanies them, and the approbation of natural objects is the proof of these sensations existing in an individual, as the contrary taste is of the ill formation or perversion of that mind which approves of preternatural appearances; there is a close analogy between the love of beauty in external objects and a mind truly disposed to the feelings of all the softer and most amiable sensations.

The prevailing unfounded idea that the English, as a people, are inferior to other nations in the talents for artistic design and invention, are, I am very glad to observe, fast being overturned by proofs that we are quite as capable, and in some instances more so than the artists of other countries, of producing designs of exquisite taste and workmanship. And I may here mention that the encouragement given to the art of design by the rebuilding of the Houses of Parliament, is in every way praiseworthy, and will give an impetus to native art it has never received since the days when the royal patronage was displayed on the very same spot, during the reign of Henry III., six centuries ago. It is sometimes necessary to bring to the recollection of those cavillers at British talent that, in many of the arts of design, we have far outstripped our contemporary brethren on the Continent. Among our early Saxon progenitors we find that they attained to higher proficiency in the art of MS. illumination than any Continental school. It is proved by early record that painting in oil was practised in England 200 years before the time of Van Eyke, who is called the inventor of it. And it is well known that until lately the French were far inferior to us in ornamental work. Why, then, do we now find that we are obliged to confess their superiority in this branch, when we know that patterns of paper-hangings (and I have myself seen them) exist, manufactured sixty years ago, equal, if not superior, to those executed in France at the present day? Several of the blocks used in the production I have also seen, and their beautiful workmanship far exceeds those in use for present purposes.

It is true that until within the last ten years a noxious tax, imposed during the time of Queen Anne, weighed down the spirit, and clogged the energies of the manufacturer; but the want of a proper national school of design was the grand evil, and kept in embryo the latent genius of English youth. These difficulties, it is pleasing to notice, are fast being overcome; and I hope soon to find our English name, proud as we all are of it, spoken of, not only as retaining its ancient glory, but being a pass-word to all other nations for all that is *talented* and *tasteful*, as well as for all that is noble and honourable.

About the year 1786, a Mr. Sherringham threw a new feature into the manufacture of paper-hanging. This gentleman, who had spent many years on the Continent, returned about this time to England, and established a business in Great Marlborough-street. His enterprising spirit and refined taste led him to engage a number of artists of first-rate ability—such men as Jones, Boileau, La Briere, and Fuxili; he was thus enabled to infuse into the art a style which for beauty and grace was not equalled before, nor has since been surpassed. Sherringham's productions were, indeed, characteristic of the true principles of art. From this establishment emanated the leading decorators of the present day, and the first houses in London built their fame upon the foundation he had constructed. Sherringham was, indeed, the Wedgewood of paper-stainers.

About this time the Messrs. Echardt, who had a manufactory at Chelsea, produced designs of most exquisite workmanship. Besides the mode generally in use, they adopted a method of applying engraved copper-plates, to form the outlines, and by an underground of silver and gold, worked up by hand in varnish colours, effects of the most beautiful kind were obtained; they were highly illustrative of the English talent when properly applied. Their well-directed taste, their eager desire to advance as much as possible their undertaking, their steady endeavour to adopt the most beautiful patterns, and their determination to get them in the best manner, are lessons for some of our modern paper-stainers which it would be well for them to take to heart and learn, for they not only depreciate their own taste by producing, as in many cases they do, patterns which they are almost ashamed of when finished, but the character of the country suffers, and they lose the opportunity of improvement, while they prevent in a great measure the encouragement that would otherwise be bestowed.

The establishments of these gentlemen, though conducted with laudable spirit and enterprise, were destined to sink as they had risen; and the spirit of emulation ended with them.

From that time paper-staining in England kept on in its trodden path without much improvement, and without increasing taste. The French took up the ground that we had left, and their manufactures were in every way encouraged by the government of Napoleon, and they reached that standard of perfection their industry and perseverence so richly merited. But it is true, while speaking of the ability of the French in comparison with ours, and of their continuing in the road we had prepared for them, they had no such difficulties as we to contend with. While a heavy tax was laid on our productions, theirs were entirely free; while their government gave them every facility, we had to fight our battles singly, and at our own hazard: while they had the best designs of great and illustrious men continually before their eyes to improve, and, in fact, *create* a taste, we were without any advantages of the kind, and had to depend solely upon our own resources.

Academies were instituted in France at which every branch was cheaply taught—our School of Design has only been in existence a few years. Still, with all these difficulties and drawbacks, we have kept on amazingly, and improvements from time to time have been issued, particularly among the minor branches of the art, which were formerly in a very low and wretched state.

I trust that our time has not been ill-spent in speaking of what our trade has been in comparison to what it is now, and how much is yet required to be done. To urge, that the example of those who have erected their temple of fame almost upon the ruins of ours should cause a spirit of inquiry into the means to be employed in attaining our lost position. It is not for me, as an humble individual, to point out any project by which this great desideratum is to be accomplished. The increasing facilities which we are every year receiving, and the attention that seems devoted to the fine arts at the present day, should also be an inducement to draw some important attention to the system of improving paper-hangings in England.

If we cast our eyes towards the French, as our principal competitors, we find that the methods in practice here are precisely the same as they have in use; that in the mechanical branches we are superior, and the colours we employ are far more durable; that one time we equalled their productions of the present day, and the only difference that exists is our want of proper artists and of course proper instructors to educate them for the profession. While they employ (as did our former manufacturers) men who understand the principles of design and the harmony of colouring, and who make it their aim to unite every beauty with taste and cultivated judgment, we throw all this important branch upon persons who, to gain a scanty living, require to unite the two professions of designer and *dealer in block-cutting*.

It is not to be expected but that those men will throw off a number of patterns of most inferior quality; they cannot be supposed to pay the attention which is required to produce good work, nor have they ever had the means of educating themselves sufficiently to enable them to equal work which is the result of careful and indefatigable study and practice. This shews a great want of encouragement on the part of the English manufacturers that we must hope to see remedied. The designer in England is not deemed the man of talent—the man of genius—who is looked up to as possessing great and superior abilities, whose refinement of mind ensures him respect and honour wherever he goes;—no, he on whom the manufacturer depends for his success in trade—he on whom devolves the important task of creating from his practice or mind beautiful forms and elegant combinations, it is a melancholy fact, is paid less for his labour than the mechanic that is merely employed to print the pattern after it is prepared to his hand who has no necessity for thought, nothing but that which is within the power of common animal strength to exert.

## GARANCINE.

A PATENT has lately been granted to Frederick Steiner, of Lancaster, for an invention of a new manufacture of certain colouring matter, called Garancine.

This colouring matter is manufactured from refuse madder, or madder which has been previously used in dyeing; such madder having, prior to this invention, ordinarily been thrown away, as spent, and of no value, and the said coloring madder, called Garancine, having been produced heretofore from fresh or unused madder. The manner of carrying the invention into effect is as follows:—Outside the building in which the dye-vessels are situate, a large filter is formed, by sinking a hole in the ground, and lining it at the bottom and sides with bricks, without any mortar to unite them. Upon the bricks a quantity of stones or gravel is placed, and over the stones or gravel common wrappering, such as is used for sacks; below the bricks is a drain, to take off the water which passes through the filter. In a tub adjoining the filter, a quantity of dilute sulphuric acid, of about the specific gravity of 1·050, (water being 1·303,) is kept. Hydrochloric acid will answer the several purposes for which sulphuric acid is used; but the patentee prefers sulphuric acid, as more economical. A channel is made from the dye-vessels to the filter. The madder which has been employed in dyeing, and which is in the state considered as spent or refuse madder, is run from the dye-vessels to the filter; and while it is so running, a portion of the dilute sulphuric acid, sufficient to change the colour of the solution, and the undissolved madder, to an orange tint or hue, is run in, and mixed with it. This acid precipitates the colouring matter which is held in solution, and prevents the undissolved madder from fermenting, or otherwise decomposing. When the water has drained from the madder, through the filter, the residuum is taken from off the filter, and put into bags. The bags are then placed in a hydraulic press, to have as much water as possible expressed from their contents. In order to break the lumps which have been formed by compression, the madder, or residuum, is passed through a sieve. To five hundred weight of madder, in this state, placed in a wooden or leaden cistern, one hundred weight of sulphuric acid of commerce is added, by sprinkling it on the madder through a leaden vessel, similar in form to the ordinary watering-can used by gardeners. The madder is then worked about, so as to mix it intimately with the acid. In this stage the madder is placed upon a perforated leaden plate, which is fixed about five or six inches above the bottom of a vessel. Between this plate and the bottom of the vessel a current of steam is introduced, by a pipe, so that it passes through the perforated plate, and the madder which is upon it. During this process, which occupies from one to two hours, a substance is produced of a dark brown color, approaching to a black. This substance is Garancine, and insoluble carbonised matter. It is next thrown on the floor to cool; and, when cool, is placed upon a filter, and washed with clear cold water, until the water passes from it without an acid taste. The substance is then put into bags, and subjected to hydraulic pressure; it is next dried in a stove, and ground to a fine powder under ordinary madder stones, and afterwards passed through a sieve. In order to neutralize any acid that may remain, for every hundred weight of this substance, from four to five pounds of carbonate mixed of soda, in a dry state, are added, and intimately therewith: the Garancine in this state is ready for use.

## NEW MODE OF SILVERING GLASS.

IN p. 103 of our Magazine, a slight notice is given of Mr. Drayton's new method of silvering looking-glasses, mirrors, &c., we now subjoin the particulars of the process as described on the patent which that gentleman has obtained, it consists in depositing silver from a solution, upon glass, by de-oxidizing the oxide of silver in solution, in such a manner that the precipitate will adhere to the glass, without the latter having been coated with metallic or other substances.

A mixture is first made of one ounce of coarsely pulverised nitrate of silver, half an ounce of spirits of hartshorn, and two ounces of water; which, after standing for twenty-four hours, is filtered, (the deposit upon the filter, which is silver, being preserved) and an addition is made thereto of three ounces of spirit, (by preference, spirit of wine,) at 60° above proof, or naphtha; from twenty to thirty drops of oil of cassia are then added; and, after remaining for about six hours longer, the solution is ready for use. The glass to be silvered with this solution must have a clean and polished surface; it is to be placed in a horizontal position, and a wall of putty or other suitable material formed around it; so that the solution may cover the surface of the glass to the depth of from an eighth to a quarter of an inch. After the solution has been poured on the glass, from six to twelve drops of a mixture of oil of cloves and spirits of wine (in the proportion of one part, by measure, of oil of cloves to three of spirits of wine) are dropped into it, at different places; or the diluted oil of cloves may be mixed with the solution before it is poured upon the glass: the more oil of cloves used, the more rapid will be the deposition of the silver; but the patentee prefers that it should occupy about two hours. When the required deposit has been obtained, the solution is poured off; and as soon as the silver on the glass is perfectly dry, it is varnished with a composition formed by melting together equal quantities of bees' wax and tallow. The solution, after being poured off, is allowed to stand for three or four days, in a close vessel; as it still contains silver, and may be again employed after filtration, and the addition of a sufficient quantity of fresh ingredients to supply the place of those which have been used: the patentee states, that, by experiment, he has ascertained that about eighteen grains of nitrate of silver, are used for each square foot of glass; but the quantity of spirit varies somewhat, as its evaporation depends upon the temperature of the atmosphere, and the duration of the process.

If the glass be placed in an inclined, or even a vertical position, and the surface covered over, leaving a narrow space for the solution between the surface of the glass and the cover, which fits close, then, by using spirits without water in the mixture, the object will be accomplished. By the addition of a small quantity of oil of carraway or thyme, the color of the silver may be varied. The oil of cassia, purchased of different manufacturers, varies in quality; therefore, it, on being mixed with the solution, must be filtered previous to use.

## FIBROUS MATERIALS FOR COVERING ROOFS, &c.

Mr. James Napier, of Hoxton, has succeeded in effecting improvements in preparing or treating fabrics made of fibrous materials, for covering roofs, and the bottoms of ships and vessels, and other surfaces, and for other uses, and for which a patent has been obtained. The invention consists in coating or incorporating with metal, by electro-deposition, fabrics made of fibrous materials. such as linen, canvas, woollen, silk, calico, cord, thread, rope, paper, pasteboard, felt, &c. The patentee does not confine himself to any particular mode of conducting the process; but he describes some methods which he has employed, dividing his description into two parts, viz., the preparation of the fabric, to give it a conducting surface; and the deposition of metal thereon by electricity.

In the preparation of the fabric, the patentee employs any of the well-known methods, of reducing the metal on the surface, but he prefers to use the following methods, which he claims as his invention:—Plumbago or black lead is made to adhere to and enter into the interstices of the fabric, by grinding it very fine, agitating it with water, and immersing the fabric therein; and, in some cases, the fabric may be boiled in it. A compound of iron and zinc is produced by subjecting a mixture of pieces of iron and zinc, for some hours, to a temperature just below that at which it distils, in an iron vessel, closely luted, with a pipe proceeding therefrom, as is usual in distilling zinc; a crystalline compound is thus produced, which is ground into fine powder, and mixed with the black lead; and, as this compound readily reduces many metallic salts, in consequence of its affinity to oxygen, it is very useful in obtaining a metallic surface. Another method of obtaining a metallic surface on one side of the fabric, consists in attaching plates or other pieces of metal closely to the other side. To produce a conducting surface of copper, the fabric is impregnated with a salt of that metal, which is then reduced by the aid of the liquid termed *glycerine;* any of the substances known as reducing agents may be employed for the reduction of the metal in the fabric; and it may also be reduced by connecting the fabric with a galvanic arrangement, so that the hydrogen generated may pass through it. Another mode of reducing metal, particularly applicable to gold and silver, consists in exposing the fabric, which has been impregnated with a metallic salt, to the action of a current of phosphoretted hydrogen and other gases: the fabric is placed in an air-tight chamber, from which, by the admission of hydrogen or ordinary coal-gas, the air is ejected, and passes off through a bent pipe, which terminates under the surface of the water in a pneumatic cistern; the reduction of the metal is then completed, by passing phosphoretted hydrogen through the chamber. This gas is generated from phosphorus and a solution of caustic potash, the surface thereof being covered with a portion of æther, which, becoming volatized on the application of heat, expels the air from the retort, and thereby prevents the combustion of the phosphoretted hydrogen. To produce a more perfect union of the fabric and the metal, the patentee sometimes introduces or weaves thin wires into the fabric, at intervals. Phosphorus dissolved in sulphuret of carbon (which may be diluted with turpentine) is also used for reducing metallic salts, with which the fabrics are to be impregnated, after having been dipped in the solution of phosphorus.

With regard to the deposition of metal on fabrics, one method consists in covering a sheet of iron, on one side, with a porous diaphragm (using any of the materials ordinarily employed in sustaining galvanic batteries; but, by preference, a mixture of equal quantities of plaster of Paris and Roman cement), and fixing the fabric on the other side, by means of wax, or any other substance not soluble in the metallic solution. Two or more sheets, thus arranged, are placed in a vessel, containing the solution of metal to be deposited, and are connected together by wires, which proceed from each sheet of iron to the cloth on the next sheet, so as to form a galvanic series. The fabric may, if preferred, be made to surround a plate, or other suitably shaped piece of metal, and be attached thereto by paste, or other suitable material; which paste may be mixed with black lead, or the compound of zinc and iron, or the finely precipitated metal obtained by the aid of *glycerine*. Another method consists in pasting the fabric upon a plate of amalgamated zinc or other metal, and rubbing the compound of zinc and iron upon its surface; it is then placed in a suitable metallic solution, and attached to the zinc plate of a galvanic battery, whilst another plate or piece of the metal to be deposited is connected to the copper plate of the battery.

The patentee claims the method of preparing or treating the fabrics, herein described, by impregnating and covering them with metal or metals, by electro-deposition, so as to obtain a material, which, on account of its lightness and other valuable properties, is peculiarly suitable for covering roofs, and the bottoms of ships and vessels, and other surfaces, and for many other useful purposes.

## ON PRESERVING ANIMALS FOR MUSEUMS.

I have occasionally noticed the defective manner in which birds are stuffed for museums. At present, I will confine myself solely to quadrupeds; and, in my remarks on the very inferior way in which they are preserved, I beg to declare that I make no allusions whatever to any one museum in particular.

In order to prevent the skins from becoming putrid, especially in hot climates, it has always been a main object with operators to get the skins dried as soon as possible. Again, finding that the skins wanted support, they have placed inside of them a hard body of straw, or of tow, or sometimes of wood, by way of a solid foundation, into which they might fix their wires. Such a process must effectually destroy every chance of success. The nose, and lips, and ears, &c., of the specimen may look well for a few days after the operation; but, in the course of time, they will become so hideous, that every connoisseur will turn from them in disgust.

These remarks are just. Let us go and examine a stuffed monkey, for example, in any museum we choose. See! its once pouting lips are shrunk to parchment; its artificial eyes are starting from the sockets; its ears seem like the withered leaf of autumn; and its paws are quite gone to skin and bone. It is what it ought not to be: it is the product of a bad system, which ought to be exploded in these days of research and improvement. But how is this defective system to be improved, so that a specimen may be produced, which shall be right in all its parts, durable as the table on which it is placed, safe from the depredations of the moth, and not liable to injury when exposed to damp? To effect this, two things are indispensably necessary. The first is, to put the skin of the quadruped upon which you are going to operate in a state to resist putrefaction, and the attacks of the moth, without the use of that dangerous, and at the same time inefficient, composition, known by the name of arsenatical soap. The second is, to keep the skin moist during the time in which you are imparting to it the form and features which it is ultimately to retain.

These most necessary points are gained by immersing the skin in a solution of corrosive sublimate in alcohol; and afterwards, when you are in the act of restoring it to the proper form, by touching certain parts of it, such as the nose, lips, and orbits, with a mixture, one portion of which is salad oil, and the other three are spirit of turpentine.

Those who preserve quadrupeds for cabinets of natural history seem not to be aware that, after the skin of the animal has been taken off, there is a necessity for some parts of it to be pared down from within. These parts are chiefly the nose, the lips, and the soles of the feet. Unless they be rendered thin by the operation of the knife, there will be no possibility of restoring to them that natural appearance which they were seen to possess in life. The inner skin of the ears, too, must be separated from the outer one, until you come close to the extreme edges. Nothing short of this operation can save the ear from becoming a deformity.

Every bone in the skin, to the last joint of the toe, next the claw, must be taken out, in order to allow the operator an opportunity of restoring the skin to its former just proportions.

The mouth must be sewed up from the inside (the skin being inside out when you sew it), beginning exactly in the front, and continuing the operation each way to the end of the gape. When the skin is taken out of the solution, it must be filled quite full of chaff or sawdust (but I prefer chaff), not minding whether the fur be wet or dry. When this has been done, the skin has almost the appearance of an inflated bag, quite deficient in feature and in muscular appearance. "Rudis, indigestique moles." It now depends upon the skill and anatomical knowledge of the operator (perhaps I ought to call him artist in this stage of the business), to do such complete justice to the skin before him, that when a visitor shall gaze upon it afterwards, he will exclaim, "That animal is alive!" "Stare loco nescit, micat auribus, et tremit artus!"

There are now no obstacles, either from without or from within, to impede the artist's progress. The skin is perfectly free from all chance of putrefaction, is quite supple, and will remain so as long as required. There is no hard body inside to obstruct the transit of a working-iron; there is not anything in the shape of wires to prevent him from lengthening or shortening the neck, body, thighs, and legs, according to his own judgment.

Now we proceed to support the skin in any attitude the artist may wish to place it in.

Join two pieces of wood in the shape of a carpenter's gimlet, and of a size corresponding to the size of the animal. When you have nearly filled the abdomen with chaff, introduce this machine, and let the shank hang down outside of the skin, just as though it were a fifth leg in the centre of the body, equi-distant from the fore and hind legs. This fifth leg, or what may be called the shank of the gimlet, is of any sufficient length, and is passed through a hole in the table before you, and then fastened with a couple of wedges. By this contrivance you can raise the animal as high as you wish, or you can lower it at your pleasure; and the feet will just touch the table, without requiring any wire inside to support them. I used formerly to put a stick into the skin by way of back-bone, with pieces of string tied to it at short intervals. These pieces of string were passed through the skin, just where the back-bone had been; and then they were attached to a gallows above, which gave an excellent support to the skin. But I now prefer the other process, as I find it more convenient.

Every thing is now ready for the artist to exercise his ability.

With a piece of iron, from the size of a large darning-needle to that of a ramrod (or larger and thicker still if the bulk of the animal require it), and shaped at one end like a carpenter's pricker, he will push out every part of the skin which ought to be pushed out, and then reduce with the end of his finger any part that may be too prominent: having already made divers small holes in the skin, with his pen-knife, in order to afford entrance to the working-iron. Thus, a small hole at the top of the head will enable him to reach the nose, upper lip, and cheeks; another behind the root of each ear; another under the jaws; others, again, on the back, that he may reach the legs and remaining parts of the body. Under each foot there will also be a hole, to give him the opportunity of getting at the toes. The lips are by far the most difficult part to manage. The operator must have a working-iron in both hands. One of these will do the work within the head, and the other that without: for the lips require to be re-formed with a beautiful rotundity; and this can only be effected by means of the inner and the outer irons working in opposite directions. During the actual operation, the animal need not be kept in its original position. A smaller animal may be placed on the operator's lap: the larger may be thrown on the ground, or on the table. Every day the nose, and lips, and orbits ought to be touched with the oil and turpentine, in order to keep them moist. At first, after you have used the working-iron in every quarter where it is required, there will be no appearance of a re-formation of the features. Nevertheless, in the due course of time, as the skin stiffens, the artist will see the features gradually appear; and every day he will be more and more content with his work. At last the skin will retain the slightest impression communicated to it by the touch of the working-iron. Thus the artist will have it fully in his power to reproduce wrinkles, or warts, or hollows, or a smooth surface, just as occasion may require.

The fur will be equally under his command. He will raise it, or depress it, according to circumstances, and it will retain the position ever after. Thus, a stuffed cat in anger will exhibit a tail of the same extraordinary bulk which it does when a dog threatens its existence.

All animals ought to be well washed in soap and water, with a hard brush, *before* they are skinned. This will have an extraordinary effect in beautifying the fur.

As there are parts of a quadruped's skin which are bound down, as it were, to the bone, (at the eyes, for example) it will be necessary to pass a thread, with a sufficient knot at one end, through these parts, and to let the end without a knot hang loose after it has been drawn out at the opposite quarter. Thus, there must be a thread in the extremities at the gape of the mouth, and one at the corners of the eyes; and others in different parts of the body, according to the operator's judgment. By pulling these at the end which hangs out, he will be enabled to depress the parts into their natural shape.

The artificial eyes must be put in on the first day of the operation, and taken out and put back again every time the head of the specimen is modelled.

When all is completed, and the skin has become perfectly dry, the artist takes out the chaff or sawdust; and he finds that the specimen is quite firm enough to stand without any support from wires. He cuts three sides of a square hole under the feet, to let out the chaff; and when this is done he returns the skin to its place.

A slit must be made in the crown of the head, or under the jaws to allow him to fix the artificial eyes with a little putty or wax. The slit, if properly done, will leave no mark on the fur. *Walerton's Natural History.*

## COVERING METALS WITH PAPER.

The following useful invention has lately been patented by Mr. Benjamin Cook, jun. of Birmingham. It consists in applying the elements or principles of the invention for which a patent was granted to the present patentee, on the 23nd of May, 1842, to other purposes than those therein contemplated. The former invention was described as consisting in constructing the post-shafts or pillars, and other parts of bedsteads, of metallic tubes, and covering the same with paper, papier-mâché, pasteboard, or other similar material, and afterwards japanning or otherwise ornamenting the same. Now, the object of the present invention is, to apply this principle or mode of covering metals with paper or papier-mâché, and afterwards japanning them, to a wider range of articles.

The present invention consists in permanently coating or covering the surfaces of metallic articles, of various shapes and forms, with paper, papier-mâché, pasteboard, or some other similar material, so as to form an external surface for japanning, painting, or otherwise decorating the said articles. A thin sheet of metal is first fastened, in any convenient manner, into the shape or form, or nearly so, of the article intended to be produced, and then covered over with a number of layers of paper, or paper-pulp, in the manner usually adopted in making papier-mâché articles. The thickness of the paper coating must depend in some measure upon the character and size of the article to be coated; but it must always be sufficiently thick to afford a firm hold to the japanning or painting materials to be put upon it. The operations of japanning, painting, and decorating, are to be conducted in precisely the same manner as when the articles are made entirely of papier-mâché, or of plate-metal, as common tea-boards, trays, dishes, &c., and therefore need not be more particularly described.

The articles to which the improvements particularly apply, are such as the following:—viz., cornice poles, rings and ends, curtain pins and bands, finger-plates, window and other cornices, trays and waiters, chimney-pieces, bread and other baskets, tea-urns, plates, dishes, and tureens, dish covers, fenders, balustrades, bars, and banister rails, portfolios, and other similar articles, which are ordinarily made of papier-mâché or metal.

The patentee desires it to be understood, that he lays no claim, under this patent, to the application of his invention to bedsteads, or any part thereof, that having been fully claimed in the specification of a former patent. But he claims permanently coating or covering the surfaces of the above-mentioned articles (bedsteads excepted) with paper, papier-mâché, or other similar materials, which are capable of forming a basis or ground for japanning, painting, or decorating; and which articles, when so constructed, coated, and covered, are made to resemble articles made of papier-mâché only, but possess much greater strength and solidity.

## VARIETIES.

*Public Baths and Washhouses in London.*—A project is on foot, which, if realised, will materially benefit a large portion of the London community. It is proposed to establish baths, coupled with wash-houses for clothes, on such a scale as to place the comforts of cleanliness within the reach of all. "It is contemplated," says the *Spectator*, "to begin with four foundations, three on the Middlesex, and one on the Surrey side of the river, at a total expense of 30,000l. The annual charge thereafter to be met by the payments of those who use them; 1d. for a cold, and 2d. for a warm bath (the use of a towel inclusive), being the rates for the bathers; while at the washhouses all appliances and means for six hours' scrubbing, drying, and ironing, are to be supplied for 2d. With the aid of an income to be derived from a few baths of a more expensive kind, the institutions are thus expected shortly to compass their own support. It cannot be doubted that the 30,000l. will speedily be raised."

*Analysis of Gunpowder.*—Boiley proposes a method for the analysis of Gunpowder, of the advantage of which he has assured himself. It is founded on the property of sulphur to dissolve in sulphurous acid in order to form sulphites. Sulphite of soda is first prepared by passing sulphurous acid into a solution of carbonate of soda, until the whole of the carbonic acid has been expelled. After the dried and weighed gunpowder has been extracted with water, the residue is dried and weighed, and is then brought into a solution of sulphate of soda (20·24 parts sulphate of soda and 1 part of the mixture of charcoal and sulphur). and is boiled for one or two hours in a flask, the evaporated water being replaced. It is then filtered, the charcoal well washed and weighed; the loss indicates the amount of sulphur. Heating a portion of the carbonaceous residue on platinum foil will show whether the whole of the sulphur has been removed.

*To sweeten musty casks.*—First wash them with sulphuric acid and then with clear cold water, or mix sulphur with a little nitrate of potash, and burn it inside the cask: observe, to wash it well before using.

*Fig.* 1.

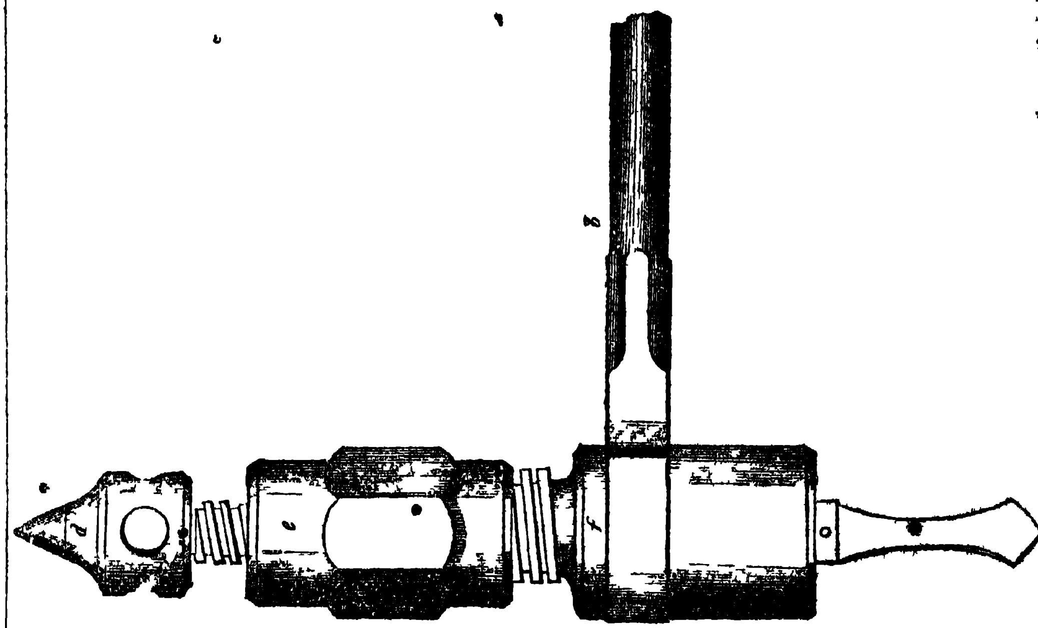
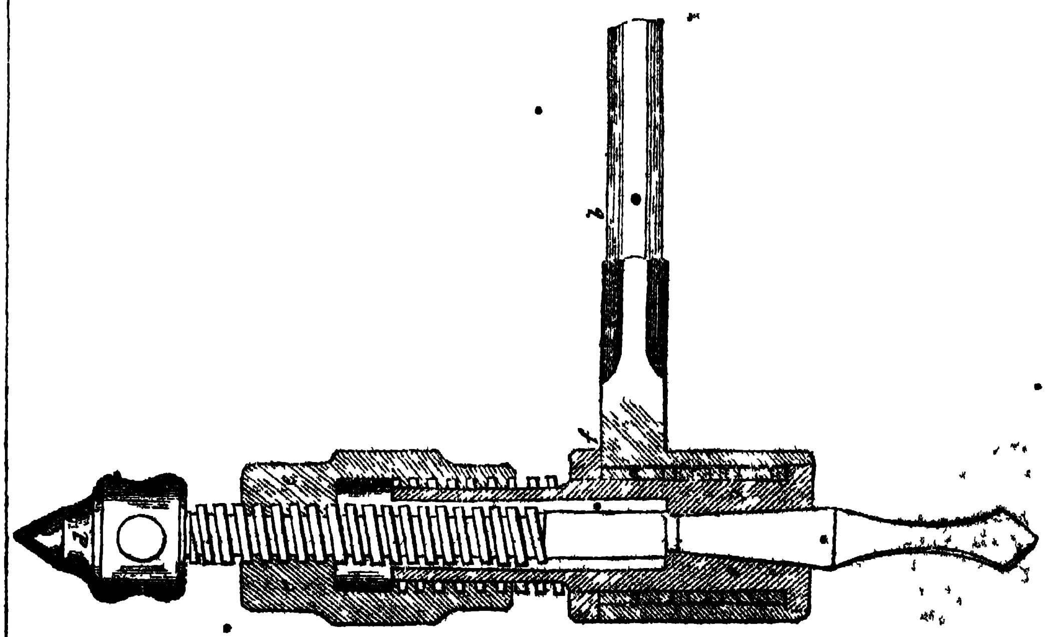


*Fig* 2.



SHANKS' IMPROVED HAND DRILL.

## SHANKS' IMPROVED HAND DRILL.

FIG. 1 represents in elevation the improved drill made by Mr. A. Shanks, a portion of the handle being removed to economise space.

Fig. 2 represents the drill in section

The principal peculiarity is the spiral clutch *a*, of which Fig 3 is a detached view. It consists of a steel riband twisted round a cylinder, and is substituted for the ratchet and detent used in ordinary hand drills; *b* is the handle; *c* the drill; *d* the screw for feeding the drill while boring; *e* the hollow nut for adjusting the drill to different lengths; *f* a washer for holding down the handle; *g* the drill-stock.

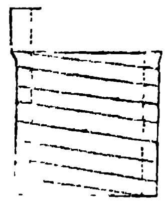


*Fig.* 3.

The clutch being truly cylindrical inside, exactly fits the drill stock *g*, and rests without being fixed upon a ruff at the lower end of the stock. The whole is embraced by the socket of the handle, to the upper part of which the clutch is fixed, and the washer *f* keeps them in their places. The second improvement is the making of the drill-stock hollow at the upper end, to allow the screw *d* to pass into it; this considerably shortens the length of these parts.

When the handle is turned, with the view of turning the drill, the clutch *a* by its friction takes hold of the drill-stock *g*, and turns the drill, however great the resistance may be. When the handle is returned, the clutch naturally slackens and slips upon the stock, preventing thereby the returning of the drill.

## MODE OF COLOURING DAGUERREOTYPE PICTURES.

*By Charles G. Page, M. D., Prof. Chem. Columbia College, Washington.*

IN the month of December, I instituted a course of experiments to determine the effects of oxidation upon the surface of Daguerreotype pictures, and arrived at some beautiful results in fixing, strengthening, and colouring these impressions. Numerous and arduous duties of a public nature have prevented me from investigating the subject as I wished, and I therefore present the facts for others to adopt, as the basis of what promises to be a most interesting course of study and experiment.

First, a mode of fixing and strengthening pictures by oxidation:—The impression being obtained upon a highly polished plate, and made to receive, by galvanic agency, a very slight deposit of copper from the cupreous cyanide of potassa, (the deposit of copper being just enough to change the color of the plate in the slightest degree,) is washed very carefully with distilled water, and then heated over a spirit lamp until the light parts assume a pearly transparent appearance. The whitening and cleaning up of the picture, by this process, is far more beautiful than by the ordinary method of fixation by a deposit of gold. A small portrait fixed in this way, more than a year since, remains unchanged, and continues to be the admiration of persons interested in this art. One remarkable effect produced by this mode of fixing, is, the great hardening of the surface, so that the impression is effaced with great difficulty. I have kept a small portrait, thus treated, unsealed and uncovered for over a year, and have frequently exposed it in various ways, and rubbed it smartly with a tuft of cotton, without apparently injuring it; in fact, the oxidized surface is as little liable to change as the surface of gold, and is much harder.

As copper assumes various colours, according to the depth of oxidation upon its surface, it follows, that if a thicker coating than the first mentioned can be put upon the plate, without impairing the impression, various colors may be obtained during the fixation. It is impossible for me to give any definite rules concerning this last process, but I will state, in a general way, that my best results were obtained by giving the plate such a coating of copper as to change the tone of the picture, that is, give it a coppery colour, and then heating it over a spirit lamp until it assumes the colour desired. I have now an exposed picture treated in this way at the same time with the two above mentioned, and it remains unchanged. It is of a beautiful green colour, and the impression has not suffered in the least by the oxidation. Should this process be perfected, so as to render it generally available, it will be greatly superior to the present inartistical mode of strippling dry colours upon the impression; for the colour here is due to the surface of the picture itself. For pure landscapes, it has a pleasing effect, and by adopting some of the recent inventions for stopping out the deposit of copper, the green colour may be had wherever desired. In some pictures a curious variety of colours is obtained, owing to the varying thickness of the deposit of copper, which is governed by the thickness of the deposit of mercury forming the picture. In one instance a clear and beautiful ruby colour was produced, limited, in a well-defined manner, to the drapery, while all other parts were green. To succeed well in the first process, viz., that for fixation and the production of the pearly appearance, the impression should be carried as far as possible without solarization, the solution of the hyposulphite of soda should be pure, and free from the traces of sulphur, the plate should be carefully washed with distilled water, both before and after it receives the deposit of copper,—in fact, the whole experiment should be neatly performed, to prevent what the French significantly call *taches* upon the plate, when the copper comes to be oxidized.—*Journal of the Franklin Institute.*

## PIN MANUFACTURE.

In making this little article there are no less than 14 distinct operations.

1. *Straightening the wire.*—The wire, as obtained from the drawing frame, is wound about a bobbin or barrel, about 6 inches diameter, which gives it a curvature that must be removed. The straightening engine is formed by fixing 6 or 7 nails upright in a waving line on a board, so that a void space measured in a straight line between the first three nails may have exactly the same thickness of the wire to be trimmed; and that the other nails may make the wire take a certain curve line, which must vary with its thickness. The workman pulls the wire with pincers through among these nails, to the length of about 30 feet, at a tunning draught; and after he cuts that off, he returns for as much more; he can thus finish 600 fathoms in the hour. He next cuts the long pieces into lengths of 3 or 4 pins. A day's work of one man amounts to 18 or 20 thousand of dozen pin lengths.

2. *Pointing*, is executed on two iron or steel grindstones, by two workmen, one of whom roughens

down, and the other finishes. Thirty or forty of the pin wires are applied to the grindstones at once, arranged in one plane, between two forefingers and thumbs of both hands, which dexterously give them a rotarary movement.

3. *Cutting these wires into pin-lengths.*—This is done by an adjusted chisel. The intermediate portions are handed over to the pointer.

4. *Twisting of the wire for the pin-heads.*—These are made of a much finer wire, coiled into a compact spiral, round a wire of the size of the pins, by means of a small wire constructed for the purpose.

5. *Cutting the heads.*—Two turns are dexterously cut off for each head, by a regulated chisel. A skilful workman may turn off 12,000 in the hour.

6. *Annealing the heads.*—They are put into an iron ladle, made red-hot over an open fire, and then thrown into cold water.

7. *Stamping or shaping the heads.*—This is done by the blow of a small ram, raised by means of a pedal lever and a cord. The pin-heads are also fixed on by the same operative, who makes about 1500 pins in the hour, or from 12,000 to 15,000 per diem; exclusive of one-thirteenth, which is always deducted for waste in this department, as well as in the rest of the manufacture. Cast heads, of an alloy of tin and antimony, were introduced by patent, but never came into general use.

8. *Yellowing or cleaning the pins,* is effected by boiling them for half an hour in sour beer, wine lees, or solution of tartar; after which they are washed.

9. *Whitening or tinning.*—A stratum of about 6 pounds of pins is laid in a copper pan, then a stratum of about 7 or 8 pounds of grain tin; and so alternately till the vessel be filled; a pipe being left inserted at one side, to permit the introduction of water slowly at the bottom, without deranging the contents. When the pipe is withdrawn, its space is filled up with grain tin. The vessel being now set on the fire, and the water becoming hot, its surface is sprinkled with 4 ounces of cream of tartar; after which it is allowed to boil for an hour. The pins and tin grains are, lastly, separated by a kind of cullender.

10. *Washing the pins,* in pure water.

11. *Drying and polishing them,* in a leather sack filled with coarse bran, which is agitated to and fro by two men.

12. *Winnowing,* by fanners.

13. *Pricking the papers* for receiving the pins.

14. *Papering,* or fixing them in the paper. This is done by children, who acquire the habit of putting up 36,000 per day.

The pin manufacture is one of the greatest prodigies of the divison of labour; it furnishes 12,000 articles for the sum of three shillings, which have required the united diligence of fourteen skilful operatives.

The above is an outline of the mode of manufacturing pins by hard labour, but several beautiful inventions have been employed to make them entirely or in a great measure by machinery; the consumption for home sale and export amounting to five millions daily, for this country alone. One of the most elaborate and apparently complete, is that for which Mr. L. W. Wright obtained a patent in May, 1824. The following outline will give our readers an idea of the structure of this ingenious machine:—

The rotation of a principal shaft mounted with several cams gives motion to various sliders, levers, and wheels, which work the different parts. A slider pushes pincers forwards, which draw wire from a reel, at every rotation of the shaft, and advance such a length of wire as will produce one pin. A dye cuts off the said length of wire by the descent of its upper chap; the chap then opens a carrier, which takes the pin to the pointing apparatus. Here it is received by a holder, which turns round, while a bevel-edged fly-wheel rapidly revolves, and tapers the end of the wire to a point. The pin is now conducted by a second carrier to a finer file-wheel, in order to finish the point by a second grinding. A third carrier then transfers the pin to the first heading die, and by the advance of a steel punch, the end of the pin wire is forced into a recess, whereby the head is partially swelled out. A fourth carrier removes the pin to a second die, where the heading is perfected. When the heading-bar retires, a forked lever draws the finished pin from the die, and drops it into a receptacle below.

The chief objection to the raising of the heads by strong mechanical compression upon the pins, is the necessity of softening the wire previously; whereby the pins thus made, however beautiful to the eye, are deficient in that stiffness which is so essential to their employment in many operations of the toilet.—*Ure.*

## DESCRIPTION OF A NEW ENAMEL FOR GLAZING POTTERY.

MESSRS. HARDTMUTH, brothers, manufacturers, of Vienna, have discovered a method of covering articles of pottery with a very brilliant and solid glare or enamel, without the employment of white-lead, and without rendering the articles much more expensive than the usual method.

The following statement on this subject was communicated by the manufacturers to the Society of the Grand Duchy of Hesse. The substances employed for this glaze are borax, felspar, and refractory earth. These substances must be severally treated or prepared in the following manner, in order to render them fit for entering into the mixture. The borax, which is the ordinary borax of commerce, must be pulverized and sifted. The felspar, in a crude state, without regard to its purity or whiteness, must be washed in pure water, and afterwards calcined in the fiercest fire that is used in potters' ovens, and finely pulverised. The clay or *argyl* is passed through a fine sieve, and afterwards baked to a red colour.

*Mixture.*—Take 50 kilogrammes of borax, 25 kilogrammes of felspar, and 22 kilogrammes of earth, prepared as above mentioned, and mix them carefully in a suitable vessel, until the several properties or natures of these substances can no longer be distinguished. During this time, several cases *(gazette)* of earth are prepared, and lined with a layer of finely pulverized silica, about 12 or fourteen millimetres in thickness; this silica must be previously calcined to facilitate its pulverization, and afterwards converted into a thick paste, in order to prevent the mixture about to be fused from adhering to the case, and to facilitate its removal therefrom. The cases, having been charged, are exposed to the fiercest fire in the oven, where the mass is fritted into a vitreous substance.

*Immersion.*—The glaze is diluted with water, until a liquid is produced, marking 40° of Beaumé's aerometer. This may, however, be varied, according as the articles are required to be baked at a greater or less degree of heat, and consequently to be immersed more or less. This operation is performed in the ordinary manner, and does not, therefore, require description.

*Baking.*—The process of baking is well known to manufacturers: it will be as well, however, here to observe, that the degree of heat which ought to be employed with this glaze, as well as the length of time for baking, must be the same as in establishments where good well-baked pottery is manufactured, but with white-lead glaze, and not like those where, to save the wood, the baking is imperfectly performed, which augments the danger already presented by these utensils. Although this glaze is much more expensive than that made with white-lead, the inventors, nevertheless assert (and which has been verified by a commission appointed for that purpose) that the difference in price for a vessel containing about three pints, does not exceed three centimes (about a farthing).

The Society of Manufacturers of the Grand Duchy of Hesse having appointed a commission to make experiments upon this glaze, the following is an extract from the Report addressed to the Society on the subject.

"We have made every effort to find materials of the greatest degree of purity possible, in order to repeat the process which had been communicated to us; but as it is very difficult to procure Bohemian felspar at Darmstadt, and probably in many other places, we have determined to make our experiments with mixtures, the price of which would be about the same as the felspar, and we have consequently chosen the following composition:—100 parts of borax, 20 parts of ordinary potter's earth, 22 parts of white sand of Ueberau, and 12 parts of potash of commerce.

"Two mixtures were made, viz:—No. 1, according to Messrs. Hardtmuth's plan; and No. 2, according to the proportions lastly mentioned; and the two fritted in precisely the same manner. No. 2. vitrified better than No. 1, and our compound seemed to melt somewhat easier than the other. The two frits were afterwards severally passed through the mill, finely pulverised, and mixed with water, and the articles, previously warmed, plunged therein, and lastly baked in the oven with the others.

"The two compounds furnished a fine solid glaze, of a pale reddish yellow colour, in which there was very little difference.

"In most cases the glaze acquires the fine colour above mentioned; we therefore resolved to make another experiment with a kind of felspar less pure. viz: that which German mineralogists call *Feldstein*, and which is to be met with in beds called porphyry at Darmstadt and other places, and may be easily procured. We chose specimens of this feldstein, of a clear colour, that is to say, not containing too large a quantity of iron and manganese, and we made therewith (because of the quantity of silica it contained) the following mixture, 100 parts of borax, 50 of feldstein, 50 of earth, and 4 of calcined soda. With this mixture, No. 3, applied as before, a perfect glaze was obtained, the colour of which, however, (a greyish brown,) was very inferior to that of the two other mixtures, besides being more difficult of fusion, a defect which is easily avoided by a large proportion of soda.

"These experiments have sufficiently demonstrated that the recipe from Vienna, as well as the one we have deduced therefrom, in which the use of felspar is avoided, furnish glazes which will bear comparison with the ordinary white-lead varnish used by potters, as regards duration and impermeability to liquids; but, on the other hand, it is to be feared, that the price thereof, even deducting the cost of the borax, which is the principal ingredient, would be too high, as the materials must be fritted, and afterwards passed through the mill, diluted with water, and applied upon articles already baked in the biscuit form; whereas the white-lead glaze ordinarily employed by potters, which, as is well known, consists of equal portions of litharge and sand, or sandy earth, which is mixed in the mill with water, and applied to articles simply dried in the air, saves the combustible which would be employed for fritting and baking the biscuit. At all events it seems to us, and has been already proved by experience, that articles glazed with a soluble glaze, made without white lead, must come to about double the price of ordinary products of the same kind."

Mr. Schneider, jun., manufacturer of pottery at Mayence, also made, a short time ago, before the Society of Manufactures of the Grand Duchy of Hesse, a favourable report upon the pottery glazed without white-lead, sent by Messrs. Hardtmuth to the exhibition of manufactures which took place lately in that town, and has also mentioned their price as an obstacle to their general use; he took that opportunity of communicating to the Society the result of experiments, made by himself, upon a process communicated to him by Mr. Bernagoud, of Mayence, which has for its object the obtaining, at a moderate price, a glaze free from metal, without the use of borax.

The mixture employed for this purpose consists of 100 parts of silica (washed sand of the Rhine), 80 parts of purified potash, 10 of saltpetre, and 20 parts of caustic lime, baked, and reduced to powder by a little water. These ingredients are mixed, and afterwards fritted in a crucible or a reverberatory furnace until perfectly fused. The mixture must be stirred several times during the fusion, as at the beginning it swells considerably from the disengagement of the carbonic acid from the potash. The melted mass is poured upon a suitable iron plate, and, after cooling, reduced to a fine powder. The articles are first passed lightly through the oven, and afterwards immersed some time in water, after which the glaze is applied or sifted thereon as evenly as possible; they are then left in the air, and the glaze is baked in the ordinary manner in the oven.

This glaze resists acids almost as effectually as common glass; and, by the addition of smalt or other metallic oxides, it may be readily coloured.

Mr. Schneider has also stated, that Mr. Fuchs, of Munich, had recommended his soluble glass as a glaze for pottery, and proposed to plunge the articles first into the solution of glass, and afterwards to cover them with his dust in a dry state. The liquor, according to his statement, penetrates into the pores of the substance, and increases its consistency. Mr. Bernagould had, from what Mr. Schneider said, made trials of this soluble glass; but, far from finding its consistency augmented, he remarked that, after a time, the potash, became efflorescent, and consequently the soluble glass was not suitable for this purpose.

Mr. Schneider said, in conclusion, that he had also made experiments upon the preparation of glaze without white-lead, by means of dross from smelting furnaces, and that he had remarked that the glaze did not melt until it had attained such a heat as to cause the earth to contract, and that not above one earth in ten would bear this application. Now, as baking at a high temperature deprives the articles of the property of resisting changes of temperature, and as in that case they break easily, it will be seen that the latter glaze is not applicable to ordinary cases.

This result agrees, at least in a general point of view, with those shewn by Mr. Gœrtler, some time ago, before the Society of Manufactures in Darmstadt.

## THE LIGHTNING CONDUCTOR AT THE ROYAL EXCHANGE.

(*From the Times.*)

Being assured that the citizens of London will feel a satisfaction in knowing that their new Royal Exchange is protected against one form of the element by which the former edifice was razed to the ground, I venture to ask a place in your journal for a description of the lightning conductor.

Experience, very dearly purchased, has taught us to regard these appendages, as of prime importance to every exposed or elevated structure, and has convinced us that the immunity from danger which has been enjoyed by many an unprotected building has been merely accidental; for, when "time and chance," so to speak, have wafted the teeming thunder-cloud within range of the edifice that had so long remained unscathed, the delusion has vanished, and the shattered towers (as those for instance, of Spitalfields, Streatham, Brixton, and St. Martin's Churches,) have borne testimony to the sad reality.

The lightning conductor of the Royal Exchange has been erected essentially as a conductor of lightning: it is not placed there under the idea that it will avert a lightning flash by draining the cloud of its electrical contents; nor will it invite a lightning flash by any attractive power inherent in itself; but it is there, ready to receive any flash that may strike it, and to conduct it in safety to the earth. It is presumed that the time may come when a cloud shall pass over the tower at the precise moment when its electrical contents are in such a state of "tottering equilibrium," that its inductive action on the conducteous bodies there present will be sufficient to overthrow this equilibrium and cause the discharge. The apex of the conductor is, therefore, so presented to the cloud, as to be more accessible to the flash than any other conducteous body; and with the broad fact before us, that the flash is journeying onward to the earth, and will arrive there by the course opposing least resistance, every precaution is taken not merely that the conductor shall be the path presenting least resistance, but that it shall be a path large enough to convey away any lightning flash whatever. In other words, we presume that the conductor may one day be struck with lightning; and, knowing that the object of the lightning is to reach the earth with the least possible opposition, we provide for it a path, not only efficient in itself, but likewise more efficient than any other vicinal path or paths.

The conductor is a copper rod three quarters of an inch in diameter—a size more than sufficient to conduct safely the largest lightning flash; for experience has not furnished us with any cases wherein a mass of copper of only half an inch in diameter has been melted by lightning; while many instances are extant of heavy discharges being safely conducted by smaller rods. It commences with a rod of copper, tipped and pointed with platinum, erected on the back of the grasshopper vane, immediately over the spindle; and terminated in a furcated form within a pit sunk near the base of the tower. As a lightning conductor is a most dangerous appendage unless its base is very effectually connected with the subsoil, the greatest attention has been paid to this point. The pit was sunk through the concrete until the native gravel was fairly entered; the furcated terminating portion was then attached, so as to reach to the bottom of the pit; a ton or two of the graphite, obtained from gas retorts, was broken small, and thrown into the pit, so as completely to bury the furcations. I may mention that this material besides being indestructible, is an excellent conductor of electricity; and that it is employed in order to present as large a conducting surface to the soil as possible, and so to facilitate the escape of the charge, and thus make the conductor in every respect the path opposing least resistance. The pit was then filled up.

As the supply pipe by which the Exchange is furnished with water passes at no great distance from the spot where the conductor enters the court-yard, the pipe has been connected with the conductor by means of a copper rod, and thus the whole mass of the water-pipes throughout London constitute an infinitely extensive discharging train. So perfect is this discharging system, that I could have contented myself without the pit of graphite, had I not looked through the vista of years to the time when these water-pipes might be removed or altered. The workmen would detach the connexions, and, if unaware of its nature, which is more than probable, they might replace the pipes without attending to the apparently useless rod of copper.

The course of the conductor is not obvious to the passer by, for I have not cared unnecessarily to create an eyesore on the architecture of the tower. I have, therefore, carried it within the tower from the vane to the belfry, and have then led it out, so as to pass over the parapet at a level with the roof of the building, and to descend into the inner court at the right hand on entering. Throughout its course the conductor is a perfect fixture, being secured to the wall by copper staples a few inches in length.

There is one question which always arises in respect to lightning conductors, and in answering this another essential feature will be recognized. Is it possible for any portion of the the flash to leave the conductor? Yes, in extreme cases it is just possible. When? Whenever, a path is at hand which, with the conductor (during the whole or a portion of the rest of the course), presents less resistance to the particular flash in question than is presented by the conductor alone; in other words, the clock-room and the belfry contain large masses of metal, which might, in an extreme case, relieve the conductor in this part of its course of a part of the charge. This remote contingency must, therefore, be provided against. Now, lightning is mainly a destructive agent during its transit from metal to metal, through stone and wood, and such like bad conductors; while travelling in capacious masses of metal it is perfectly harmless; therefore, in order to prevent its attaining to these masses of metal through the intervention of bad conductors, the clock and the bells are respectively connected with the lightning conductor by a series of copper rods, so that, should the case ever occur in which a portion of the charge should claim the supplementary path presented by these necessary appendages to the tower, it will pass innocently to them in the first instance, and from them afterwards, without any flash or explosion being made manifest. In like manner, where the conductor passes over the parapet, near the gutters and water-spouts, a copper-rod is led away to the nearest gutter, and secured to the metal of which it is constructed. By these means the whole of the metal work about the building is included in the general system; and no supplementary or side path is open to the flash that is not in perfect metallic connexion with the rod itself.

I have embodied in this description the principles by which we are guided in erecting a lightning conductor, because I wish it to be of some practical use to your readers. I cannot consistently trespass on your columns to enter into the minute details; it is enough to have put forth the broad and very general features that are applicable to all cases. It is to be hoped that the example set by the architect of the Royal Exchange, and by those under whose directions several other public edifices have been erected, will be followed out as a general rule, and not stand as an exception; and that our temples and our national edifices may not stand, as they constantly do, boldly thrust up into the region of storms, as if daring the fury of the tempest, and inviting down its vengeance.

I remain, Sir,
Your very obedient servant,
CHARLES V. WALKER.
Westbourne-green, Oct. 28.

## IMPROVEMENTS IN IRON.

Mr. Arthur Wall, Poplar, has lately patented certain improvements in the manufacture of iron. The first part of this invention consists in adding to the iron, while in a state of fusion in the smelting, puddling, balling, or reheating furnaces, certain compound masses, which the patentee has designated for more clearly explaining his process, A, and B.

The composition A, is a mixture of steel or wrought iron, in a commuted state, such as filings or fine cuttings, with melted rosin; it is made into balls of five pounds each, and thrown upon the melted iron, in the ratio of one ball to five hundred weight of metal. If prefered, instead of the rosin, other resinous substances, and the varieties of turpentine, asphaltum, tar, and pitch, may be substituted; and a few pounds of charcoal may be added to the composition. The compound B, is a mixture of common salt, resin, and charcoal or other carbonaceous matter, which is made into balls, and thrown upon the fused iron, after it has been acted upon by the balls A, in the proportion of one pound of the composition B, to each hundred-weight of metal. Certain other fluxes, such as borax, nitre, or fixed alkalis, may be substituted for the salt.

The second part of this invention consists in subjecting the iron, while in a fluid state, and while in the act of solidifying, to a current of electricity, which is caused to traverse the whole mass.

In casting a bar or similar mass, the electric current is caused to traverse from end to end, by conductors so arranged, that when the metal runs into the mould it may complete the electric circuit, or by means of a wire or wires, passed from one end of the mould to the other. If the castings are horizontal, a piece of wrought iron or other conducting material is placed at each end of the mould, which is made of sand or other non-conducting substance: these conductors are then connected by wires with a galvanic apparatus, or voltaic pile, or electro-magnetic or other battery; so that, when the melted iron is run into the mould, it will complete the electric circuit; and the patentee prefers to continue the electric current for some time after the iron has solidified. When the castings are vertical, a similar arrangement is made for the passage of the electric current through the metal, by placing a conductor at the top and bottom of the mould, in such a manner, that the electric circuit will be completed the moment the mould is filled with the liquid iron.

To apply electricity to iron in a smelting furnace or cupola, a wrought-iron rod is introduced through or at the side of the tap-hole, until it comes in contact with the melting metal, and another wrought-iron rod is introduced at the upper and posterior part of the hearth, or through one of the tuyère holes, until it reaches the metal; the outer ends of these rods being then connected with a battery, the electric current will be caused to pass through the iron; care being taken not to continue it so long as to entirely decarburate the iron, and bring it to a malleable state. When the electricity is to be applied to the iron in a puddling or balling furnace, two iron rods are also used; one of which is inserted into the fused metal, and the other end is connected with a battery; the other is attached to an insulating handle of porcelain, pottery, or other non-conducting substance, and a wire from the battery is connected to it, close to the handle. By means of the handle, the extremity of the rod is caused to traverse the iron in its melted state, or during its transition to the solid state, and the electric current will therefore pass through the metal in every possible direction.

## A NEW ELECTRICAL MACHINE.

By Martyn Roberts, Esq., F.R.S. Ed. &c.

(*To the Editor of the Electrical Magazine.*)

In experimenting with the common plate glass machine, I perceived that the collective points of the prime conductor did not gather the electricity from the plate, as rapidly as this was charged by the action of the rubber; and, on testing the plate, the moment after it had passed in its revolution from the prime conductor, I found it still highly charged with positive electricity: this led me to believe that it would be a great improvement if the machine were constructed in such a manner that the prime conductor should not only collect the electricity generated or thrown upon the plate by the amalgamated rubber, but that it should also take away from the glass some of its natural electricity, and in this manner prepare it to receive its charge of positive electricity from the rubber, with greater avidity, as well as to contain a much larger charge than it could have done were the glass merely in a natural state, or still more so than when the glass is in a partially charged positive state, as it now is, in all plate, or cylinder machines on meeting the amalgamated or charging rubber.

To effect this, I removed the collecting points from the prime conductor, and replaced them by a rubber calculated to render the plate negatively electrified, and I found the plan to answer admirably; for now, the prime conductor not only wiped off the electricity given to the plate by the rubber covered with amalgam, but it also abstracted a further quantity from the glass, and thus fitted it for receiving a much larger charge, through the amalgamated rubber, from the earth, than could otherwise be obtained. An extraordinary quantity of electricity was thus produced from a plate machine of only nine inches diameter; and I was thus also enabled to turn the machine as rapidly as I pleased; for the plate always issued from the prime conductor *or collecting* rubber, in a negative condition; whereas when points only were used on the prime conductor, I found that the plate, if turned *very rapidly*, was nearly as high charged with positive electricity, *after it had passed the collecting points*, as when it had just parted from the amalgamated rubber.

The only difficulty I met with was to procure a rubber that would render the glass plate negatively electrified. Cat-skin was used, and this was found to answer well for a short time; but if care were not taken, the amalgam from the other rubber would sometimes accumulate upon the collecting rubber, and thus neutralize its good effects. I also ascertained the curious fact, connected with the use of cat-skin, that when the hair was long and unworn, it electrified the glass negatively; but when the hair was worn down to its stumps, it then electrified the glass positively.

Of course, if a resinous plate were used in lieu of glass, there would be no difficulty in obtaining both positive and negative rubbers. Other pursuits have prevented my following up this particular experiment; but this I have fully proved, that a machine, fitted up with two rubbers, one to excite positively, the other negatively, will enable us to circulate a much larger quantity of frictional electricity than can be obtained by any other at present known manner of mounting machines.

I remain, yours truly,
MARTYN ROBERTS.

## ENGRAVING DAGUERREOTYPE PLATES.

A Patent has recently been granted to Antoine Francois Jean Claudet, of Holborn, for improvements in rendering the Daguerreotype picture susceptible of producing, by printing, a great number of proofs or copies; thereby transforming it into a complete engraved plate.

The process is established upon the following facts, which have come to the knowledge of the inventor:—

1. A mixed acid, composed of water, nitric acid, nitrite of potassa, and common salt, in certain proportions, being poured upon a Daguerreotype picture, attacks the pure silver, forming a chloride of that metal, and does not affect the white parts, which are produced by the mercury; but this action does not continue long. Then, by a treatment with ammonia (ammonia containing already chloride of silver in solution, is preferable for this operation), the chloride of silver is dissolved, and washed off, and the metal being again in its naked state, or cleansed from the chloride, it can be attacked afresh by the same acid. This acid acts better warm than cold.

2. As all metallic surfaces are soon covered (when exposed to the atmosphere) with greasy or resinous matters, it is necessary, in order that the action of the acid upon the pure silver should have its full effect, for the surface to be perfectly purified; this is effected by the employment of alcohol and caustic potash.

3. When a Daguerreotype picture is submitted to the effect of a boiling concentrated solution of caustic potash, before being attacked by the acid, the state of its surface is so modified that the acid spares or leaves, in the parts which it attacks, a great number of points, which form the grain of the engraving.

4. When the effect of the acid is not sufficient, or, in other words, if it has not bitten deep enough, the effect is increased by the following process:—Ink the plate as copper-plate printers do, but with a siccative ink; when the ink is sufficiently dry, polish the white parts of the plate, and gild it by the electrotype process; then wash it with warm caustic potash, and bite in with an acid, which will not attack the gold, but only the metal in those parts which, having been protected by the ink, have not received the coating of gold. By these means the engraving is completed, as by the action of the acid alone it is not generally bitten in deep enough.

5. To protect the plate from the effects of wear, produced by the operation of printing, the following process is employed:—The surface of the plate is covered with a very thin coating of copper, by means of the electrotope process, before submitting it to the operation of printing; and when that pellicle or coating of copper begins to shew signs of wear, it must be removed altogether, by plunging the plate in ammonia, or in a weak acid, which, by electro chemical action, will dissolve the copper, without affecting the metal under it; the plate is then coppered again, by the same means, and is then ready for producing a further number of impressions. This re-coating operation may be repeated as many times as may be required. The following is the description of the whole process, which is divided into two parts, consisting of a preparatory and finishing process:—

*Preparatory Engraving.*—For this operation, which is the most delicate, it is necessary to have, 1. A saturated solution of caustic potash. 2. Pure nitric acid at 36° of the areometer of Beaumé (spec. grav. 1·333). 3. A solution of nitrite of potassa, composed of 100 parts of water and 5 parts of nitrite, by weight. 4. A solution of common salt, composed of water 100 parts, and salt 10 parts, by weight. 5. A weak solution of ammoniacal chloride of silver, with an excess of ammonia. The ammoniacal chloride of silver must be diluted with 15 or 20 parts of pure water. In the description of the process, this solution will be called ammoniacal chloride of silver. 6. A weak solution of ammonia, containing 4 or 5 thousandths of liquid ammonia. This solution will be called ammoniacal water. 7. A weak solution of caustic potash, containing 4 or 5 thousandths of the saturated solution. which will be called alkaline water. 8. A solution composed of water 4 parts, saturated solution of potash 2 parts, alcohol 1 part, all in volume. This solution will be called alcoholized potash. 9. Acidulated water, composed of water 100 parts, and nitric acid 2 parts, in volume. Besides, it is necessary to have three capsulæ or dishes, made of porcelain, large enough to contain the plate, and covered with an air-tight piece of ground plate-glass, and two or three more capsulæ, which do not require to be covered; two or three glass funnels, to wash the plate; and two or three glass holders, in the shape of a spoon or shovel, by which the plate is supported when put in and taken out of the solution, without touching it with the fingers.

The Daguerreotype plate is submitted to the engraving process, after having been washed in the hyposulphite of soda, and afterwards in distilled water.

*First process for biting in or engraving the plate.* The following solutions must be put in the capsulæ, in sufficient quantity, so as to entirely cover the plate:—1. Acidulated water. 2. Alkaline water. 3. Alcholized potash, in covered capsulæ. 4. Caustic potash, in covered capsulæ. 5. Distilled water.

The plate being put upon the glass holder or spoon, is plunged in the acidulated water, and agitated during a few seconds, then put into a glass funnel, and washed with distilled water. It is taken again with the glass spoon, and plunged in the capsula containing alcoholised potash. This capsula is covered with its glass cover, and then heated, by means of a spirit-lamp, to about 144° Fahrenheit. The plate must remain in the capsula half an hour, during which the solution is heated now and then, and agitated. During that time the following acid solution, which will be called *normal acid*, must be prepared; it is composed as follows:—Water 600 parts, nitric acid 45 parts, solution of nitrite of potassa 12 parts, solution of common salt 45 parts. These proportions are in volume. The normal acid must be poured in a capsula, covered with its glass cover, and a sufficient quantity must be kept in the bottle.

When the plate has been immersed in the alcoholized potash during half an hour, it is taken out of the solution by means of the glass holder, and immediately plunged in the alkaline water, and agitated pretty strongly; from thence it is put in distilled water. (A)

This being done, the plate is plunged in the acidulated water, and moved about therein for a few seconds: it is then put into the normal acid. When the plate has been immersed a few seconds in the acid, it is taken out by means of the glass holder, taking care to keep it as much as possible covered with the solution, and it is immediately placed horizontally upon a stand, and as much acid as the plate can hold, is poured upon it from the bottle; it is then heated with a spirit-lamp, but without attaining the boiling point. During this operation it is better to stir or move about the acid on the plate by pumping it, and ejecting it again, by means of a pipette or glass syringe; after two or three minutes the acid is thrown away, the plate is put in the glass funnel, and there well washed with water, and afterwards with distilled water. (B)

Then, without letting the plate dry, it is put upon the fingers of the left-hand, and with the right-hand some ammoniacal chloride of silver, which is moved about the surface by balancing the hand, is poured upon it; the solution is renewed until the chloride, formed by the action of the acid, is dissolved; the plate is then washed by pouring upon it a large quantity of ammoniacal water, and afterwards some distilled water. (C)

Without allowing the plate to dry, it is then put in the caustic potash, and the capsula being placed upon the stand, the potash is heated up to the boiling point; it is then left to cool (D); and beginning again the operations described from A, to D, a second biting is obtained; and by repeating again the operations described in A, and B, a third biting is produced. The plate is then dried; in this state the black parts of the plate are filled with chloride of silver.

The plate is then polished until the white parts are perfectly pure and bright. This polishing is done with cotton and "ponce" (pumice stone); afterwards, the chloride of silver, filling the black parts, is cleansed by the means described in B, and C. The plate is then dried, but before drying, it is well to rub the plate slightly with the finger, in order to take off from the black parts any remains of an insoluble body, which generally remains on it. The preparatory engraving is then finished, and the plate has the appearance of a very delicate aquatint engraved plate, not very deeply bitten in.

Nevertheless, if the operation has been well managed, and has been successful, it is deep enough to allow the printing of a considerable number of copies.

*Note.*—Sometimes, instead of treating the plate with the boiling potash in the capsula, a similar result may be obtained by placing the plate upon the stand, covering it with the solution, and heating it by means of a spirit lamp, until, by evaporation, the potash becomes in a state of ignited fusion. By this means the grain is finer, but the white parts are more liable to be attacked.

(*To be continued.*)

## VARIETIES.

*Artificial Cold.*—A very intense degree of cold may be produced by mixing together equal parts of muriate of ammonia and saltpetre, both finely powdered, in about six parts of water, even in the hottest day; this is the method generally preferred to cool wine, and may be economically employed in many chemical experiments to produce artificial cold; the theory of this process is, that a solid, in assuming a liquid state, abstracts a large portion of the caloric from the fluid in which it is immersed. —*Cox's Chemical Delectus.*

*Marine Population.*—The ocean teems with life—the class of polyps alone are conjectured by Lamarck to be as strong in individuals as insects. Every tropical reef is described as bristling with corals, budding with sponges, and swarming with crustacea, echini, and testacea, while almost every tide-washed rock is carpeted with fuci and studded corallines, actiniæ, and mollusca. There are innumerable forms in the seas of the warmer zones, which have scarcely begun to attract the attention of the naturalists; and there are parasitic animals without number, three or four of which are sometimes appropriated to one genus, as to the Balæna, for example. Even though we concede, therefore, that the geographical range of marine species is more extensive in general than that of the terrestrial (the temperature of the sea being more uniform, and the land impeding less the migrations of the oceanic than the ocean those of the terrestrial) yet we think it most probable that the aquatic species far exceed in number the inhabitants of the land. Without insisting on this point, we may safely assume, as we before stated, that, exclusive of microscopic beings, there are between one and two millions of species now inhabiting the terraqueous globe; so that if only one of these were to become extinct annually, and one were to be every year called into being, more than a million of years would be required to bring about a complete revolution in organic life.

*Fig. 1.*

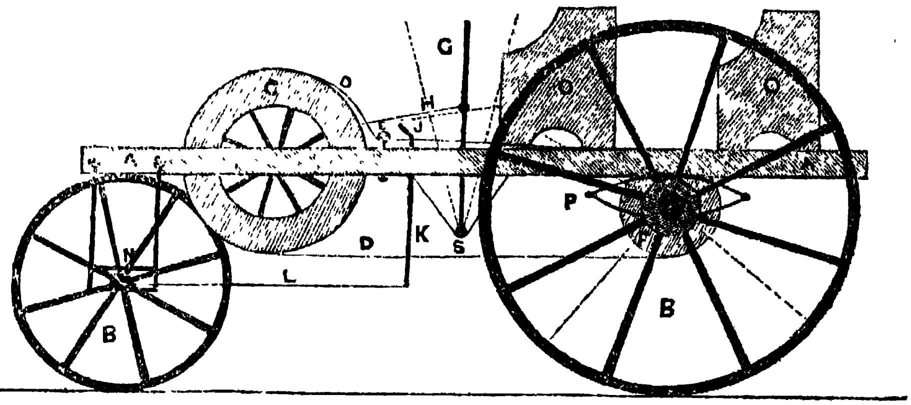
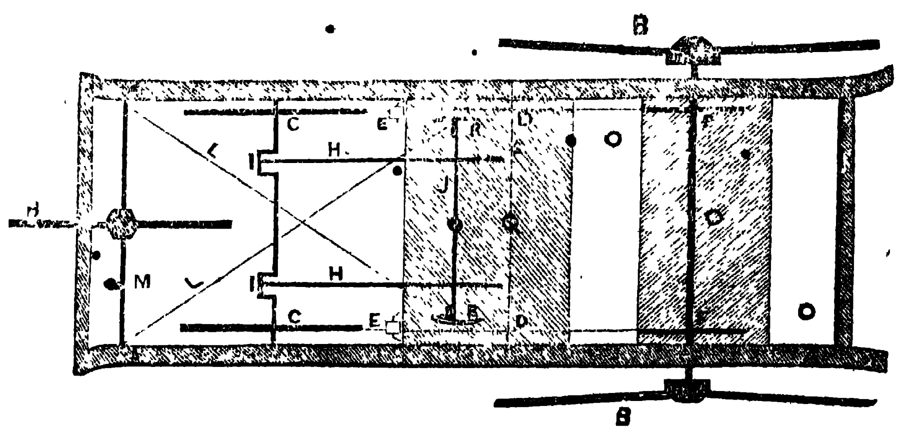



*Fig. 2.*




MANUMOTIVE CARRIAGE.

*To the Editor of the Magazine of Science.*

SIR,

I send you a plan of a Manumotive Carriage, to be inserted in your valuable Journal. The letters in both figures are the same. AAAA, a light frame work mounted on three wheels; BBB, the guide-wheel, being four feet diameter, and the two large wheels six feet diameter, on the axle of which are two grooved wheels, FF, one foot diameter. CC are two grooved fly-wheels, three feet diameter, round each of which passes a band, DD; and round the grooved wheels, FF. EE, two wheels through which the band passes in order that it may be tightened by a nut underneath. G is a lever (of which there are two, but only one shown in the Fig.) by which motion is given through the bars, HH, to the fly-wheels by cranks, II. J, is an iron bar upon a swivel, having an arm, K, at each end projecting downwards, at the ends of which arms a cat-gut, LL, passes to the opposite ends of the axle of the guide-wheel, which will turn either way by pressure of the foot at either end of the bar. M, the axle of the guide-wheel which ranges in a groove, N. OO, are the seats. P, the spring. QQ, gratings for the convenience of those riding. RR, grooves through the grating for the arms K, to work. S, a bar for the ends of the levers G, to work, shown in Fig. 2 by dotted lines. I have purposely omitted the steps in order to prevent confusion.

The power that will be spent to move this machine will, I think, be recompensed by the speed at which it will travel, the fly-wheel being three feet diameter, and the grooved wheel fixed on the axle of the six-feet wheel being only one foot diameter, the six-feet wheel will of course turn three times to every turn of the fly-wheel, which, supposing it could be turned eighteen times in a minute, would travel at the rate of a mile in five minutes; but I think it might go faster according to the strength of the driver.

I remain, Sir,
Your obedient Servant,
THOMAS FORD.

Lincoln's Inn Fields.

## AERATED SEA WATER.

LONG since the inhabitants of the sea-coast have employed salt water either as a purgative or as a laxative. Several physicians, and especially Russell, have written on the advantages which might be derived from its internal use. But the experiments have been few in number, and entirely limited to localities situated near the coast, because the sea water could not be preserved and transported without undergoing alteration. M. Pasquier has, by overcoming this difficulty, rendered great service to therapeutics. Being moreover convinced that the disagreeable taste of the sea water was the principal cause which prevented its general use, he has endeavoured to disguise and destroy it, without in the least altering its chemical composition. For that purpose he takes his sea water from a certain depth, and at several miles distant from the coast; he then filters it, in order to remove all the animal and vegetable substances which it holds in suspension, and which are the cause of its rapid decomposition; and lastly he charges it with carbonic acid gas, in order to destroy the disagreeable taste. One hundred bottles thus prepared by M. Pasquier were placed at the disposal of the Commission; they had been kept from four to six months, and we found that they had undergone no change whatever. Being requested to verify the exactitude of the facts stated by M. Pasquier, I have employed sea water prepared by him in the Hospital de la Charite, and I have been able to confirm—first, that it is a powerful laxative: that a bottle of sea water acts more strongly than a 32-grm bottle of seidlitz water; second, that the patients took it without repugnance, and found it agreeable to taste; third, that no accidents, no inconveniences, have resulted from its employment. We consequently believe that the purified and aerated sea water prepared by M. Pasquier may be employed with advantage in all cases where saline laxatives are recommended. We have moreover observed that it has a special and favourable action on individuals affected with scrofulous diseases.—*Chemical Gazette.*

## COMPOSITION FOR MOULDINGS.

Benedict Albano, Piccadilly, London, civil engineer, has patented the following improvements in materials, and applying them to the manufacture of ornamental mouldings:—The mode by which the patentee prepares fibrous substances for the purposes of mouldings consists in first forming the cotton or hemp into sheets in the ordinary manner and of the required thickness. The sheet is then sprinkled with boiling water as it passes on to two wooden rollers covered with cloth, which express the water and compress the fibrous substance, which is subsequently dried and immersed in a compound of resin, oil, and tar, prepared as follows:—In the first place, 70 parts of coal-gas tar, 20 of resin, and 15 of oxide of manganese, is also prepared in the same way, and of the two preparations a compound is made, by melting them together by hot-water pipes, or other means. The sheet of fibrous substance, after being dipped in this, is again pressed in rollers and dried, and is subsequently dipped in a preparation of linseed oil and yellow ochre, and in that state it is fit for moulding, which is done by forcing it into dies with punches of soft metal previously cast in the die. The ornaments thus moulded undergo several processes of varnishing before they are completed.

## ON THE SUBSTITUTION OF STARCH-SUGAR FOR HONEY.

*By M. Lassaigne.*

IN the wholesale grocery trade we had some time since an opportunity of satisfying ourselves that a delivery of thirty-five kilogrammes of starch-sugar solidified into a granulated mass, had been made as British honey of an inferior quality. This gross substitution having been discovered in time, was put a stop to by communicating the circumstance to the contractor, who had received this article under the false name of *common honey.*

This species of adulteration to which we now call the attention of pharmaciens and traders, well deserves being taken into consideration, for it should be considered not as a mere mistake, but a shameless act to be condemned by every honest man. In 1842, one of our colleagues in the Pharmaceutical Society of Paris, M. Menier, showed that this same starch-sugar was employed for the preparation of a spurious manna, having some physical resemblance to the fragments of genuine manna in tears.

The case we are now publishing shows, that the drug trade is likely to be infected by a number of articles, which frequently bear no relation whatever to the substances for which they are made to pass, except in the name which the avarice of individuals has audaciously imposed on them.

The article which forms the subject of this notice, was contained in a small cask, about the size of those in which the honey of Britain is every day exported, with the exception of its being paler, it had the consistence of common honey solidified, as also its granular and crystalline appearance. The odour of it was not that of honey, but that of *syrup too much boiled* and a little caramalized; its taste at first, slightly saccharine, became ultimately a little sour and bitter. To these physical characters, very different from those of common honey of inferior quality, there was joined one that was more particularly remarkable; viz., the tendency of this article to become more and more concrete, and to harden on being exposed to dry air, at a temperature of 51° Fahr., whilst pure honey retains its consistence as every one knows, and becomes even more fluid, according as the temperature is raised.

Diluted in from two to three times its volume in water, it yielded a granular substance, which, when pressed between several folds of blotting-paper, in order to free it from the coloured liquid, assumed the appearance of a whitish mass, consisting of small crystalline grains. These crystals, being well dried, were very like the starch-sugar found at present in commerce, by reason of their fresh and slightly saccharine taste, and in corroboration of our assertion is this, viz., that the solution of these crystals in distilled water evidently contained sulphate of lime, as was shown by nitrate of baryta and oxalate of ammonia. These crystals, when compared with the crystallizable part of pure honey, presented an obvious physical difference.

The same quantity of these crystals, and of the crystallizable sugar of honey, was dissolved in the smallest quantity of water possible, and a drop of one of these two solutions was placed on one and the same glass plate. On exposure to the dry air, at a temperature of 68° Fahr., the sugar of honey soon began to crystallize in small white grains, formed of needles shooting out from the same central point, whilst the sugar of starch assumed the appearance of a viscid granular mass in the same space of time.

The viscid, brownish, yellow liquid in which the crystals were observed, which we separated by the cold paper, had an acrid and saccharine taste; on being examined with nitrate of baryta and oxalate of ammonia, it was immediately rendered turbid by the use of these two re-agents, and formed copious white precipitates. The presence of a greater quantity of sulphate of lime in this saccharine coloured liquor (a salt not formed, or scarcely found, in the presence of honey), proves that it is a product of art, and not of bees, as is clearly proved by the physical characters above assigned to this product, manufactured at the present day, in a very large quantity for different uses.—*Journal de Chemie Medicale.*

## AMERICAN NEEDLES.

A correspondent of the Rochester Democrat, says a factory to make needles has been established at Haverstraw, Rockland County, New York. He thus describes it:—"I saw needles in various stages of the process by which they are made from the wire, prepared on the same premises, and was surprised at the facility afforded by the curious machinery which human ingenuity has invented to lessen the manual labour, and multiply the results of the numerous operations. The wire is at first cut into lengths which will make two needles each. The depressions where the eyes are to be made, and where the grooves are to be found on the finished articles, are stamped in both needles by a single stroke of the machine, with which a single hand can turn off thirty thousand in a day. It is then turned over to another boy, who with a machine punches the eyes, and another separates the two needles and smoothes away any irregularities. The eye of the needle is then bored by another process, which renders it so smooth that it will not cut the thread. After this, a man grinds a handful at a time on a common grindstone, holding them in his left hand, and giving them perpetual rotatory motion with the riget, so that they are made round and sharp. They are now to be case-hardened, and finally burnished, all of which is done by simple processes, in which immense numbers can be subjected to the operation at the same time."

*To the Editor of the Magazine of Science.*

SIR,

YESTERDAY morning, about half-past ten o'clock, my attention was called to a streak of light extending across a large meadow, and exhibiting faintly the prismatic colours.

On entering the meadow I observed two such streaks, forming with each other an angle of about 60 degrees, and immediately under me there appeared a beautiful bow, like an inverted rainbow, with the prismatic colours brilliant and well-defined, and apparently connecting the two streaks.

I remarked that the field was entirely covered with spider's web, on which was a heavy dew. I noticed the same appearances this morning.

As this phenomenon is not, I believe, of frequent occurrence, or at least is but seldom witnessed, I send this account for insertion in your interesting Magazine, if you should consider it of sufficient importance to be made generally known.

I am, Sir, yours respectfully,

W. B. P.

Langport, Somerset, 23rd October, 1844.

## ENGRAVING DAGUERREOTYPE PLATES.

(*Continued from page* 248.)

*Last operation of biting in.*—This operation requires some of the re-agents before named, and also,

1. A siccative ink, made of linseed oil, rendered very siccative by boiling it sufficiently with litharge; it may be thickened with calcined lamp-black.

2. An electrotype apparatus, and some solutions fit to gild, and copper the plate.

*Means of operating.*—The plate must be inked as copper-plate printers do, taking care to clean off the white parts more perfectly than usual; the plate is then to be placed in a room sufficiently warm, until the ink is well dried, which requires more or less time, according to the nature of the oil employed. The drying of the oil may be hastened by heating the plate upon the stand with the lamp, but the slow process is more perfect and certain.

When the ink is well dried, the white parts are cleaned again, by polishing the plate with cotton and pounce, or any other polishing powder: a ball of cotton, or any other matter, covered with a thin piece of caoutchouc or skin, can be used for this purpose. When polished, the plate is ready to receive the electro-chemical coating of gold, which will protect the white parts.

*Gilding.*—The gilding is obtained by any of the various processes of electrotyping which are known. The only indispensable condition is, that the surface obtained by the precipitation must not be liable to be attacked by any weak acid; a solution answering this purpose is made of ten parts (by weight) of ferrocyanide of potassium, one part of chloride of gold, and 1000 parts of water, used with a galvanic battery. During the gilding the plate must be turned in several positions, in order to regulate the metallic deposit. In some cases the gilding may be made more perfect, if the plate is covered with a thin coating of mercury before being put in the gilding solution.

When the plate is gilded, it must be treated with the boiling caustic potash, by the process already indicated for the preparatory engraving, in order to cleanse it from all the dried oil or ink, which fills the hollows. The plate is then washed and dried, and when the oil employed has been thickened with the lamp-black, the surface of the plate is rubbed with crumb of bread, in order to cleanse and take off the black remaining; then, the white parts being covered and protected by a varnish not liable to be attacked, and the black parts being uncovered and clean, the plate can be bitten in by aqua-fortis, according to the ordinary process used by engravers.

This operation must be done upon the stand, and not by immersing the plate in the solution.

Before this last biting-in, if the preparatory engraving has not succeeded well, and the plate still wants a sufficient grain, it can be given by the various processes of aquatint engraving.

Before submitting the plate to the operation of printing, in order to insure an unlimited number of copies, it is necessary, as before stated, to protect it by a slight coating of copper, which is obtained by the electrotype process; otherwise the printing would soon wear the plate. This coating must be kept very thin, lest the fineness of the engraving, and the polish of the white parts, should be destroyed. In this state the plate can be delivered to the printer.

After a certain number of impressions have been obtained, it will be perceived that the coating of copper is worn in some places: then, this coating must be removed, and a fresh one applied in its place. For this purpose, the plate must be purified and cleansed by warm potash, and plunged in a weak acid, composed as follows:—Water, 600 parts; nitric acid, 50 parts; nitrous acid of engravers, 5 parts; all in volume. This acid will dissolve the coating of copper, and the plate being coppered again, by the same means as before, may be again submitted to the operation of printing; and as nothing can prevent the success of a repetition of the same operation, any number of impressions may be obtained. The coating of copper can also be removed by caustic ammonia.

The Daguerreotype plate engraved by this process, which constitute the present invention, consist,—

First,—in the discovery and employment of certain properties of a mixture composed of nitric acid, nitrous acid, and hydrochloric acid, in determined or fixed proportions. The two last-mentioned acids may be employed either in a free state, or combined with alkaline or other basis. This mixed acid has the property of biting the pure silver, which forms the black parts of the Daguerreotype picture, without attacking the white parts formed by the amalgam of mercury. The result of the action of the biting, is to form on the black parts of the picture an insoluble chloride of silver; and this chloride of silver, which, when formed, stops the action of the acid, is dissolved by ammonia, which allows the biting to continue.

Secondly,—in the discovery of certain properties of a warm solution of caustic potash, and in the employment of the said solution, by which the mercury forming the picture is better and deeper amalgamated with the silver under it, so that many imperceptible points of the amalgam are effected in such a manner that the acid has no action upon them.

Thirdly,—in the discovery and employment of a process which produces a grain favourable to the engraving, by which the biting on the plate is rendered deeper. This is effected by filling the parts engraved with a siccative ink, or any other substance, and then gilding the plate, by the electrotype process: the gold is not deposited on the parts protected by the ink. When the plate is gilded, the ink is cleansed by the caustic potash, and the plate may be submitted to the effects of an acid, which does not attack the coating of gold, but bites only on the silver in the parts already engraved by the first operation.

Fourthly,—in the employment of a process by which the plate is protected from the wear of the printing operation. This is effected by covering the plate, before printing, with a slight coating of copper, by the electrotype process, and when the coating begins to wear by printing, it is removed by a weak acid, or by ammonia, which dissolves the copper without affecting the silver under it. The plate is coppered again, and after another printing, the same operation is repeated, so that a considerable number of copies may be printed without much injury to the engraving.

---

## THE BARN OWL.

If this useful bird caught its food by day, instead of hunting for it by night, mankind would have ocular demonstration of its utility in thinning the country of mice; and it would be protected, and encouraged everywhere. It would be with us what the ibis was with the Egyptians. When it has young, it will bring a mouse to the nest about every twelve or fifteen minutes. But, in order to have a proper idea of the enormous quantity of mice which this bird destroys, we must examine the pellets which it ejects from its stomach in the place of its retreat. Every pellet contains from four to seven skeletons of mice. In sixteen months from the time that the apartment of the owl on the old gateway was cleaned out, there has been a deposit of above a bushel of pellets.

The barn owl sometimes carries off rats. One evening I was sitting under a shed, and killed a very large rat, as it was coming out of a hole, about ten yards from where I was watching it. I did not go to take it up, hoping to get another shot. As it lay there, a barn owl pounced upon it, and flew away with it.

This bird has been known to catch fish. Some years ago, on a fine evening, in the month of July, long before it was dark, as I was standing on the middle of the bridge, and minuting the owl by my watch, as she brought mice into her nest, all on a sudden she dropped perpendicularly into the water. Thinking that she had fallen down in epilepsy, my first thoughts were to go and fetch the boat; but before I had well got to the end of the bridge, I saw the owl rise out of the water with a fish in her claws, and take it to the nest. This fact is mentioned by the late much revered and lamented Mr. Atkinson of Leeds, in his *Compendium*, in a note, under the signature of W., a friend of his, to whom I had communicated it a few days after I had witnessed it.

I cannot make up my mind to pay any attention to the description of the amours of the owl by a modern writer; at least the barn owl plays off no buffooneries here, such as those which he describes.

When farmers complain, that the barn owl destroys the eggs of their pigeons, they lay the saddle on the wrong horse. They ought to put it on the rat. Formerly I could get very few young pigeons till the rats were excluded effectually from the dovecot. Since that took place, it has produced a great abundance every year, though the barn owls frequent it, and are encouraged all around it. The barn owl merely resorts to it for repose and concealment. If it were really an enemy to the dovecot, we should see the pigeons in commotion as soon as it begins its evening flight! but the pigeons heed it not: whereas, if the sparrow-hawk or hobby should make its appearance, the whole community would be up at once; proof sufficient that the barn owl is not looked upon as a bad, or even a suspicious, character by the inhabitants of the dovecot.

Till lately, a great and well-known distinction has always been made betwixt the screeching and the hooting of owls. The tawny owl is the only owl which hoots; and when I am in the woods after poachers, about an hour before daybreak, I hear with extreme delight its loud, clear, and sonorous notes, resounding far and near through hill and dale. Very different from these notes is the screech of the barn owl. But Sir William Jardine informs us, that the owl hoots; and that he has shot it in the act of hooting. This is stiff authority; and I believe it because it comes from the pen of Sir William Jardine. Still, however, methinks that it ought to be taken in a somewhat diluted state; we know full well that most extraordinary examples of splendid talent do, from time to time, make their appearance on the world's wide stage.

The barn owl may be heard shrieking here perpetually on the portico, and in the large sycamore trees near the house. It shrieks equally when the moon shines, and when the night is rough and cloudy; and he who takes an interest in it may here see the barn owl the night through when there is a moon; and he may hear it shriek when perching on the trees, or when it is on wing. He may see it and hear it shriek when perching on the trees, or when it is on wing. He may see it and hear it shriek, within a few yards of him, long before dark; and again, often after daybreak, before it takes its final departure to its wonted resting-place.

I am amply repaid for the pains I have taken to protect and encourage the barn owl; it pays me a hundred-fold by the enormous quantity of mice which it destroys throughout the year. The servants now no longer wish to prosecute it. Often, on a fine summer's evening, with delight I see the villagers loitering under the sycamore trees longer than they would otherwise do, to have a peep at the barn owl, as it leaves the ivy-mantled tower: fortunate for it, if, in lieu of exposing itself to danger, by mixing with the world at large, it only knew the advantage of passing its nights at home.--*Waterton*

## ON THE SOLUBILITY OF LEAD IN WATER.

*By Mr. J. C. Calvert.*

At a recent meeting of the Pharmaceutical Society, Mr. J. C. Calvert laid before the meeting the result of some experiments which he has made with reference to this subject.

If some portions of sheet-lead free from oxide be put into two stoppered bottles, one of which contains recently distilled water, and the other common water, the water of the Seine for example, the lead of the first bottle soon becomes tarnished and covered with a white layer, consisting probably of carbonate of lead, whilst the metal in the second bottle will not undergo the action of the water, and of the solid and gaseous substances contained in it, till after a much longer lapse of time. Besides, the distilled water will assume a milky appearance in a few minutes, and will contain a considerable portion of lead after some hours, whilst ordinary water will remain perfectly limpid, and will present a colour scarcely perceptible on the addition of hydrosulphuric acid after the same number of hours, from three to twelve for instance.

The above facts will become still more interesting when we shall become capable of ascertaining the entire influence which salts dissolved in water may exercise in the non-alteration of lead by water. The action of the salts is so great, that Seine water and well-water never contain so many soluble and insoluble compounds of lead as distilled water. Having placed, about a year ago, some well-scoured portions of lead in some stoppered bottles, and having filled these bottles with recently distilled water, with aerated distilled water, with Seine water, and lastly with waters from several wells and springs in Paris, they presented the following results;—A few days ago, after employing sulphuretted hydrogen, distilled water and aerated distilled water presented an intensely black colour of sulphuret of lead, whilst the Seine and the spring waters presented but a very light tint.

The distilled water which I employed was quite free from hydrochloric acid; it was obtained from an alembic which continues in action for sixteen hours without its being necessary to renew the water, and it is well known that the hydrochloric acid is not formed till the termination of the operation, when the chloride of magnesium, becoming deposited on the sides of the still, is decomposed into magnesia and hydrochloric acid. That common water should retain less of the lead salts is not surprising, because it may be admitted, that containing soluble sulphates, carbonates, and chlorides, insoluble salts of lead are produced, to which some sulphur might be united, which may have been formed by the action of the organic matters on the sulphates, and the insoluble salts so deposited on the surface of the metal, might prevent the ulterior action of the liquid on it.

I also remarked a considerable difference in the quantity of sulphuret of lead formed in river-water and spring-water, when tested with sulphuretted hydrogen. This induces me to think that the nature and quantity of the salts contained in the waters exert considerable influence on the proportion of lead which the waters are capable of dissolving. After the above observations, I am satisfied that the action of water on lead depends principally on the quantity of salts which it contains, Likewise, there must exist a ratio between the quantities of salt and of water, in order that the action of the latter may be at the minimum, so that there is a limit where the water containing determinate proportions of salt of the same nature, or of different composition, must exert, its minimum effect; thus these limits and relations being once passed, or fallen short of, the action of the water increases, and is capable of becoming charged in greater quantity with soluble compounds of lead.

I also remarked, that the portions of lead which had been in contact during a year with distilled water, were covered with a white crust, whilst the lead acted on by drinkable waters presented a black surface.

## RESULTS OF MACHINERY.

It is just possible that you will say. It matters not to us, the working men of England, whether the people of India sell us raw cotton or piece goods; or whether the trade in cotton amounts to one million a-year or thirty-six millions. You may want to know how you individually, whether labourers or mechanics, are benefitted by those changes, which look so large in figures. We will endeavour to tell you how you are benefitted.

Of the cotton cloth made in England, three hundred and sixty million yards are exported, and three hundred and ninety-nine million yards are retained for home consumption. This was the state of trade upon an average for years from 1824 to 1828. You are, doubtless, benefitted very greatly, though indirectly, by the cotton cloth and the cotton yarn which go out of the country. The difference in the value between the raw cotton and the cotton yarn or cloth, is the price of your own industry, and of the profits of capital which sets your industry in motion. At that price you buy foreign produce, by which purchase you bring many articles of necessity and luxury within your reach. But this, you say, is a doubtful good. The good is doubtful; but the objects which produce the good are spread over a large surface. We shall confine your attention therefore to one object.

Near twenty years after Arkwright had begun to spin by machinery, the price of a particular sort of cotton yarn much used in the manufacture of calico was thirty-eight shillings a pound. That same yarn is now sold for between three and four shillings, or one-twelfth of its price forty years ago. If cotton goods were worn only by the few rich, as they were worn in ancient times, and even in the latter half of the last century, that difference of price would not be a great object; but the price is a very important object when every man, woman, and child in the United Kingdom has to pay it. The four hundred million yards of cloth which are annually retained for home consumption, distributed amongst twenty-five millions of population, allow sixteen yards every year for each individual, We will suppose that no individual would buy these sixteen yards of cloth unless he or she wanted them; that this plenty of cloth is a desirable thing; that it is conducive to warmth and cleanliness, and therefore to health; that it would be a great privation to go without the cloth. At sixpence a yard, the four hundred million yards of cloth amount to ten million pounds sterling. At half-a-crown a yard, which we will take as an average price about five and twenty years ago, they would amount to fifty millions of pounds sterling—an amount equal to all the taxes annually paid in Great Britain and Ireland. At twelve times the present price, or six shillings a yard, which proportion we get by knowing the price of yarn forty years ago and the present day, the cost of four hundred millions of pounds sterling. It is perfectly clear that no such sum of money could be paid for cotton goods, and that, in fact, instead of ten millions being spent in this article of clothing by persons of all classes, in consequence of the cheapness of the commodity, we should go back to the very nearly the same consumption that existed before Arkwright's invention, that is, of the year 1753, when the whole amount of the cotton manufacture of the kingdom did not exceed the annual value of two hundred pounds. At that rate of value, the quantity of cloth manufactured could not have been equal to one-five-hundredth part of that which is now manufactured for home consumption. So that thirty-one people each now consume sixteen yards of cotton cloth where one person eight years ago consumed one yard. We ask you, therefore, if this last difference in the comforts of every family by the ability which they now possess of easily acquiring warm and healthful clothing, is not a clear gain to all society, and to every one of you as a portion of society? It is more especially a gain to the females and children of your families, whose condition is always degraded when clothing is scanty. The power of procuring cheap clothing for themselves, and for their children, has a tendency to raise the condition of females more than any other addition to their stock of comfort. It cultivates habits of cleanliness and decency; and those are little acquainted with the human character who can doubt whether cleanliness and decency are not only great aids to virtue, but virtues themselves. John Wesley said that cleanliness was next to godliness. There is little self-respect amidst dirt and rags, and without self-respect there can be no foundation for those qualities which most contribute to the good of society. The power of procuring useful clothing at a cheap price has raised the condition of women amongst us, and the influence of the condition of women upon the welfare of a community can never be too highly estimated. That the manufacture of cotton by machinery has produced one of the great results for which machinery is to be desired, namely cheapness in production, cannot, we think, be doubted. If increased employment of human labour has gone along with that cheapness of production, even the most prejudiced can have no doubt of the advantages of this machinery to all classes of the community.—*Working Man's Companion.*

## IRON TUBES.

Mr. J. Roose, of Staffordshire, has recently obtained a patent for an invention which relates to improvements in welding the points or seams of wrought iron tubes, when made by external pressure, by passing the iron, in a state fit for welding, between dies or through holes.

The improvement consists in employing internal support, in such a manner that the mandril (which gives the internal support) is fixed or stationary, during the operation of welding the tube; an "internal slit sliding tube," and a fixed outer or outward tube, or pulleys and guides. being placed on the outside of the stem of the mandril, for the purpose of stiffening it, and for giving the internal support; by which means the requisite pressure is obtained. When the tube has passed the bulb, and is on the stem of the mandril, and the weld is completed, the mandril used for giving internal support, owing to its being of smaller diameter, when compared with the internal diameter of the finished tube, may readily be withdrawn.

The manner in which this invention may be most readily carried into effect, is described as follows:—First, take a strip of iron, of the required length breadth, and thickness, depending on the diameter and length of tube required, and proceed to turn, draw, or convert it into a skelp, or form of tube. If for a lap-joint tube, the strip is bent into a cylindrical shape, by bringing the edges together, or nearly so; the one edge lapping a little over the other edge, as is commonly practised in making welded lap-joint iron tubes. When the tubes are thus far prepared, they are placed in a furnace, so as to bring the two edges to a good welding heat, and when in this state, the tubes, having a mandril between each of them, are to be drawn through the dies. At the mouth of the furnace is placed the end of a drawbench, and upon this bench, two steps; against these steps a die or dies, or a pair of groove-rolls of the required size for the tube about to be welded. A mandril is placed upon the draw-bench, with pulleys and guides placed upon the outside of the stem of the maddril. These pulleys have grooves in them, of the required diameter, and revolve by the passing of the tube, and are for the purpose of stiffening the stem of the mandril, so as to keep it from bending while the welding pressure is upon it. One end of the mandril is to be made secure at the back end of the draw-bench, and the other end is to be passed through the die or dies, or groove of the rolls; a ferrule or ring of iron or steel is to be placed in the end of the tube which first passes over the mandril, and is capable of sliding over the stem thereof. When these instruments are so prepared, and the skelp or tube is at a welding heat, the mandril is to be forced through the die or dies, and sufficiently inserted into the skelp or tube to allow of the end (which was previously made smaller) being passed through the die or dies, or groove of the rolls. The iron or steel ring, or ferrule is now to be pushed inside the end of the skelp; pliers should then take hold of that part of the skelp or tube in which the ferrule or ring is inserted; and the chain of the draw-bench, being attached to the pliers, should be immediately set in motion, when the hot skelp or tube will be drawn along and over the mandril, and through the die or dies, or through the groove or rolls. The compression on the outer surface of the edges or joint of the hot skelp or tube, and the resistance opposed by this way of using or stiffening the stem of the mandril within, will effect the welding of the joint or seam more firmly, and allow more or greater external pressure on the outer surface of the skelp or tube; this will cause a greater reduction of the substance or thickness of the iron, and lengthen the skelp or tube much more than is now done in the welding of wrought-iron tubes, which will be found most advantageous in such productions.

The iron preferred by the patentee for welding into tubes upon the principle of lap-joints, is from nine to fifteen wire gauge; depending upon the reduction of each heat and strength of tube wanted; but he does not confine himself to any particular thickness or form of iron. The pliers are the same as those now used in the welding of iron tubes, when drawn, with this difference, that at the top of the perpendicular pillars they turn in, or are bent in a direction pointing to each other, and form at their end part of a circle, so as to go between the pulleys, and grasp the pipe or tube. The mandril has a bulb at one end, which first enters the tube, and should be like a little taper. The back end of the bulb should be the size required for the diameter of the tube, when the final welding pressure would be from the die or dies, or from the groove in the rolls, which would leave the inside surface smooth. The patentee does not confine himself to any particular form of mandril; the die or dies are in the form of hand-tongs, having a bell or enlarged mouth; these tongs are very similar to those now used in the welding of wrought-iron tubes. The patentee does not confine himself to the form or shape of the die or dies, but prefers the pressing dies in the form of tongs, on account of the cheapness of their construction, and the facility they offer for being cleansed, by dipping them in water after each using, when the scale, if any adhere, may be readily removed: such construction of dies also allows the workman to change them from one side to another more readily, at the same time. In making a butt-joint, the two edges of the skelp should stand up a little, or in preparing the skelp, the edges standing up should touch each other (that part being partly of an oval form or shape), so that when the welding pressure is upon it, such would have the effect of pressing the joint together; the greater part of the pressure being on the joint or seam. The tube is again re-heated, and drawn through the die or dies, as may be required; the same end first entering the die or dies as before, which may be kept a little larger than the bulb of the mandril, on account of its allowing the mandril to be quickly inserted, and the pliers to grasp it without chilling the heat. The tube, after being passed through the die or dies sufficiently often, so as to finish and complete the welding, and making it equal in its thickness, is then placed on a shortening-plate, the ends cut off, and then finished. If the grooved rolls are used in the drawing of the tubes, when in the process of welding they should revolve by the draught of the tube passing, and not by machinery.

Another method of producing welded iron tubes according to this invention, is as follows:—A strip of iron is first converted into a skelp or form of tube, by any of the known methods, and placed in the furnace, as before. Near the mouth of the furnace is a pair of rolls, capable of being driven by machinery, having grooves of a required diameter and form. Between, or in each of the grooves of the rolls, is the bulb of a mandril, at the back end of which is a stop inserted in a slot in the mandril This stop is attached, and fastened in, or to, a trough, by which the mandril is suspended. On the outside of the mandril is a tube, having a slit nearly the whole of its length; the tube is much longer than the mandril, and the slit is for the purpose of allowing the tube to slide over the stop at the back end of the mandril. On the outside thereof, a fixed tube is placed, which is large enough in its diameter to admit the hot tube without being an obstruction; and when the tube has reached a good welding heat, it is forced under the grasp of the rolls, and the draught or friction of the rolls passes the tube through, immediately the slit sliding tube is drawn off, by machinery, or any other means that may be preferred. When the hot tube is sliding on the mandril, the cold slit tube is sliding off. This sliding tube passes inside the fixed tube, and is for the purpose of preventing the end or edge of the hot tube offering resistance against the fixed tube.

These two tubes, namely, the slit sliding tube, and the fixed outer tube, are for the purpose of giving support, and preventing the stem of the mandril from bending, so that it may retain its position while the welding pressure is upon it. After the hot tube has passed the bulb of the mandril, and the sliding tube has passed off, the back end of the stem of the mandril is heaved up and knocked with a hammer; the bulb is then taken hold of, and the hot tube drawn off. It is then placed in the furnace, and again passed under the pressure of the rolls, as often as found requisite. The patentee does not confine himself to the using of these tubes, as pullies may be applied in this case.

In conclusion, the patentee states, that, " What I claim as this part of my invention, is giving support to the stem of the mandril, in whatever way it may be applied, for the purpose of support or stiffening. I likewise claim the construction of the mandril with a slit in it, in which the stop is fixed in; and I claim the construction of the pliers used for grasping the tube between the pulleys, &c. And, after having so far described the nature of my invention, I wish it to be understood, that I do not confine myself to the various details shewn and described, provided the particular mode of applying internal support, when support is given to the stem of the mandril, combined with the welding of wrought-iron tubes, by external pressure, be retained, whereby a mandril with pulley, or pulleys and guides, or a slit sliding tube, and a fixed outer tube, is placed on the outside of the stem of the mandril, and is thereby caused to give any external support that may be wanted to the seam, or joint of the tube, when being welded by external pressure; and whereby the mandail is stationary, while in the operation of the tube being welded. very similar to that called, and well known by tube masters, as the suspended mandril, and be released after the weld is obtained; owing to the stem of the mandril being smaller in its diameter than the internal diameter of the tube, and the support of the mandril being no obstruction, as above described."—*Newton's Journal.*

## VARIETIES.

*Cement for Joining Stone.*—A cement which gradually indurates to a stony consistence may be made by mixing 20 parts of clean river sand, two of litharge, and one of quicklime, into a thin putty with linseed oil. The quicklime may be replaced with litharge. When this cement is applied to mend broken pieces of stone, as steps of stairs, it acquires after some time a stony hardness. A similar composition has been applied to coat over brick walls, under the name of mastic.—*Ure.*

*Preservation of Timber.*—There are yet some who keep their timber as moist as they can by submerging it in water, where they let it imbibe, to hinder the cleaving; and this is good in fir, both for the better stripping and seasoning; yea, not only in fur, but other timber. Lay, therefore, your boards a fortnight in the water (if running, the better, as at some mill-pond head); and there, setting them upright in the sun and wind, so as it may freely pass through them (especially during the heats of summer, which is the time of finishing buildings), turn them daily; and thus treated, even newly-sawn boards will floor far better than many years' dry seasoning, as they call it. But, to prevent all possible accidents, when you lay your floors, let the joints be shot, fitted and tacked down only for the first year, nailing them for good and all the next; and by this means they will lie staunch, close, and without shrinking in the least, as if they were all one piece. And upon this occasion I am to add an observation, which may prove of no small use to builders, that if one take up deal boards that may have lain in the floor a hundred years, and shoot them (plane their edges) again, they will certainly shrink (*toties quoties*) without the former method. Amongst wheelwrights the water seasoning is of especial regard, and in such esteem amongst some, that I am assured the Venetians, for their provisions in the arsenal, lay their oak some years in water before they employ it. Indeed, the Turks not only fell at all times of the year, without any regard to the season, but employ their timber green and unseasoned; so that they have excellent, it decays in a short time by this neglect.—*Evelyn.*

*How to make good Mortar.*—In forming mortar from the lime, it must, when slaked, be passed through a sieve leaving only a fine powder, an operation usually performed with a quarter inch wire screen set at a considerable inclination to the horizon, against which the lime is thrown with a shovel after shaking. That which passes through is fit for use; the core falling on that side of the screen against which the lime is thrown, being entirely rejected for the purpose in question, though it is an excellent material for filling in the sides of foundations under wood floors where they would otherwise be next the earth, and the like. The sifted or screened lime is next to be added to the sand, whose quantity will vary as the quality of the lime, of which we shall presently speak. In making mortar, there is no point so important as respects the manufacture itself, as the well tempering and beating up the lime with the sand after the water is added to them. In proportion, too, as this is effectually done, will a small proportion of lime suffice to make a good mortar. The best mode of tempering mortar is by means of a pug-mill with a horse-track similar to the clay-mills used for making bricks. But if such cannot be had, the mortar should be turned over repeatedly, and beaten with wooden beaters, until it be thoroughly mixed. That this process should be carefully performed will appear of the more importance when it is considered that it thereby admits a greater proportion of sand, which is not only a cheaper material, but the presence of it renders a less quantity of water necessary, and the mortar will consequently set sooner: the work, too, will settle less; for as lime will shrink in drying, while the sand mixed with it continues to occupy the same bulk, it follows that the thickness of the mortar beds will be less variable. It may be taken, indeed, as an axiom, that no more lime is necessary than will surround the particles of sand.—*Gwilt.*

*Nasmyth's Steam Hammer.*—One of these hammers, of a small size, has been recently set up at Messrs. Pain's factory, at Greenwich, and the contrivance seems likely to prove useful to the smith. By this hammer the force of the blow as well as its rapidity may be regulated with great nicety, and the face of the hammer comes down fair upon the piece of iron on the anvil, whatever be its size. The heaviest hammer of this kind will drive a nail into a piece of wood as gently as a common carpenter's hammer, while in an instant the power may be so increased as to overcome all opposition.

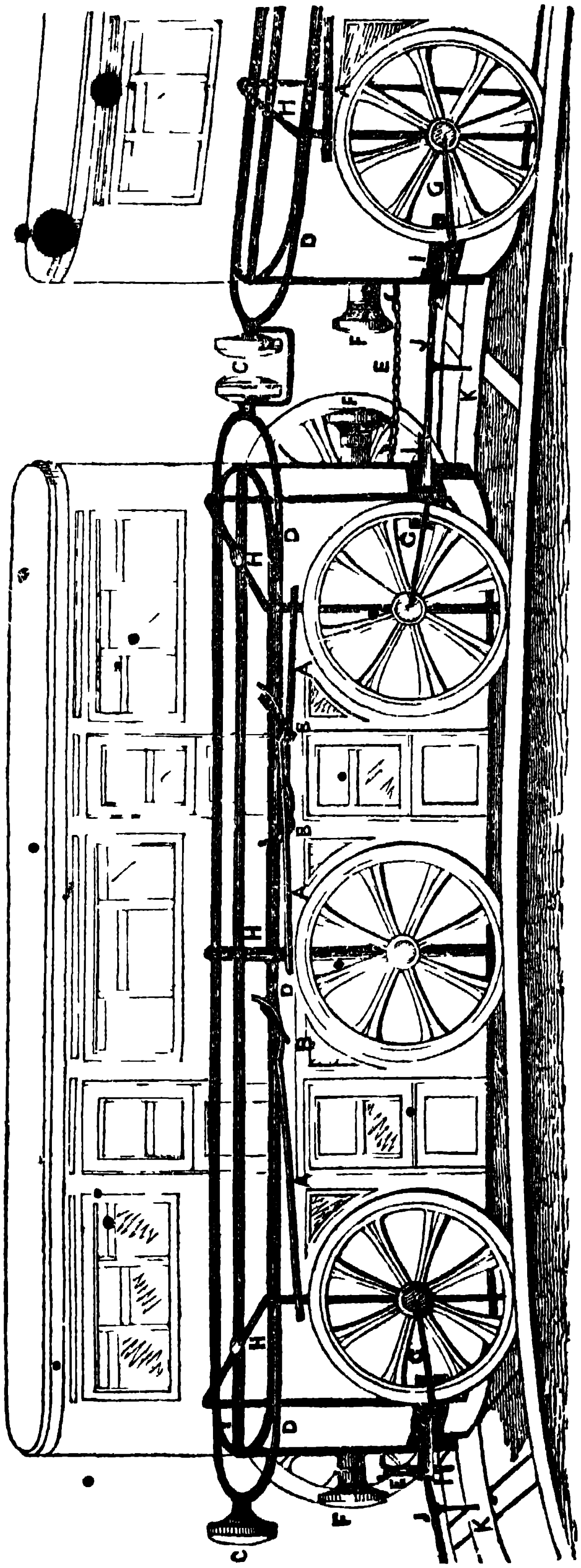


Fig 1.—Car [illegible] round a Curve.

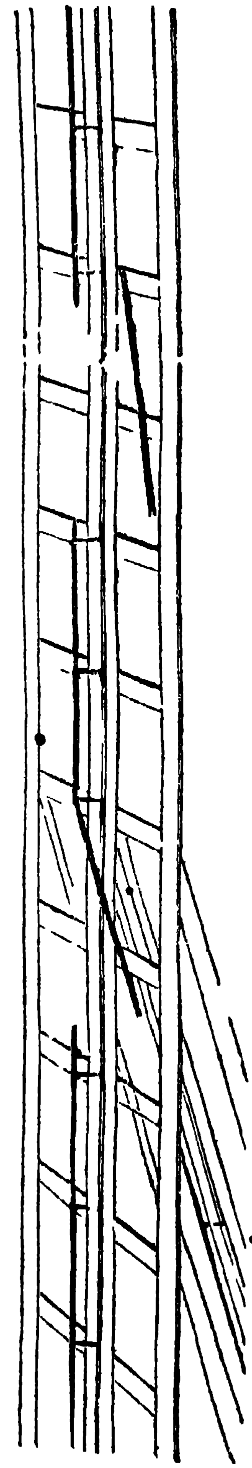


Fig 2.—Railway with Sidings.

PETIT'S ANTI-FRICTION RAILWAY.

## PETIT'S ANTI-FRICTION RAILWAY.

THAT lateral friction is the great bar to that safety, ease, and economy which railway travelling is so calculated to afford, no one, we imagine, is inclined to doubt; for it must be self-evident to any one who will allow himself time to consider this subject, that if two wheels are fixed on one axle, so that the axle must revolve with the wheels, and such axle is fixed to any unyielding frame, that the only natural course for such wheels to travel is a perfectly straight line, but the moment a curve presents itself, the cone or flange of the wheel, if travelling quickly, strikes the inner side of the rail, the effect of which is not merely a side rub, but the carriage is thereby driven across the rails, as far as the opposite flange will permit; hence arises that oscillation so unpleasant, and generally complained of in railway travelling; this is not the only evil produced by such mode of guidance, but is also one of the greatest impediments to the progress of a train; such violent concussions require that the whole machinery should be made much stronger than would otherwise be requisite to carry twice the weight, consequently, much unpaying weight is unnecessarily carried about. There is also great waste of power, the rails are forced out of their proper guage,—the axles and wheels are often broken, having not only to carry the weight, but to contend with that lateral strain common carriages are not subject to.

Mr. Petit has lately brought before the public a contrivance, which by the introduction of guide wheels and guide rails, is calculated to effect this desirable object, and bring railway carriages as near as possible under the same system of guidance as those on common roads.

Fig. 1, is a side view of a carriage attached to another supposed to be going round a curve. The axles, marked H, forming a square, encompassing the bodies of the carriages, thus forming part of the frame, the centre axle being fastened at all points to the frame; this axle may also pass through the body of the carriage, it would only form a division inside —the two end ones are allowed so swerve a little, being bolted through the middle only, they acting upon the scale beam principle, their sloping position will show what is intended; but it is not to be supposed that so great a slope would ever be required on a railway. It must be remembered at the same time that all the wheels revolve freely on their axles; and the swerving axles are placed as far from the ends of the carriage as may be practicable, say four or five feet; the guide arms G are fitted on to that part of the axles on which the carrying wheels revolve, and, stretching from thence, turn round the ends of the carriages, and being furnished with forked ends the guide wheels revolve in them; and supposing these wheels to be two feet diameter, one part may revolve under the end seat of the carriage, and so be little or nothing in the way; the guide arms may slope a little, according to the height of the guide rail, without reducing their leverage effect. Here it may be observed that the guide arms being placed as near as the rail will permit in a parallel line with the working axles, so that their five or six feet leverage effect must be great on the axles, and the lateral pressure on the guide wheels is reduced to its minimum, consequently the fear of breakage or obstruction to the progress of the train is quite out of the question, and the swerving axles are kept continually in the exact position of the road, being pinned as it were, to the guide rail; the guide wheels working close on each side of it, there cannot be any vibration.

In order to get a simple but clear idea of this contrivance, it is only needful to consider that the guide rail performs exactly one part a horse does when placed between the shafts of a waggon if he turn to the right or left—the shafts act as levers on the swerving axle of such waggon, and let the load be what it may, he has to exert but little power to turn it into its right course; just so it is with the guide rail being properly fixed, it will not give way, consequently the guide wheels must, and so communicate their lateral pressure to the guide arms, which act as horizontal levers on the swerving axles.

The frames of these carriages shown by straight lines, are formed of bar iron of an appropriate size, the bed and roof is placed and bolted edgeways; these carriages might bend with a violent blow, but would not be broken to splinters like the wooden ones. The beds of these carriages are brought down as close as practicable to the ground, and the wheels revolving outside like other carriages, by which means the weight of the body is carried below the centre of gravity.

Fig. 2, is the centre raised rail, with those on which the divided periphery of the driving wheel take; these may be wood, with or without iron bars, fastened edgeways to the sides; on the centre rail is shown two plans where a crossing may be indispensable; at one place part of the rail is removed, which should be replaced by the proper person as soon as a vehicle has passed; but should such wicked neglect ever happen, yet a train might pass on safely. The other part shows an opening similar to a gate or bar, which will answer the purpose of a switch; where a siding is required the small or slant lines will explain.

The following is one of the methods of stopping a train, or rather making it stop itself:—At letter A is represented a lever with an end turned up; B, an incline plane fixed to the slide rods D; the slide rods turn round the ends of the carriages, and pass down the other side to perform the same office there. C, represents the buffers fixed to the slide rods D, and connected with the corresponding one; on the following carriage, the connecting crank can easily be removed. E, the connecting chain; F, the protection buffers; G, the guide arms; H, the axles moving with the arms; I, the guide wheels also attached to the arms; J, the rail on which the guide wheels work; K, the rails on which the driving wheel of the engine takes.

*To be continued.*

## THE NEW METHOD OF EVAPORATION OF M. ADOR.

***Report by Messrs. Armengaud, Civil Engineers.***

HAVING been ordered by Messrs. Ador and Bidult to prove the results of which the new system for distilling fuel was capable, when applied to the evaporation of water, and which is the patented invention of M. Ador, we repaired to the foundry of Madame Jammetel, where the apparatus was fixed up, and which we were enabled to examine minutely. This apparatus of M. Ador is composed of a cilindrical boiler of copper, 3 feet 4½ inches diameter, and 6 feet 6 inches in length, and inclosed in a brick furnace, from the end of which it projects 16 inches, or thereabouts. Under this boiler, in front of the furnace, is a cast-iron retort of a form nearly elliptical, having an internal length of 5 feet 6 inches, and an extreme diameter of 21 inches, and a minimum of $10\frac{1}{2}$ inches. This retort is for the distillation of coal, and was heated by means of coke placed on a grating underneath. On the side, and in the same furnace, were two pneumatic heating tubes of 5 feet 6 inches in length, and of $9\frac{1}{2}$ inches internal diameter, constructed of cast-iron plates of about of a fifth of an inch in thickness, which are to receive the condensed air by two piston pumps, working rectilinear and alternating, each being of the following dimensions:—Internal diameter, $12\frac{3}{4}$ inches; the course, $9\frac{1}{4}$ inches. The diameter of the pipe which conducts the condensed air of the two pumps with the heating tubes was $1\frac{1}{2}$ inch in one part of its length, and an inch near the tubes. These tubes, as well as the retort, communicate with the interior of the boiler. The view, therefore, of this invention of M. Ador, is to effect the evaporation of water by the combustion of gases resulting from the distillation of coal, and brought in contact with a current of hot air, and then to utalise these gases and heated air as an additional motive power to that of the steam from the engendered water. The apparatus works in the following manner:—The retort is charged with coal, as is done in the ordinary gas machinery, to about three parts of its capacity. The boiler is filled with water to the ordinary level, according to the work which is to be performed, when the fire is placed on the grating, this heat is continued until the retort arrives at a temperature sufficiently red hot for inflaming the gas by a light, and its combustion by a current of air. At this moment pumping is commenced and the air sent into the tubes, in the interior of which it heats itself, so as, on going out, it inflames the gases in the interior of the boiler. The result of this combustion is, that the water is heated, and soon gets into an ebullition. Therefore, if we collect the steam which is discharged, as well as the gases and the heated air which combines with it, there is obtained a motive power so disposable as to be used like ordinary steam. We must remark here, that as in this operation the gases are entirely burnt, and the coke consumed in the grating, there ought to be no smoke from the chimney. and this was proved in the most decided manner. After having made ourselves perfectly acquainted with the interior of M. Ador's apparatus, and its operation, we proceeded to work in the following manner:—The apparatus having been worked overnight, we caused the retort to be perfectly emptied, as well as the grating underneath, when we placed in the retort about 132lb. of coal. We filled the boiler with a cubic metre (31 cubic feet), or 1000 litres (390 gallons), of water, and as the furnace was still hot, we observed that the temperature of this water was at the beginning of the operation 122° F.; we also weighed out 88lb. of coke, so as successively to charge the grating. After this, we caused the retort to be heated, and placed the fire on the grating at 5 min. before three o'clock. Up to half-past three, the fire remained very inactive; at 33 min. past four, the gas was inflamed, by opening the cock of a small escape tube placed in the interior of the furnace, and used for the purpose of knowing the degree of distillation at which we arrived, but it did not burn without some difficulty, and it was not until half-past five that the gas was found to burn in an efficient manner by a continuous current of air; at this time the pumps were not going, for which purpose two men were placed at each extremity of the beam which moved the pumps, when we perceived that the water of the boiler had preserved its primitive temperature of 122° F., and there had been no portion of heat used to heat the water of the boiler, whilst the temperature of the products of the combustion was 248° F. The pumps were kept going, and the grating was charged until a quarter to seven o'clock, at which time the steam from the water commenced forming. At a quarter to eight we found 6 gallons of water evaporated, and at ten minutes past eight 12 gallons; as the boiler was open at the top, this steam disengaged itself with the gas and the hot air. The 88lb. of coke, weighed at the commencement of the experiment was consumed, and the grating was charged with a new supply of coke, when we continued going till ten o'clock, after some short intervals of stoppage, between eight and ten o'clock, for slight repairs. At the above hour the experiment ceased, when the total quantity of water evaporated was found to be 32 gallons, and the addition to the coke on the grate was $27\frac{1}{2}$lb. On the next day, the 14th, we opened the retort from which we took 99lb. of coke, so that 33lb. had been converted into gas, and served for the evaporation of 32 gallons of the water. We drew out from under the grating 26lb. of waste, containing 18lb. of cinders. On this quantity we might have employed again $16\frac{1}{2}$lb., so that the total quantity of coke consumed on the grating was 99lb.—*Mining Journal.*

## PLASTERING.

WHAT is called fine stuff is made of pure lime, slaked with a small quantity of water, and afterwards, without the addition of any other material, saturated with water, and in a semi-fluid state placed in a tub to remain until the water has evaporated. In some cases, for better binding the work, a small quantity of hair is worked into the composition. For interior work, the fine stuff is mixed with one part of very fine washed sand to three parts of fine stuff, and is then used for trowelled or bastard stucco, which makes a proper surface for receiving painting.

What is called gauge stuff is composed of fine stuff and plaster of Paris, in proportions according to the rapidity with which the work is wanted to be finished. About four-fifths of the fine stuff to one of the last is sufficient, if time can be allowed for the setting. This composition is chiefly used for cornices and mouldings, run with a wooden mould. We may here mention that it is of the utmost importance, in plasterers' work, that the lime should be most thoroughly slaked, or the consequence will be blisters thrown out upon the work after it is finished. Many plasterers keep their stuffs a considerable period before they are wanted to be used in the building, by which the chance of blistering is much lessened.

When a wall is to be plastered, it is called *rendering;* in other cases the first operation, as in ceilings, partitions, &c., is *lathing*, nailing the laths to the joists, quarters, or battens. If the laths are oaken, wrought-iron nails must be used for nailing them, but cast-iron nails may be employed if the laths are of fir. The lath is made in three or four foot lengths, and, according to its thickness, is called single, something less than a quarter of an inch thick, lath and half, or double. The first is the thinnest and cheapest, the second is about one-third thicker than the single lath, and the double lath is twice the thickness. When the plasterer laths ceilings, both lengths of laths should be used, by which, in nailing, he will have the opportunity of breaking the joints, which will not only help in improving the general key, (or plastering insinuated behind the lath, which spreads there beyond the distance that the laths are apart,) but will strengthen the ceiling generally. The thinnest laths may be used in partitions, because in a vertical position the strain of the plaster upon them is not so great; but for ceilings the strongest laths should be employed. In lathing, the ends of the laths should not be lapped upon each other where they terminate upon a quarter or batten, which is often done to save a row of nails and the trouble of cutting them, for such a practice leaves only a quarter of an inch for the thickness of the plaster; and if the laths are very crooked, which is frequently the case, sufficient space will not be left to straighten the plaster.

After lathing, the next operation is laying, more commonly called plastering. It is the first coat on laths, when the plaster has two coats or set work, and is not scratched with the scratcher, but the surface is roughed by sweeping it with a broom. On brick-work it is also the first coat, and is called rendering. The mere laying or rendering is the most economical sort of plastering, and does for inferior rooms or cottages.

What is called pricking up is the first coat of three-coat work upon laths. The material used for it is coarse stuff, being only the preparation for a more perfect kind of work. After the coat is laid on, it is scored in diagonal directions with a scratcher (the end of a lath), to give it a key or tie for the coat that is to follow it.

*Lath layed* or *plastered and set* is only two-coat work, as mentioned under laying, the setting being the guage or mixture of putty and plaster, or, in common work, of fine stuff, with which, when very dry, a little sand is used; and here it may be as well to mention, that *setting* may be either a second coat upon laying or rendering, or a third coat upon *floating*, which will be hereafter described. The term finishing is applied to the third coat when of stucco, but setting for paper. The setting is spread with the smoothing trowel, which the workmen uses with his right hand, while in his left he uses a large flat-formed brush of hog's bristles. As he lays on the putty or set with the trowel, he draws the brush, full of water, backwards and forwards over its surface, thus producing a tolerably fair face for the work.

Work which consists of three coats is called floated: it takes its name from an instrument called a float, which is an implement or rule moved in every direction on the plaster while it is soft, for giving a perfectly plane surface to the second coat of work. Floats are of three sorts: the hand float, which is a short rule that a man by himself may use; the quirk float, which is used on or in angles; and the Derby, which is of such a length as to require two men to use it. Previous to floating, which is, in fact, the operation of making the surface a perfect plane, such surface is subdivided in several bays, which are formed by vertical styles of plastering, (three, four, five, or even ten feet apart), formed with great accuracy by means of the plumb rule, all in the same plane. These styles are called screeds, and being carefully set out to the coat that is applied between them the plaster or floating laid on between them is brought to the proper surface by working the float up and down on the screeds, so as to bring the surface all to the same plane, which operation is termed filling out, and is applicable as well to ceilings as to walls. This branch of plastering requires the best sort of workmen, and great care in the execution.

Bastard stucco is of three coats, the first whereof is roughing in or rendering, the second is floating, as in trowelled stucco, which will be next described; but the finishing coat contains a small quantity of hair behind the sand. This work is not hand-floated, and the trowelling is done with less labour than what is denominated trowelled stucco.

Trowelled stucco, which is the best sort of plastering for the reception of paint, is formed on a floated coat of work, and such floating should be as dry as possible before the stucco is applied. In the last process, the plasterer uses the hand-float, which is made of a piece of half-inch deal, about nine inches long and three inches wide, planed smooth with its lower edges a little rounded off, and having a handle on the upper surface. The ground to be stuccoed being made as smooth as possible, the stucco is spread upon it to the extent of four or five feet square, and, moistening it continually with a brush as he proceeds, the workman trowels its surface with the float, alternately sprinkling and rubbing the face of the stucco, till the whole is reduced to a fine even surface. Thus, by small portions at a time, he proceeds till the whole is completed. The water applied to it has the effect of hardening the face of the stucco, which, when finished, becomes as smooth as glass.

From what has been said, the reader will perceive that mere laying or plastering on laths, or rendering on walls, is the most common kind of work, and consists of one coat only; that adding to this a setting coat, it is brought to a better surface, and is two-coat work; and that three-coat work undergoes the intermediate process of floating between the rendering or pricking up, and the setting.

Ceilings are set in two different ways; that is the best wherein the setting coat is composed of plaster and putty, commonly called guage. Common ceiling are formed with plaster without hair, as in the finishing coat for walls set for paper.

Pugging is plaster laid on boards, fitted in between the joists of the floor, to prevent the passage of sound between two stories, and is executed with coarse stuff.

The following materials are required for 100 yards of render set; viz. 1½ hundred of lime, 1 double load of river sand, and 1 bushels of hair; for the labour, 1 plasterer 3 days, 1 labourer 3 days, 1 boy 3 days; and upon this 20 per cent. profit is usually allowed. For 130 yards of lath plaster and set—1 load of laths, 10,000 nails, 2½ hundred of lime, 1½ double load of river sand, 7 bushels of hair; for the labour, 1 plasterer 6 days, 1 labourer 6 days, 1 boy 6 days; and upon this, as before, 20 per cent. is usually allowed.

In the country, for the interior coating of dwellings and outbuildings, a species of plastering is used called roughcast. It is cheaper than stucco or Parker's cement, and therefore suitable to such purposes. In the process of executing it, the wall is first pricked up with a coat of lime and hair, on which, when tolerably well set, a second coat is laid on of the same materials as the first, both as smooth as possible. As fast as the workman finishes this surface, another follows him with a pailful of the roughcast, with which he bespatters the new plastering, so that the whole dries together. The rough-cast is a composition of small gravel, finely washed, to free it from all earthy particles, and mixed with pure lime and water in a state of semi-fluid consistency. It is thrown from the pail upon the wall, with a wooden float, about 5 or 6 inches long, and as many wide, formed of half-inch deal, and fitted with a round deal handle. With this tool, while the plasterer throws on the roughcast with his right hand, in his left he holds a common whitewasher's brush dipped in the roughcast, with which he brushes and colours the mortar and the roughcast already spread, to give them, when finished, an uniform colour and appearance.—*Gwilt.*

## LIPSCOMBE'S PATENT APPARATUS FOR LESSENING THE VIBRATION AND NOISE OF RAILWAY WHEELS.

It is now generally understood that the rapid deterioration, as regards the strength, of railway wheels and axles, is chiefly caused by the intense vibration to which they are subjected. This can readily be made evident:—If the journal of an old railway axle is struck with a smith's hammer, it will, in many cases, break off with a single blow, presenting at the fractured part a weak brittle appearance; whereas the journal of a new axle will take several hundred blows before breaking, a tough fibrous appearance being presented at the fractured part. Suppose a finger in the act of creating a musical sound, by laterally distending a harp-string, it is plain, if the finger is taken away, the elasticity of the string will cause it to fly to and fro until, from the friction of its fibres, the string is brought to a quiescent state. It is clear the same effect would be produced by deflecting the string with a weight, and suddenly withdrawing that weight. We thus see that, as the weight upon a wheel in motion is ever shifting, the particles composing a wheel are successively deflected every revolution; the weight shifting with a rapidity depending upon the speed of the wheel, it follows, as in the case of the harp-string, the deflected particles, immediately the weight is shifted, will begin and continue to vibrate until the wheel stops; the consequence is, either the spokes become loose, thus rendering the wheel useless, or the particles of the wheel, by being wedged and dovetailed together, become by this wriggling motion so loosened and broken, as in a few years to render the wheel unsafe, consequently useless, from its great decrease of strength, although the actual quantity of metal in the wheel remains the same as ever.

The same remarks are applicable to railway axles. The vibration which takes place in a wheel is communicated to the axle, as the axle is struck by the vibratory particles of the wheel; so that it is evident vibration is exceedingly destructive to wheels and axles: their great decrease of strength, and the pecuniary loss every railway company sustains from this cause, together with the accidents which have occurred, by the breakage of axles, is sufficient testimony.

Mr. Lipscombe, after a variety of experiments, ascertained that any metallic body could be prevented from vibrating, by simply pressing a quantity of sawdust, &c. in contact with it, so that when the particles of a body are deflected by a weight, their elasticity, when the weight is withdrawn, is spent in forcing back the sawdust while resuming their original position. An apparatus was constructed, and applied to the wheels of a ballast waggon, by way of experiment. The experiment succeeded perfectly, completely preventing vibration, not only in the wheels but likewise in the axles: the noise of the wheels was very slight, and what remained was occasioned by passing over the joints of the rails, when loose or not exactly level.

Mr. Lipscombe subsequently, through the recommendation of Mr. Robert Stephenson, obtained permission of the directors of the London and Birmingham Railway to apply his apparatus to one of their first-class carriages. Previous to the wheels being placed under the carriage, one pair, with the apparatus applied, was slung off the ground, and struck in various parts of the axle and wheels, but not the slightest vibration could be detected. Another part, not fitted with the apparatus, was afterwards slung, in a similar manner; and when struck its vibration created a sound as loud and prolonged as a bell would have done. The carriage has been running daily with the trains for upwards of nine weeks, and is a great favourite, for its peculiarly smooth motion and comparative noiselessness, although, from being in a train with carriages before and behind, its taciturnity is the less perceptible.

The apparatus is very simple, consisting of a plate of zinc placed on each side of a wheel, for the purpose of retaining pressed sawdust in contact with part of the rim and spokes. Each plate has two wooden rings, of unequal size, permanently fixed to it. The combined depth of the corresponding rings is equal in width to the tyre; these rings meet, and are screwed together, certain parts of the rings being cut away, to let in the spokes. The cost of the apparatus per wheel is 1*l.* and will last for many years.—*Apprentice.*

## KALSOMINE PAPER-HANGINGS.

This is an invention that we are persuaded will rise to great importance, and which is well deserving of the favourable attention of the public. It consists in coagulating the size with which the colours of paper-hangings are mixed, by the aid of a solution of alum, by which means it is made insoluble; and the surface of the paper may then be washed with as little damage as if it were covered with oil paint. A papering for rooms may thus be introduced of a greatly superior kind to that now in use, and with an equal economy; for the greater first cost will be made up by a greater durability. There is no glare upon the paper of any kind, but its surface is just the same as if it had never undergone any preparation; and in some of the specimens we have seen, the appearance bore a very close resemblance to that of fresco. Rooms may be decorated with great elegance with this paper, by making use of appropriate borders and centre pieces; and the effect is at least equal to that produced by fresco painting. The following are the details of the kalsomine process, as given by the inventor:—

"Tempera may be said to possess (resistance to water excepted) all the advantages of other modes of painting, without any of their disadvantages. It is not acted on chemically by smoke, as oil paint is; its foundation white is an earth which is neither blackened nor in any way changed by any gas that may occur in the atmosphere, like the white lead that is the basis of oil paint, which is liable to be discoloured by the sulphuretted hydrogen constantly escaping from drains and coal fires. Size (the vehicle used in tempera) has no chemical action on the metallic oxides; it reflects light, instead of absorbing it like oil. But it cannot be washed; itself a water colour, water will remove that which it will put on. Remove this difficulty, and the artist possesses everything he can desire,—purity and permanency of colour, breadth and facility of handling, and durability. This, we believe, our invention fully accomplishes. The patent kalsomine is, in fact, a washable tempera. It is, like ordinary tempera, applied to a surface by the medium of size. It differs only in the care with which the size has been prepared, and the greater quantity employed. When painted, it would wash off again, like any other tempera, but for an *after-process*, in which the great novelty of our invention consists. As this after-process may be applied with equal success to other substances besides size, equally susceptible of being employed as vehicles for painting, we will briefly state the nature of the invention; and, in the present account, limit ourselves to giving those particulars most necessary to explain its application to the higher branches of decorative art, or to the purposes of the artist. Its treatment, when applied to plain house-painting, is much more simple. The invention consists in using, as vehicles for painting, certain substances soluble in water; which, by the after-application of chemical agents or re-agents, can be rendered insoluble in water. Thus, the paintings so treated are susceptible of being cleaned by washing. It is well known that many chemical agents, when brought into contact with albumen or gelatine in solution, form, with them, insoluble compounds. Moreover, a soap of wax, or of certain resinous substances, being an alkaline compound, would be decomposed by an acid or earthy re-agent, and the wax of resin restored to its originally insoluble state. As this effect is produced by alum, or by the acetate of alumina, in solution, and as these also form an insoluble compound with albumen, and with size of a certain quality, all these vehicles may be used together, in the same picture, according to the quality of the surface or mode of working which the artist may require for producing a satisfactory effect. Clear, lustrous, and opaque lights, not liable to darken or *sink*; transparent shadows and dark colours, easily spread and glazed on, free from gloss and reflection; these are the qualities it is most desirable to combine, if possible, in all paintings intended for decoration. These effects may be obtained by the following treatment:—

"Size being the best vehicle for all body colours and lights, from not changing colour, and from its being naturally tough, not liable to crack or peel, and from its not absorbing light, we recommend that the white paint, and all light bright body colours, be mixed with size. For the shadows and dark colours a transparent vehicle is best, that they may be rich and deep in tone, and recede from the eye. It is, therefore, desirable to grind up the brown, red, green, and dark blue colours in the soap of wax, as oil colours are in linseed-oil. Besides this, to thin the colours so prepared for working, a vehicle is required to be used, as spirits of turpentine are used in oil-painting, for the purpose of giving fluidity to the size colour in finishing up, or for laying on semi-opaque washes of body colour. The white of egg, beaten up with an equal weight of water, is the best thinning vehicle. It forms, with the re-agent, a particularly intractable coagulum, which, being very opaque, will be found as good for the light colours as it is useful in neutralizing whatever gloss the soap of wax might give the deep colours, according to the proportions in which these vehicles are combined. This must be left to the judgment of the artist. If the lights and white are thus mixed with size, and the darks and colours with soap of wax, every gradation of opacity will be obtained by the simple mixing of the colours. The shadows will recede and the lights will come forward by the optical properties of the vehicles—an advantage of great value in the hands of an intelligent artist, which cannot be wholly and permanently obtained in oil, in fresco, or in tempera. For in oil the lights sink from the action of the oil on the white, and become discoloured from the action of the atmosphere on the oil and driers, while the rich dark tints become dingy. In fresco, the absence of gloss in all tints alike is accompanied by a dullness and meagreness of tone and texture which puts fine colouring and effect out of the question, besides the difficulties of manipulation and risks of the process. And though in tempera a greater richness and depth of tone and effect may be aimed at, with all the rapidity of execution and breadth of fresco, it cannot be cleaned; and in the climate of England it is soon destroyed by damp, which destroys and decomposes the size used as a vehicle. But when our prosess has been applied to a picture so painted, it is no longer susceptible of this decomposition. The painting when finished, is washed over with a solution of alum, or the acetate of alumina. This renders the size (as well as the other vehicles) insoluble in water. It is converted into a kind of horn, or tanned, much in the same way as sheepskins are converted into 'whit-leather,.' We have said that a certain core is necessary in the selection of the size. It is a fact known to chemists, and perhaps only to them, that there are two varieties of size, possessing exactly the same external qualities, but differing in this, that the one kind is not coagulated by alum, and the other is. The former has the name of gelatine, the latter that of chondrine. Fish-glue, or size made from isinglass, is an example of the gelatine variety; and tempera made of this will not be rendered washable by being subsequently treated with alum.

"Size that will coagulate is procured from the tendons of animals, and, consequently, abundantly from such parts of their skin as have many tendons inserted into them. The parts about the head are well fitted to make size proper for our purpose. A simple method of ascertaining whether size is fit or not is to warm a little of it, just to the melting point, but no more, as it would injure the fixing property. and pour into it a little strong alum-water. If the size immediately coagulate, it is fit for our purpose. As chondrine, by keeping, gradually changes into gelatine, and becomes unfit for our purpose, because it cannot then be fixed, it is quite necessary to use it very fresh, to mix up only as much white paint as will last three or four days, and in summer to keep it in a cool place. Another important precaution is to use only such colours, with size or with albumen, as do not decompose, effervesce, or dissolve, in the 'fixing solution or re-agent.' Their fitness is easily tested, like the size, by pouring a little of the solution on a sample of the colour. All the carbonates of earths and metals are unsuitable; all the vegetable lakes made with chalk; but as the latter are exceedingly fugitive, their unfitness is no loss. The white we prefer to use as a basis is porcelain clay, a compound of pure alumina and silica. It possesses none of that dry meagre whiteness common to chalk or barytes. but a certain silky lustre not easy to describe; yet most agreeable to the eye. Besides this, clay retains water with much tenacity, and therefore tempera executed with it does not dry so inconveniently fast. It is also less absorbent in use than other whites. We beat it up with water into a paste to the consistency of butter, and add from half to two-thirds of the weight of the paste, of strong double size. The whole must be well mixed, and passed through a muslin; it must then be set aside to cool till it begins to set or gelatinize, and then beaten up with a spatula. And it is desirable to use as much as possible, that the point may be solid when fixed; and as size alone is inconvenient to use, from its setting, when the paint is made so strong, we recommend the previous preparation of the size in the following manner, to make it work more soft and dry less rapidly:—If a solution of white tallow soap in sixteen times its weight of water be prepared by long boiling, and kept for use, about two ounces of this solution to every pound of size, with a table spoonful of drying oil, stirred in when the size is just melted, will be found a great improvement. The size will then work easily, give more body to the colour: and further, the fixing solution will act on this mixture in such a manner, that after its application the surface will be impervious to water or damp.

Or a little white wax may be incorporated with the soap by means of heat, and then brought to the consistence of lard, by adding water instead of the oil. But as a general rule, we would suggest, that as the coagulated size and albumen are the most simple and unalterable vehicles, we make a point of being as sparing in the use of any addition as possible. The best fixing solutions are alum, and the acetate of alumina or mordant of the calico printers. For all choice and delicate work we prefer the latter. The strength of the solution should be such that a pint of water shall contain about an ounce of alum, as a maximum. If, after dissolving the alum in warm water, about one-tenth of its weight of chalk be added, and when the effervescence has ceased, about three quarters of its weight of acetate of lead, sulphate of lead will be precipitated, and the acetate remains in solution fit for use. This fixing solution is applied with a large brush, taking care (if the painting be on a wall) that no more be applied than the paint will absorb, without letting any run down along the painting. If, after the picture is quite dry, it be washed a second time with a lather of soap, the latter will combine with the excess of alum left by the first wash, and fill up the pores of the fixed distemper with a soap of alumina that resists the further introduction of water or damp. This is in case the soap should not have been combined with the size in mixing, which nevertheless we recommend in preference. Lastly, we must caution those who use size combined in the manner we recommend, with fatty substances in very minute proportions—to be not the less scrupulous in using their size quite fresh, and not keeping much paint mixed at a time. For, although size so combined would not turn sour, or smell, or appear in the least decomposed, its fixing property is not the less destroyed in about the same time that it would be without this mixture. And though a little sulphate of zinc added to the size will preserve it fit for our purpose several weeks, size so treated will not work with albumen, because the sulphate of zinc coagulates the latter."—*Engineer.*

## WORSTED MANUFACTURE.

Wool is the filamentous substance which covers the skins of sheep, and some other animals, as the beaver, the ostrich, the llama, the goats of Thibet, of Cachemir, &c. These varieties of wool serve for the manufacture of various stuffs and fabrics used for raiment and other purposes, under the name of broad cloths, kerseymeres, baizes, flannels, worsted stuffs, merinos, castorine, vigontines, cachemires, &c. Sheep's wool alone possesses the fulling or felting property.

Wools have been distinguished in commerce into two classes; fleece wools, and dead wools. The first are obtained from the annual shearing of sheep; the last are those cut from the dead animals, and are characterized by their harshness, weakness, and incapacity of taking a good dye especially if the animal has perished from a malignant disease. In general, the best wools are those shorn towards the end of June, or the beginning of July. Hence, on the sixth of this month, the celebrated sheep-shearing fete of Mr. Coke of Holkham is held.

Sheep's wool is greatly modified by the breeding of the animal; for it is a coarse hairy substance, mixed with a soft down close to the skin, on the wild *moufflon*, to which genus all the varieties of the domestic sheep have been traced. That animal, and others with a similar coat, when placed in a temperate climate under the fostering care of man, lose their long rank hair, and retain the soft wool. Attention to the cultivation of fine wool has been long paid in many countries, and has produced the highly valued merino species. It has been ascertained that the female has more influence than the male on the bodily form of an animal; but that the male, in sheep particularly, gives the peculiar character to the fleece. The produce of the breed from a coarse-woolled ewe and a fine woolled ram will give a fleece approaching half-way to that of the male; and a breed from that progeny with a fine-woolled ram. will yield a fleece differing only one-fourth from that of the sire. By proceeding in the opposite ratio, the wool would rapidly degenerate into its primitive coarseness. Great care must therefore be taken to exclude from a breeding flock any accidental varieties of coarse-woolled rams.

Wools differ from each other in value, not only according to the coarseness and fineness, but also the length of their filaments. Long wool, called also combing wool, differs as materially in a manufacturing point of view from short or clothing wool, as flax does from cotton. Long wool varies in length from three to eight or ten inches; it is treated on a comb with long steel teeth, which open the fibres and arrange them horizontally like locks of flax, and such wool, when woven, is unfit for felting. Short wool varies in length from three to four inches: if longer, it is cut or broken to adapt it to the subsequent operations of carding or felting, in which the fibres are convoluted and matted together.

Among the long or combing wools, the shorter varieties are used principally for hosiery, and are spun into softer yarn than the longer varieties. The longer are manufactured into hard yarns for worsted pieces, such as waistcoats, carpets, bombazines, crapes, poplins, &c.

With regard to broad cloth, the finer, shorter, and to a certain degree softer the filaments of wool, the better the goods they make, because they accommodate themselves better to the fulling operation.

Short-stapled, or cloth wool, is valued by the fineness, softness, soundness, density, uniformity, and whiteness of its fibres. These qualities are estimated with considerable accuracy by the cloth-manufacturer, wool-sorter, and wool-dealer, experienced by multiplied trials in discerning with the touch minute differences quite imperceptible to common observers, and not appreciable by the microscope. The fibres are stretched gently across a graduated slip of glass, and kept in their place by a similar slip of glass laid over them, which is then fixed to the other by a slender clamp at each end. For very nice measurements Troughton's micrometer eye-piece, with parallel wires moved by a fine screw and graduated head, may be attached to the instrument. Thus equipped, it is capable of measuring pretty exactly the one hundred thousandth part of an inch.

The fibres of wool, viewed naked in a good achromatic microscope, have somewhat of a pearly lustre, and are covered with little rugosities, like pig's skin. The finer wools, viewed in balsam, show an annular arrangement. They are all tubular. The chief use of the microscopic observations of wool would seem to be the determination of the inequalities of size and form in one parcel. In good wools, the diameters of the filaments appear to be pretty uniform.

Four qualities are distinguishable in the fleece of the same animal. The finest is upon the spine from the neck to within six inches of the tail, including one-third of the breadth of the back or saddle. This kind is called by the Spaniards *floretta*. The second quality covers the flanks, and extends from the thighs to the shoulders. The third covers the neck and the rump; and the fourth lies upon the lower part of the neck and the breast down to the feet, as also upon a part of the shoulders, and the thighs to the bottom of the hind quarters. The spaniards call this portion *cayda*. The sorting of these four qualities takes place immediately after the shearing, by tearing asunder the several portions, and throwing each into a particular bin.

The highest price of the best Saxony wool is 7s. or 8s.; but little of that quality is imported. One shilling a-pound, however, is of little consequence for the best qualities of broad cloths. It comes in washed in a superior manner.

The hardness of some of the English wools does not depend entirely on the race, or the climate, but on certain peculiarities in the soil which affect the pasture. The fleece of sheep fed on chalky districts is generally harsh; that of those fed on rich loamy argillaceous soil is distinguished for its softness. The Saxony sheep, being exposed to a less ardent sun than the Spanish, yield a softer fleece. The sheep pastured on the Cheviot hills in Cumberland, though not of the finest-woolled English breed, yield fleeces of remarkable softness, and have been refined still more by artificial means, particularly by smearing the sheep with an unguent, composed of tar and butter, immediately after shearing them. The felting property of wool is in some measure proportional to its softness, and depends conjointly on the annular and other rugosites of the filaments observable by means of a good microscope, and on their elasticity. In consequence of this structure, when they are pressed and rolled together, they become convoluted, and entangled by mutual friction. Heat and moisture favour the flexure and curling of the wool, which are essential to the matted texture. For this process, only the curling fibres are fitted which continually change their directions in the fulling movements, and thereby interlace themselves round other fibres. The furs of the hare, the rabbit, and the castor, being naturally straight, cannot be employed alone for felting, till they have acquired a curling texture at their points, by the application of nitrate of mercury,—an article called *secretage*.

The best length of staple for the clothing or fulling species of wool is from two to three inches. But Saxony wool, though four or five inches long, admits, from its tenderness, of being easily broken down by carding to the proper shortness, and is preferable, on account of its variable lengths, for making kerseymeres, pelisse-cloths, shawls, and such fabrics as require fine yarn.

*(To be Continued.)*

---

## VARIETIES.

*Trees killed by the Effect of Paint and Oil.*—A gardener of Chalons-sur-saone declared, at a meeting of the Horticultural Society, that, having nailed up some peach and apricot trees upon a trellis freshly painted with verdigris, towards the end of June, in a short time they all died, except one apricot tree, which only lost the branches which were attached to that part of the trellis that had been painted. Another gardener reported also that, having rested some bars of wood painted with verdigris, upon some pear trees, he observed that deep cancer suddenly formed wherever the paint had left any marks. A gardener from the department of Haute-Marne, M. Delisle, wrote to us, saying he had seen trees die from oil which had been spread upon the branches to destroy the caterpillars. The use of soft soap, of which oil is the base, says this gardener, has caused the branches of trees which have been rubbed with it to die.—*Revue Horticole.*

*Deleterious Effects of Impure Air.*—The statistical reports laid before Parliament by the War office on the sickness and mortality of the troops of the United Kingdom stationed in different parts of the world, prove most clearly the immense effects upon human life produced by small and almost inappreciable differences in the quality of the atmosphere. For on the same class of persons performing the duties, and placed as nearly as possible in the same circumstances, the average mortality varies in different parts of the world, from 1·37 per cent. per annum to 66·83 per cent. per annum; or the mortality is nearly forty-nine times as great in some localities as in others. The morbific influence of certain gaseous emanations from the earth, in various parts of the globe, is well known. "The banks of the Nile about Sennaar," says Bruce, "resemble the pleasantest part of Holland in the summer season; but soon after, when the rains cease, and the sun exerts its utmost influence, the dora begins to ripen, the leaves to turn yellow and to rot, the lakes to putrify, smell, and be full of vermin, and all this beauty suddenly disappears—bare-scorched Nubia returns; and all its terrors of poisonous winds and moving sands, glowing and ventilated with sultry blasts, which are followed by a troop of terrible attendants —epilepsies, appoplexies, violent fevers, obstinate agues, and lingering and painful dysenteries, still more obstinate and mortal." So pestilential is the spot, that no "horse, mule, ass, or any beast of burden, will breed or even live at Sennaar, or many miles round it. Poultry does not live there. Neither dog nor cat, sheep nor bullock, can be preserved a season there. They must all go every half-year to the sands."—*Hood.*

*Fig.* 3.

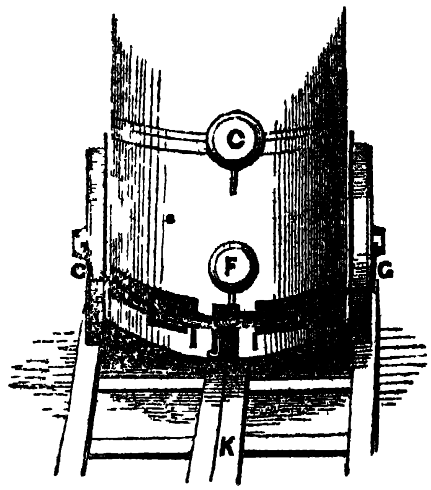



*Fig* 4

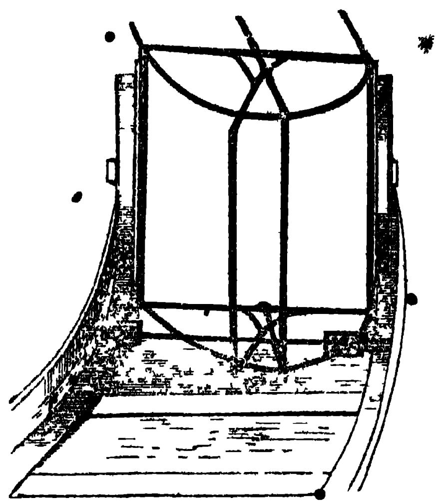
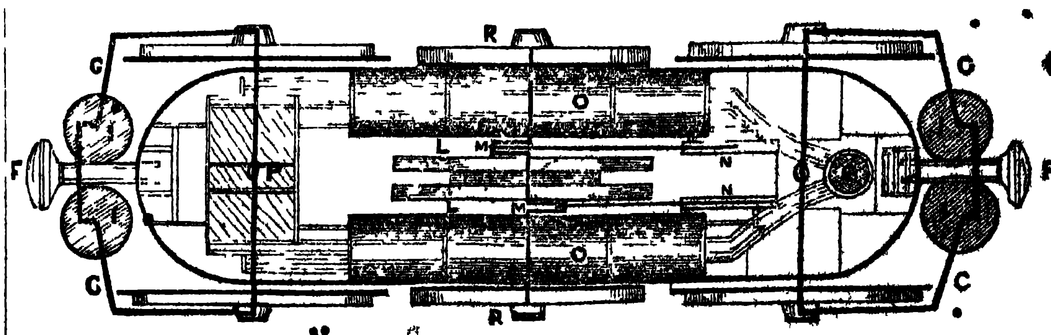


*Fig* 5.




PETIT'S ANTI-FRICTION RAILWAY.

## PETIT'S ANTI-FRICTION RAILWAY.

We resume our description of this ingenious application of a principle which is worthy the consideration of Railway Companies.

*Fig.* 3, is an end view of Fig. 1, by which may be seen the impossibility of a carriage getting off the rails; the opening along the bed of the carriage is cased over inside, forming a seat along the middle.

Fig. 4, is an end view of a carriage where side rails might be preferred instead of the centre raised rail. In such case a plain rail along the middle will be sufficient for the driver of the engine to take on to; in such case it need not be divided; the cranks work on each side, but one could be made to work in the opening of the wheel to save room.

Fig. 5, is a plan view, or as it were looking down upon an engine, suitable to the carriages and rails. E, represents the driving wheel of the engine; M, the cranks; N, the cylinders; O, the boilers; Q, the branch chimney, terminating in one; R, the middle carrying wheels. It is not here intended to show every minute part relative to a locomotive engine, but only so much as may be needful to give the idea that such an engine would turn any way as far as the swerving axle will admit, and that these axles are always under the powerful leverage control of the guide wheels and rails; should swerving axles be considered an objection, a contrivance may be resorted to that would quickly fix them, circumstances requiring it. In the first place, relative to the engine, the carriage is furnished with two small boilers instead of one large one, so that each engine has its own boiler, and in lieu of two driving wheels, there is but one, and that is placed in the centre between the two boilers: and it is well known that one wheel will turn on a point any way the frame may direct it; but if two wheels be fixed on in the same axle in going round a curve, the near wheel must make as many revolutions as the off one, consequently the near one must skid, the axle is thereby strained, and the progress retarded; and if the wheels have conical peripheries, there must be space left for them to run across the rails, until the flange prevents them going any farther, which is another great obstruction and natural strain; but by using one driver only, and that in the middle, and allowing all the other wheels to revolve freely on the axles, and the end axles kept by appropriate guide wheels and rails in the exact position of the road, this with many other evils in connexion therewith are overcome. There are several advantages to be derived from having only one driving wheel, and that in the centre, which cannot be said of an engine that uses one driver on one side only, that can only have a natural effect where a complete circle of small diameter is required to be made; but when the tractive power is in the centre, it is always direct, however serpentine the road may be, and part of the weight bears in the middle between the line of rails, and not all on the sides of an embankment; it has also an appropriate rail to itself, and does not depend on the slippery iron rails, the centre rails being all or partially of wood; the periphery of the driver can be furnished with little studs, which bite into the wood as far as the iron binding would permit, this would not impede the progress, but give it all the advantage of a cog wheel, with a corresponding rail, and would greatly assist in ascending inclines, which might also be descended with great safety and speed; the carriage and boilers being long, the weight would be spread over a larger surface, and a long and steady stroke may be obtained instead of a short and rapid one; as the driver may be of any reasonable height, there is no necessity for the crank axle to extend farther than the inner part of the frame between the two boilers, which are brought down as near the ground as the appendages will admit, and the cylinders may be brought up to suit the cranks, which can be worked as far above, or between the boilers, as the height of the driver may require. Where the centre raised rail is used, the driver must be divided as it were into two to admit of the rail.

If the crank axle M extends across the frame like the end axles, the two middle wheels marked R can revolve on it, and the axle will also revolve in the boxes of the wheels; but if these middle wheels are not required for bearing wheels they can be made smaller, so as not to touch the rails, and being made fast on the crank axle, they would serve as friction wheels only, against which a powerful break can be brought. The buffer rods will serve as supports to the guide arms and wheels — the crank slide will show that they revolve below the rods.

The boilers being partially below the frame, there would be much spare room, which might be so contrived that the engine could carry sufficient fuel and water to supply itself, if so, the tender could be dispensed with, as plenty of breaks can be brought into action without it. It appears to me quite plain, that an engine constructed after this plan would be as much under command, as a common carriage on a turnpike road, with its guide pole between a pair of horses, and there could be no particular objection to curves, except so far as they might lengthen distance; the most valuable property and high hills might be avoided, which would otherwise require deep cutting or tunnelling. Should an engine of this description appear objectionable, because of its supposed width, if there were two boilers of eighteen inches diameter each, the outer rails need not be much more than a five feet guage; but it would be impossible to say how little power would be required to draw a moderate train, when not only all lateral straining is done away, but many other obstructions indispensable to the system now in use; the rails having no lateral strain would keep their guage, and require less fastening, and have a finer finished edge, be brought up more sharp, but not so as to injure the wheels. If the peripheries of the wheels are perfectly even to the flanges, and sufficiently wide, the joints of the rails may be so managed that they should never be felt when passing over them, let the contraction be little or much, supposing the rails to be fastened with chairs; let those at the joints be so formed that the outer part of them shall rise to a level with the top of the rail, and overlap the joints an inch or two each way; it must be plain that the periphery of the wheel must take on to them, and not sink into the joints; for if a rail be perfectly even, and the wheel rolling upon it be perfectly round, it can only touch on a point at one time, consequently it cannot roll over the least opening without receiving a shock in proportion to that opening, therefore the plan that is most calculated to take away all obstructions and friction, except that produced by specific gravity, must be the best plan, let the introducer of it be who or what he may; and if the wheels be enlarged, and the axles made smaller, having nothing to do but bear the weight, the friction on them and the boxes of the wheels may soon be reduced to one-third of what it now is—friction must in a great measure depend upon the surface that is gone over or touched. An engine constructed after the foregoing plan would have a fair chance, being flexible enough for anything but get out of its proper course; but should locomotive engines be superseded, the carriages will be applicable to any kind of traction, the rails and carriages might be tried as to the effect of this mode of guidance without a steam engine; if a frame only were made of wood or anything else similar to that shown at Fig. 5, without boilers or steam apparatus of any kind, but only the wheels with the driver in the centre, fix a winch on each side the driver, and let two men be placed where the boilers ought to be, and let them try at what speed they can draw one or two carriages; it may be that short branch railways might be worked on that plan to convey passengers to and from the main line, especially where double inclines may be formed, the momentum gained in going down a steep gradience, would, with a little help, force a carriage up the same height on the opposite end; a great velocity could not overturn the carriages with the lower body only, should the wheels come off, which is not likely any more than those of other carriages, the body of those carriages would ride along the top of the centre rail, should such an accident ever happen, a small friction roller could be fixed at each end of the opening just to ride clear of the rail, if considered necessary.

---

## WORSTED MANUFACTURE.

*(Continued from Page 264.)*

The grease, or yolk of the fleece, is a species of soap secreted by the sheep, and consists of oil with a little potash. Hence it serves to facilitate the scouring of wool by means of water alone, with which it forms a kind of sud or emulsion. It is most abundant in those breeds which grow the softest fleeces, and on the part of the back covered with the finest wool. This yolk, however, though favourable to the growing fleece, becomes injurious to it after it is shorn, and ought to be immediately removed, otherwise it will produce a fermentation in the wool heap, and render it hard and brittle, a change which takes place most rapidly in hot weather. Sometimes the fleece is washed with cold water on the animals before shearing; but when it is thick, as in the merino breed, it is washed after it is shorn, either with cold or hot water, the latter being most effectual, and is afterwards squeezed in a press to accelerate its drying. Wool loses in this process from thirty to forty-five per cent. of its weight. A Merino sheep frequently yields from three to four pounds of pure wool, while the finest English fleece rarely weighs more than two pounds in the foul state, or a pound and a half when cleaned.

Long wool, called also carding wool, requires length and soundness in its staple, in order to admit of being spun in a way suitable for worsted fabrics. The fineness of the fibres, of the first consequence in the clothing wool, is of subordinate importance in the combing variety. There are two kinds of long wool; the one used in the manufacture of hard yarn for worsted pieces, the other in that of soft yarn for hosiery; the former being eight inches at least in length, the latter about four or five.

The rich pastures of England and of Belgium seem to be more favourable to the growth of long combing wool than any other country of the world hitherto tried; and they suit very well with the Lincolnshire and Leicestershire breeds of sheep. The average weight of a fleece being about eight pounds, renders the growth of such wool an object of importance to the farmer. For the general purposes of the worsted manufacturer, this long-stapled fleece leaves nothing further to be sought after in British trade, and makes it an object of desire to other nations.

Of the origin of the worsted manufacture little is known, or the period when the comb was introduced in the treatment of long wools.

The long-woolled sheep of England are of four breeds: the Dishley, or new Leicestershire; the Lincolnshire; that of Tees Water, and of Dartmoor.

The Dishley wool has a staple about a foot in length; it is very fine, and weighs eight pounds on an average of each fleece.

It is supposed that this peculiar product of our agricultural industry employs fifteen thousand looms, and is worked up into worsted goods worth three millions sterling.

The goats of Thibet, which furnish the fine shawl wool, grow it in the form of a soft down at the roots of their long coarse hair. The Angora goat also grows an extremely fine silky hair, often worked up with silk into a peculiar style of goods.

The imported wools are almost entirely worked on the card; the finer kinds to be manufactured into cloth, the coarser into carpets. Of late years, a wool of the merino fleece has been grown to great advantage in New South Wales, and imported in great quantities. It is fully equal to the best Spanish merino.

The wool of the lamb is generally softer than that of the sheep from the same flock; and as it has the felting quality in a high degree, is much used in the hat manufacture. The wool of dead lamb-skins possesses less of the felting property, and is employed for flannels, and lamb's-wool hosiery.

Our races of short woolled sheep are principally the Dorsetshire, Herefordshire, and Southdown.

We know little concerning the woollen manufactures of the Egyptians, Greeks, or Romans; but we may conclude that the latter nation had carried this important art to high perfection, from the great pains bestowed by them on the improvement of the breed of sheep, the high prices at which the fine-fleeced animals were sold, and from the large supplies of clothing sent to their armies. Woollen garments formed almost exclusively the attire of the Romans, male and female, of every rank. After the downfall of their empire, the cloth manufacture, which had been with all the other arts of civilized life involved in a temporary ruin, began first to revive about the middle of the tenth century in the Low Countries, where it continued to bestow peculiar opulence, freedom, and consideration on the people for several hundred years.

In the middle ages Spain seems to have abounded in fine-woolled sheep of the Tarentine breed, which it originally derived from its ancient Roman masters. So far back as 1243, the woollen cloth of Barcelona and Lerida is spoken of with admiration, and as being in high esteem at the gay court of Seville, in the reign of Peter the Cruel. Innumerable flocks existed in Spain in the time of Charles V., of which so many as 30,000 belonged to one shepherd, and served to supply foreign nations with the softest wool. The finest wool then went to the Italian States, to the amount of many thousand sacks annually, at from forty to fifty gold ducats each; that is from £10 to £12 of our present money. A coarser wool was exported to the Netherlands. The French were next in order to the Italians in manufacturing fine cloth, which they consumed partly at home, and exported to Turkey. In 1646, Nicholas Cadeau obtained a patent of twenty years for making at Sedan, black and coloured cloths of the finest Spanish wool, like those of Holland; and thus laid the foundation of a local manufacture which has been famous ever since. Prior to their great revolution, the French excelled all the rest of Europe in the fabric, finish, and softness of superfine broad-cloth.

Winchester, according to Camden, was the seat of a cloth manufacture, under the rule of the Romans in Great Britain. But on their departure the arts also took their flight, and left the English, for upwards of one thousand years, to clothe themselves in skins. Even George Fox, the founder of the Quakers in the reign of Charles I., travelled as a missionary through the country, buttoned up in a leathern doublet with sleeves, instead of a cloth coat: this being the common dress at the time of labouring mechanics, to which class this gifted individual belonged. History affords very scanty materials respecting the woollen manufactures of England prior to Edward III. That wise prince gave a new impulse to them by affording liberal protection to foreign merchants and artisans, who had been proscribed or molested by absurd enactments and prejudices. About this period Thomas Blanket and others set up looms in their houses at Bristol for weaving woollen stuffs, but were so harrassed by the impositions of the mayor and bailiffs, that they were obliged to solicit letters from the king to permit them to exercise their calling without impediment, calumny, or exaction. In the year 1357, Blackwell Hall was appointed by the mayor and common council of London for a market, which was to receive the cloth goods exposed to sale. The statutes, in the following reigns, concerning the woollen manufacture, show that the manufacturers had now become a jealous body, desirous of imposing restrictions on the making and sale of goods to suit their own narrow interests.

During the reign of Henry VI., the exportation of woollen yarn was prohibited. Two *cloth-searchers* were appointed for every hundred throughout the realm, with authority to inspect and seal all cloth, even that made in private families, which was sent to the fulling-mill, and to levy a penny on each piece. In the same reign, a reciprocity law ordained that, "if our woollens were not received in Brabant, Holland, and Zealand, then the merchandise growing or wrought within the dominions of the Duke of Burgoyne shall be prohibited in England under pain of forfeiture." It would hence appear that we were beginning to supply these countries with the kind of goods which we had been taught by their weavers to work only a century before.

About the year 1482, hats, made by felting wool, were introduced, instead of the caps in universal use before; but the hatters continued a small body in comparison of the cappers for a long time thereafter.

Among the sapient acts of the good old times may be mentioned the ordinance of Henry VII., declaring "that every retailer who should sell a yard of the finest scarlet-grained cloth above sixteen shillings, or a yard of any other coloured cloth above eleven shillings, was to forfeit forty shillings a yard for the same." In the year 1493, this prince quarrelled with the archduke Philip, and thereby caused "an interruption of trade between the English and Flemish, which began to pinch the merchants of both nations very sore," in the wise language of Lord Bacon.

Multitudes of eminent manufacturers were driven from the Netherlands to England by the Duke of Alva's persecution of the Protestants, where they were graciously received by Queen Elizabeth, and obtained liberty to settle at Norwich, Colchester, Sandwich, Maidstone, and Southampton. These refugees contributed to improve our manufactures of worsted and light woollen goods, and to introduce the manufacture of linens and silks, and probably extended the frame-knitting business. Elizabeth passed an act to relieve the counties of Somerset, Gloucester, and Wiltshire from the old oppressive statutes, which confined the making of cloth to corporate towns.

*(To be Continued.)*

## TEA.

*(From the Supplement to Dr. Ure's Dictionary of Arts, Manufactures, and Mines.)*

This well-known plant has recently acquired peculiar interest among men of science, both in a chemical and physiological point of view. In its composition it approaches, by the quantity of azote it contains, to animalized matter, and it seems thereby qualified, according to Liebig, to exercise an extraordinary action on some of the functions of animals, especially the secretion of bile. The chemical principle characteristic of tea, coffee, and cocoa-beans, is one and the same, when equally purified, from whichever of these substances it is extracted; and is called indifferently either Theine or Caffeine. Mulder takes it from tea, by treating the evaporated extract by hot water with calcined magnesia, filtering the mixture, evaporating to dryness the liquor which passes through, and digesting the residium in ether. This solution being distilled, the ether passes over, and the theine remains in the retort. This principle is extracted in the same way from ground raw coffee, and from *guarana*, a preparation of the seeds of *Paullinia*, highly valued by the Brazilians. Theine, when pure, crystallizes in fine glossy needles, like white silk, which lose, at the heat of boiling water, 8 per cent. of their weight, constituting its two atoms of water of crystallization. These needles are bitter tasted. They melt at 350° Fahr., and sublime at 543°, without decomposing. The crystals dried at 250° dissolve in 98 parts of cold water, 97 of alcohol, and 194 parts of ether. In their ordinary state, they are but little more soluble in these menstrua. Theine is a feeble base, and is precipitable by tannin alone from its solutions.

Mr. Stenhouse prepares theine by precipitating a decoction of tea with solution of acetate of lead, evaporating the filtered liquor to a dry extract, and exposing this extract to a subliming heat, in a shallow iron pan, whose mouth is covered flatly with porous paper, luted round the edges, as a filter to vapour, and surmounted with a cap of compact paper, as a receiver to the crystals. In this way he obtained, at a maximum, only 1·37 from 100·00 of tea. But M. Peligot, from the quantity of azote, amounting to about 6 per cent., which he found in tea leaves, being led to believe that much more theine existed in them than had hitherto been obtained, adopted the following improved process of extraction:—To the hot infusion of tea, subacetate of lead and then ammonia were added; through the filtered liquor a current of sulphuretted hydrogen was passed, to throw down all the lead, and the clear liquid being evaporated at a gentle heat afforded, on cooling, an abundant crop of crystals. By re-evaporation of the mother liquor, more crystals were procured, amounting altogether to from 5 to 6 out of 100 of tea.

The composition of theine may be represented by the chemical formula, C8, H5, N2, O2; whence it appears to contain no less than 29 per cent. of nitrogen or azote.

Peligot found, on an average, in 100 parts of—

| | Parts soluble in boiling water. |
|---|---|
| Dried black teas | 43·2 |
| —— green teas | 47·1 |
| Black teas, as sold | 38 4 |
| Green teas, ditto | 43·4 |

Tea, by Mulder's general analysis, has a very complex constitution; 100 parts contain—

| | Green. | Black. |
|---|---|---|
| Essential oil (to which the flavour is due) | 0·79 | 0·60 |
| Chlorophyle (leaf-green matter) | 2·22 | 1·84 |
| Wax | 0·28 | |
| Resin | 2·22 | 3·64 |
| Gum | 8 56 | 7·28 |
| Tannin | 17·80 | 12·88 |
| Theine | 0·43 | 0 46 |
| Extractive matter | 22·80 | 19·88 |
| Do. , dark-coloured | — | 1·48 |
| Colorable matter, separable by muriatic acid | 23·60 | 19·12 |
| Albumine | 3·00 | 2 80 |
| Vegetable fibre | 17 08 | 28·32 |
| Ashes | 5 56 | 5·24 |

Since the proportion of azote in theine and caffeine is so much greater than even in any animal compound, urea and uric acid excepted, and since so many different notions have been, as it were, instinctively led to the extensive use of tea, coffee, and chocolate or cocoa, as articles of food and enlivening beverage, which agree in no feature or property, but in the possession of one peculiar chemical principle, we must conclude that the constitution of these vegetable products is no random freak of nature, but that it has been ordained by Divine Wisdom for performing beneficial effects on the human race. Hitherto, indeed, medicine, a conjectural art, exercised too much by men superficially skilled in the science of nature, and the slaves or abettors of baseless hypotheses, has lead tea and coffee generally under its ban, equally infallible with the multitude as that of the Pope in the olden time, and has denounced their use, as causing a variety of nervous and other *nosological* maladies. But Chemistry, advancing with her unquenchable torch into the darkest domains of Nature, has now unveiled the mystery, and displayed those elemental transformations of the organic functions in the human body, to which tea and coffee contribute a salutary and powerful aid.

Liebig, in his admirable researches into the kingdoms of life, has been led to infer that the bile is one of the products resulting from the decomposion of the animal tissues, and that our animal food may be resolved, by the action of oxygen, so amply applied to the lungs in respiratian, into bile, and urea, the characteristic constituent of urine.

When the consumption of tissue in man is small, as among mankind in the artificial state of life, with little exercise, and consequently languid digestion, assimilation, and decomposition, the constant use of substances rich in azotised compounds, closely analogeous to the chief principle of the bile, must assist powerfully in the production of this secretion, so essential to the healthy action of the bowels and other organs. Liebig has fully proved that the bile is not an excrementitious fluid, merely to be rejected, as a prejudicial inmate of the system; but that it serves, after secretion, some important purposes in the animal economy, being, in particular, subservient to respiration.

It may be remarked here, however, with regard to tea and coffee, that while they agree in the main feature, they differ in some others, and especially in the large proportion of tannin in the former, and its non-existence, according to my experiments, in the latter, notwithstanding the statement of its presence in many chemical works. Hence, tea may act injuriously in persons of *Cretian* babits; while coffee has no constipating power, however much it may cause excitement and heat under certain idio-syncrasies.

A pure, agreeable, and convenient concentrated preparation of tea and coffee has been recently made the subject of a patent, by Mr. Staite; which preparation I can recommend as being made from the best articles in the market, by a perfectly wholesome apparatus and process. The patentee has printed a little explanatory pamphlet on the object of his improvement, from which the following extracts are taken:—

"The quantity of tea grown and consumed in China cannot be ascertained, but the consumption of Europe and America may be taken as follows:—

| | |
|---|---|
| Russia | 6,500,000 lbs. |
| United States of America | 8,000,000 |
| France | 2,000,000 |
| Holland | 2,800,000 |
| Other countries | 2,000,000 |
| Great Britain | 50,000,000 |
| | 71,300,000 lbs. |
| | or 31,830 tons. |

"The number of tea-dealers in the year 1839 was, in England, 82,794; in Scotland, 13,611; and in Ireland, 12,744; making a total of 109·179. It is presumed that in consequence of the increased population, their number at present must exceed 120,000.

"The observations of Liebig afford a satisfactory explanation of the cause of the great partiality of the poor not only for tea, but for tea of an expensive and superior kind. He says, 'We shall never certainly be able to discover how men were first led to the use of the hot infusion of the leaves of a certain shrub (tea), or of a decoction of certain roasted seeds (coffee). Some cause there must be, which will explain how the practice has become a necessary of life to all nations. But it is still more remarkable, that the beneficial effects of both plants on the health, must be ascribed to one and the same substance *(theine* or *caffeine)*, the presence of which in two vegetables, belonging to natural families, the products of different quarters of the globe, could hardly have presented itself to the boldest imagination. Yet recent researches have shewn, in such a manner as to exclude all doubt, that *theine* and *caffeine* are in all respects identical.' And he adds, 'That we may consider these vegetable compounds, so remarkable for their action on the brain, and the substance of the organ of motion, as elements of food for organs, as yet unknown, which are destined to convert the blood into nervous substance, and thus recruit the energy of the moving and thinking faculties.' Such a discovery gives great importance to tea and coffee, in a physiological and medical point of view.

"At a meeting of the Academy of Sciences, in Paris, lately held, M. Peligot read a paper on the Chemical Combinations of Tea. He stated, that tea contained essential principles of nutrition, far exceeding in importance its stimulating properties; and shewed that tea is, in every respect, one of the most desirable articles of general use. One of his experiments on the nutritious qualities of tea, as compared with those of soup, was decidedly in favour of the former.

"Coffee is grown in Brazil, Cuba, Hayti, Java, British West Indies, Dutch Guiana, States of South America, French West India Colonies, Porto Rico, Sumatra, Ceylon, Bourbon, Manilla and Mocha. Brazil produces the largest quantity, 72,000,000 pounds weight; and the other states and colonies according to the order in which they are enumerated, down to Mocha, which produces the least, or 1,000,000 pounds; making a total of 346,000,000 pounds, equal to the consumption of the enormous quantity of 2,900 tons weekly, or 150,800 tons per annum.

"From the official returns, the quantities of coffee exported in one year from the different places of production were 854,550 tons:—

| | Tons. |
|---|---|
| To France | 29,650 |
| U. S. of America | 46,070 |
| Trieste | 2,000 |
| Hamburg | 20,620 |
| Antwerp | 10,000 |
| Amsterdam | 8,530 |
| Bremen | 4,500 |
| St. Petersburg | 2,000 |
| Norway and Sweden | 1,170 |
| Denmark | 1,500 |
| Spain | 1,000 |
| Prussia | 930 |
| Naples and Sicily | 640 |
| Venice | 320 |
| Fiume | 170 |
| Great Britain (average of 10 yrs.) | 18,250 |
| | 154,550 |

"Every reflecting man will admit, that articles of such vast consumption as tea and coffee (amounting together to more than 185,000 tons annually), forming the chief liquid food of a whole nation, must exercise a great influence upon the health of the people, and that any discovery which tends to the purification of these alimentary drinks, rendering them more wholesome, without rendering them less agreeable, is a great boon conferred upon society"

## IMPROVEMENTS IN THE MANUFACTURE OF BUTTONS, &c.

Mr. W. Sheldon, of Birmingham, has recently obtained a patent for the following improvements in the manufacture of buttons, and in japanner's ware, and articles in substitution of papier-mâché.

The first part of this invention consists in an improved mode of making buttons. A mixture is made of eight pounds of glue dissolved in water, six ounces of cotton or flock, six ounces of linseed oil, and three ounces of Venice turpentine; then forty pounds of whiting or blue-black, (or a mixture of those matters,) five pounds of lamp-black, and five pounds of fine flour emery, are mixed together; and these two mixtures are combined, forming a composition of the substance of thick dough. This composition is rolled into sheets of from a quarter to half an inch thick, according to the size of button required, and after remaining for a day, it is cut into discs, with the tools ordinarily used for making horn buttons. Wire or other shanks are now to be applied to the discs; and after being pressed into the composition, by the aid of pliers, they are turned partly round, so that their projections may be well imbedded in the backs of the discs. The discs are next brought to the form of the intended button, by pressure between dies, and are then coated by means of a brush, with a composition of white of egg, mixed with Prussian or Italian blue, (to colour it,) and well ground together; when this is dry, the discs or buttons receive two or three coats of a varnish, composed of naphtha polish ground with a little Prussian or Italian blue. The buttons are then pressed in cold dies, engraved or not, as in making horn buttons; after which the rough edges are removed, and a coating of varnish is applied to the edges and back.

Black buttons are produced by the process above described; but dark-coloured ones may be made by mixing suitable colours with the coatings of egg and varnish, together with or instead of the Prussian or Italian blue. A light drab, or other light colour, is obtained by omitting the lamp-black and using suitable colouring materials, and more whiting or white-lead; a corresponding colour being also given to the white of egg and varnish. Instead of whiting, other earthy powder and white lead may be employed; and paper or other fabric may be applied to one or both surfaces of the disc, as hereafter described for japanner's ware.

The second part of the invention consists in improvements in making japanner's ware, and articles in substitution of papier-mâché. The mode of operation is as follows:—Six pounds of glue dissolved in seven gallons of water, twelve pounds of flour, six pounds of sharps, (separated from flour,) nine pounds of spent hops, four pounds of whiting, and two pounds of finely cut hair, are reduced by boiling to a thick paste, which, after it has become cool, is rolled into sheets of the required size for manufacturing trays or other articles. To make a tray or similar article, a sheet of the composition is placed between two thin sheets of paper, and subjected to pressure, between a pair of moulds or dies, for an hour or more, to cause it to assume the desired shape; two thick sheets of paper are now damped, and one is applied to each die; after which paste (consisting, by preference, of equal parts by weight of flour and glue) is spread over each sheet, and over thin sheets of paper which enclose the composition, and the whole is subjected to great pressure between the dies for about an hour. The tray, thus far made, is then placed between two iron trays of the same shape and dried in a stove; when dry, it is removed from the iron trays and dressed; then dipped in oil, and finished in the usual manner of treating japanner's ware.

The following is another method, adopted by the patentee, for making trays and other articles of japanner's ware, or in substitution of papier-mache.—Six pounds of pulp, (made in the ordinary manner,) in a stiff state, one pound of [illegible], one pound of spent hops, one pound of fuller's earth, and one pound of flour, with or without glue, are mixed with water, so as to form a thick yet fluid composition, which is run on to a sieve (such as is used in making paper by hand) and a sheet of a suitable thickness for making a tray or other article is thereby produced. After standing for a few minutes the sheet of composition is inserted between two felts or flannels, and placed in a press (in this state, when dry, it may be used for making buttons, instead of the ordinary button-board), after which, the sheet is taken from between the felts or flannels, and submitted to pressure between dies to bring it to the required form; it is then clamped, or otherwise secured between two sheet-iron shapes or moulds, and dried in a japanner's oven; when dry, it is dressed, treated with oil, and finished in the ordinary manner.

The patentee does not confine himself to the materials or proportions above mentioned, but he claims, Firstly,—the mode, herein described, of making die and pressure made buttons by employing a composition of fibrous materials and adhesive matter with other materials. Secondly,—the mode of making japanner's ware and articles in substitution of papier mache by applying a composition of fibrous materials with adhesive matter between surfaces of paper, as herein described. Also the mode of making japanner's ware and articles in substitution of papier mache and button board for making buttons by combining fibrous materials with adhesive matter and pulp, as herein described.

## THE GEYSERS

ICELAND may be considered as a mass of volcanic matter, the only substances not of volcanic origin in the whole island being beds of surturbrand or bituminous wood, in which occur leaves, trunks, and branches of trees, with clay and ferruginous earth. These strata support an alternation of basalt, tufa and lava, forming the summit of the hill in which these vegetable remains occur. The Geysers, of which there are a considerable number, are springs, or rather intermittent fountains of hot water, which issue from crevices in a bed of lava. A fountain of boiling water first appears, and is ejected to a considerable height, accompanied with a great evolution of vapour; a volume of steam succeeds and is thrown up with great force, and a terrific noise like that produced by the escape of steam from the boiler of an engine, and this operation continues sometimes for more than an hour; an interval of repose of uncertain duration succeeds, after which the same phenomena are repeated. If stones are thrown into the mouth of the cavity, from which the fountain has issued, the stones, after a short interval, are ejected with violence; and again a jet of boiling water, vapour, and steam appear in succession. Sir G. S. Mackenzie, in his interesting work, "Travels in Iceland," has proposed an ingenious theory, also adopted by Mr Lyell, to explain these phenomena.

The water from the surface percolates through crevices into a cavity in the rock, and heated steam, produced by volcanic agency, rises through the fissures in the lava. The steam becomes in part condensed, and the water filling the lower part of the cavity is raised to a boiling temperature, while steam under high pressure occupies the upper part of the chasm. The expansive force of the steam becomes gradually augmented, till at length the water is driven up the fissure or pipe, and a boiling fountain with an escape of vapour is produced, and continues playing till all the water in the reservoir is expended, and the steam itself escapes with great violence till the supply is exhausted.

The siliceous concretions formed by these springs cover an extent of four leagues. M. Eugene Robert, who has recently visited Iceland, states that this curious siliceous formation may be seen, passing by insensible gradations, from a loose friable state, the result of a rapid deposition, to the most compact and transparent marbles, in which impressions of the leaves of the birch tree, and portions of the stem are distinctly perceptible and present the appearance of the agatized woods of the West Indies. Stems and leaves of Equiseta, and different mosses, also occur, but none of these plants now exist in the island, the species appearing to have been wholly destroyed by the siliceous deposits. Numerous thermal springs, in the midst of which the Geysers are situated, occupy the valley in the interior of the island. It is evident that these waters arise from deep crevices in which they have been heated by volcanic fires. The rivers proceeding from the springs often resemble milk in appearance, owing to the argillaceous bole which they take up in their passage among the siliceous concretions: such are the white rivers of Olassai. Mount Hecla, like all the mountains of Iceland, is entirely covered with snow, and no smoke appears on its summit. Accumulations of rolled masses of obsidian and pumice stone form a layer on the flanks of the mountains, thirty feet thick; fragments of branches of the birch-tree occur in the midst of this bed; they are the remains of the ancient forests of the island, which the volcanic eruptions have entirely extirpated.

This extensive modern formation of silicious deposits, is a fact of great interest and importance. It tells us in language that cannot be mistaken, that the most solid and refractory substances may be reduced into a liquid state, and assume other modifications, merely by the agency of thermal waters; hence the envelopment of the delicate corals, shells, and spices, in flint nodules is readily explained.

## MR VALENTINE'S SUBSTITUTE FOR THE IRON RAIL

AT a recent meeting of the projectors of the Waterford and Kilkenny Railway, Mr Valentine stated it to be his intention to substitute for the iron rail the wooden rail lately introduced; and this wood to be prepared by a process for chemically transmuting the timber by the injection of two salts, alkaline and metallic, which, by decomposition, produced insolubility, destroyed the vegetable quality, and, acting on the petrifying principle of nature, prevented the decay of the wood; but though it would seem thus petrified, still its elasticity was not destroyed. He would state an experiment which he made a short time since with hydraulic pressure upon a piece of beech 3½ inches square; he placed on it the segment of a wheel of iron, and then laid upon it the weight of 140 tons, which, had not the wood undergone the process before described, would have had the effect of completely crushing it: it was indented three-eighths of an inch, but when the weight was removed, the deflexion was lessened one eighth of an inch, and in a fortnight it completely recovered its original figure. He considered that the result of the experiment fully justified him in saying that any weight to which it might be subjected, when laid down, would not crush the wood, because a rail would never be subjected to more than six or seven tons at a time. He further stated that it was allowed on all hands that not ouly the rails but the engines and the carriages could be constructed with the greatest economy, and it might be calculated that in the first formation of the line, the expense would be reduced thirty per cent., with the same or even a greater degree of efficiency. There were also other advantages in this system; ground could be passed over which would render the formation of lines on other principles impracticable, and it also admitted of the use of curves of a small radius to allow of passing round the demesnes and houses of gentlemen; extensive excavations of embankments were avoided, and it was next to an impossibility that the carriages would run off the rails, as might be observed by examining the model. The wooden rail which he now produced had been s bjected to the Kyanising process, and had absolutely for a length of time formed a portion of a line over which an engine had passed 28,000 times. It was a piece of Scotch fir, which in its natural state was well known to be one of the softest woods, and yet it might be seen that not the slightest friction or abrasion had taken place, and even the saw marks had not been obliterated. The rails should be formed square, and as soon as one side was worn the rail could be turned, till the whole sides had performed their duty.

## VARIETIES.

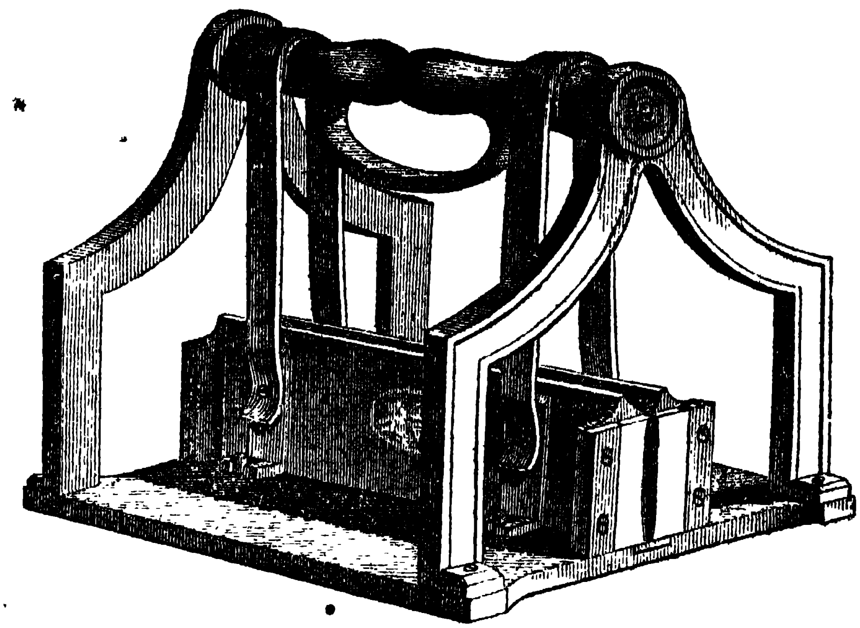
*Principal Gold Mines.*—Spain anciently possessed mines of gold in regular veins, especially in the province of Asturias; but the richness of the American mines has made them be neglected. The Tagus, and some other streams of that country, were said to roll over golden sands. France contains no workable gold mines; but it presents in several of its rivers auriferous sands. There are some gold mines in Piedmont; particularly the veins of auriferous pyrites of Macugnagna, at the foot of Monte Rosa, lying in a mountain of gneiss; and although they do not contain 10 or 11 grains of gold in a hundred weight they have long defrayed the expense of working them. On the southern slope of the Pennine Alps, from the Simplon and Monte Rosa to the valley of Aoste, several auriferous districts and rivers occur. Such are the torrent Evenson, which has afforded much gold by washing; the Orco, in its passage from the Pont to the Po; the reddish grounds over which this little river runs for several miles, and the hills in the neighbourhood of Chivasso contain gold spangles in considerable quantity. In the county of Wicklow, in Ireland, a quartzose and ferruginous sand was discovered not long ago, containing many particles of gold, with *pepitas* or solid pieces, one of which weighed 22 ounces. No less than 1000 ounces of gold were collected. There are auriferous sands in some rivers in Switzerland, as the Reuss and Aar. In Germany no mine of gold is worked, except in the territory of Salzburg, amid the chain of mountains which separates the Tyrol and Carinthia.—*Ure's Dict.*

*Perkins's Transfer Engraving.*—Mr. Perkins's admirable process of Transfer Engraving may be thus explained:—A soft steel plate was first engraved with the required subject in the most finished style of art, either by hand or mechanically, or the two combined, and the plate was then hardened. A decarbonized steel cylinder was next rolled over the hardened plate by powerful machinery until the engraved impression appeared in relief, the hollow lines of the original becoming ridges upon the cylinder. The roller was re-converted to the condition of ordinary steel and hardened, after which it served for returning the impression to any number of decarbonized plates, each of which became absolutely a counterpart of the original; and each plate when hardened would yield the enormous number of 150,000 impressions without any perceptible difference between the first and the last. In the event of any accident occurring to the transfer roller, the original plate still existed, from which another or any required number of rollers could be made, and from these rollers any number of new plates, each capable of producing as many impressions as above cited.—*Holtzapffel.*

*Manchineel.*—This is a large tree of the West Indies and South America; the wood possesses some of the general characters of mahogany, and is similarly used, but it is much less common. The wood is described as a yellow brown, beautifully clouded, and very close, hard and durable. It is said the Indians poison their arrows with its juice, and that the wood-cutters make a fire around it before felling it, to cause the injurious sap to run out, to avoid injuring their eyes. This has been accurately described in Bancroft's Guiana, p. 36—7, and Colonel Lloyd says of it; "The juice of this tree is a most deadly poison: it bears a little apple appearing so like the English fruit, and so tempting, that many new-comers have been poisoned by eating it. The tree is poisonous while green; sleeping under it has the most deadly effect, and I have myself been blistered most severely by passing under one in a shower of rain, when some of the drops have fallen on me; its effects are like molten lead"—*Holtzapffel.*

*How to destroy Ants.*—Take a saucer, smear the inside slightly with honey, place it inverted near their haunts; in an hour examine the saucer, and see if the honey be all gone; if not, let the saucer remain until it is. When it is all gone repeat it, and let them eat it off. Do this a third time; but now, when many are under the saucer feeding (and I have found hundreds), having with you a basin of boiling water, gently raise the saucer without turning it up, and hold it within an inch or two of the hot water; the ants feeling the steam will drop, and of course die. Put the saucer, renewing the honey, in the same place, and in a quarter of an hour steam again, and so on, until you destroy all, which will be done in a very short time. As according to the numbers, two or three saucers may be used if wished; but I have found one always sufficient. By this means you kill all the workers, and by killing them, I need not say destroy the colony.—*W. H. G. in Gardener's Chronicle.*

*Vignole's Carpet Tapestry*—is made on the principle of the ancient mosaics, being composed of innumerable transverse sections of woollen threads. No painting, no colouring is used; all the effect is produced by ends of worsted, about one-eighth of an inch long standing vertically, one end being seen, and the other cemented by Indian-rubber to a cloth. From the facility of reproduction, this fabric is likely to come into general use for carpets, rugs, curtains, table and chair covers, &c.



KNIFE CLEANING MACHINE.

MADDEN'S PATENT KNIFE CLEANER.

THIS very ingenious and useful article has lately been brought before the public, which, in addition to many advantages, preserves the knives brought under its operation, an equal pressure being applied to all parts of the blade. There is no noise or dust in using. Its portability is also another great recommendation; it occupies so little room that it may be placed on a table, or carried with ease to any place that may be desired. The absence of noise and dust before mentioned, renders it invaluable for cleaning knives direct from the table in the nearest and most convenient place, and it performs its work in a very effectual manner. We consider it a decided improvement on the old fashioned knife-board, and recommend it accordingly.

VOLCANOES.

THE celebrated mountain of Vesuvius, or Somna, is about 4000 feet high, and its summit is now broken and irregular; but, observes Mr. Lyell, when northern Italy was first colonized by the Greeks, "its cone was of a regular form, with a flattish summit, where the remains of an ancient crater, nearly filled up, had left a slight depression, covered in its interior by wild vines, and with a sterile plain at the bottom." From the earliest period to which tradition refers, to the first century of the Christian era, the mountain had exhibited no appearance of activity, but we then arrive at a crisis in the volcanic action of this district, which gave rise to "one of the most interesting events witnessed by man during the brief period throughout which he has observed the physical changes of the earth's surface." In the year 63 after Christ, the volcano exhibited the first symptom of internal change, in an earthquake which occasioned considerable damage to many neighbouring cities, and of whose effects traces may yet be witnessed among the interesting memorials of the awful catastrophe which afterwards took place. After this event slight shocks of earthquakes were frequent, when on the 24th of August, in the year 79, a tremendous outburst of the long pent-up incandescent materials of the volcano took place, and spread destruction over the surrounding country, overwhelming three cities, with many of their inhabitants, and burying all traces of their existence beneath immense accumulations of ashes, sand, and scoriæ. All the fearful circumstances connected with this event, and the attendant physical phenomena, are so well known, that it is unnecessary to dwell upon the subject.

From that period the internal fires of Italy have resumed their ancient focus, and Vesuvius, with occasional periods of tranquillity, has been more or less active to the present time. The principal eruptions are recorded in Mr. Lyell's interesting volume on the Principles of Geology. He mentions one remarkable event which happened in 1538. After frequent earthquakes, a gulf opened near the town of Tripergola, which discharged mud, pumice-stones, and ashes, and threw up in one day and night a mound of volcanic materials, now called Monte Nuovo, a mile and a half in circumference at the base, and 440 feet in height; at the same time the coast to beyond Puzzuoli was permanently elevated many feet above the level of the Mediterranean.

In the early periods of activity, violent explosions, with showers of scoriæ, ashes, and sand, characterized the eruptions of Vesuvius, but since the existence of the present crater, lava currents have generally been ejected. The appearance of an ordinary eruption, seen by night, is thus graphically described by a late traveller:—

"It was about half-past ten when we reached the foot of the craters, which were both tremendously agitated; the great vent threw up immense columns of fire, mingled with the blackest smoke and sand. Each explosion of fire was preceded by a bellowing of thunder in the mountain. The smaller mouth was much more active; and the explosions followed each other so rapidly, that we could not count three seconds between them. The stones which were fourteen seconds in falling back to the crater; consequently, there were always five or six explosions—sometimes more than twenty—in the air at once. These stones were thrown up perpendicularly, in the shape of a wide-spreading sheaf, producing the most magnificent effect imaginable. The smallest stones appeared to be of the size of cannon-balls; the greater were like bomb-shells; but others were pieces of rock, five or six cubit feet in size, and some of the most enormous dimensions; the latter generally fell on the ridge of the crater, and rolled down its sides, splitting into fragments as they struck against the hard and cutting masses of cold lava. The smoke emitted by the smaller cone was white, and its appearance inconceivably grand and beautiful; but the other crater, though less active, was much more terrible; and the thick blackness of its gigantic volumes of smoke partly concealed the fire which it vomited. Occasionally both burst forth at the same instant, and with the most tremendous fury; sometimes mingling their ejected stones.

"If any person could accurately fancy the effect of 500,000 sky-rockets darting up at once to a height of three or four thousand feet, and then falling back in the shape of red-hot balls, shells, and large rocks of fire, he might have an idea of a single explosion of this burning mountain; but it is doubtful whether any imagination can conceive the effect of one hundred of such explosions in the space of five minutes, or of twelve hundred or more in the course of an hour, as we saw them. Yet this was only a part of the sublime spectacle before us.

"On emerging from the darkness, occasioned by the smaller crater being hidden by the large one, as we passed round to the other side of the mountain, we found the whole scene illuminated by the river of lava, which gushed out of the valley formed by the craters and the hill on which we now stood. The fiery current was narrow at its source, apparently not more than eighteen inches in breadth, but it quickly widened, and soon divided into two streams, one of which was at least forty feet wide, and the other somewhat less; between them was a sort of island, below which they re-united into one broad river, which was at length lost sight of in the deep windings and ravines of the mountain."

In an eruption witnessed by Sir W. Hamilton, jets of liquid lava, mingled with stones and scoriæ, were thrown up to a height of ten thousand feet. The liquid streams of lava issue with great velocity, and are in a state of perfect fusion; but as they cool on the surface, they crack, and the matter becomes vesicular or porous; at a considerable distance from their source they resemble a heap of scoriæ or cinders from an iron foundry, rolling slowly along and falling with a rattling noise one over the other.

The cone of Vesuvius consists of concentric coatings of lava, sand, and scoriæ, inclining outwards from the axis of the mountain in an angle of from 30° to 45°. The fissures and rents produced in the cooled lavas and beds of volcanic products, by the earthquakes which generally precede eruptions, become filled up by subsequent ejections of melted matter, and form dykes and veins; when these are injected into masses of materials which readily decompose, the solid and durable matter of the dyke remains in the form of vertical walls, of which many striking examples occur in Etna, and are figured and described by Mr. Lyell in the third volume of his Principles of Geology.

Lava is a term applied to any rock liquefied by heat; when consolidated by cooling, it may be in a state of scoria, pumice, basalt, obsidian, trachyte, &c., according to its mineral composition, and its slow or rapid refrigeration. The chief constituents of lavas are the substances called felspar and augite, and titaniferous iron, and the lavas are classed according as either of these ingredients predominates. When the felspar prevails, the mass is called *trachyte*, which is generally of a coarse grain, with a harshness of texture, and a degree of porosity; when the grain is fine and compact, but irregular, it constitutes, *trachytic porphyry;* when the particles are so fused as to have a resinous or glassy texture, it forms *pitchstone* and *obsidian.* If augite or titaniferous iron constitute a large proportion of a rock, it is termed *basalt,*—when the structure is slaty, it forms *clinkstone.*

The Vesuvian lavas present considerable variety of appearance and structure; pumice-stone, scoriæ, and vesicular, or full of hollow cells; compact and heavy like iron; yellowish, or greenish-grey, or black; and internally spotted with red, yellow, brown, or grey; crystallized quartz and hornblende, so abundant in granite, are extremely rare; but mica occurs plentifully in some recent trachytes. Pumice is supposed to have been produced from a considerable disengagement of vapour, while the lava was in a plastic, but not entirely in a fluid state,—the escape of the gaseous matter giving rise to the porous structure of this substance. But we will not embarrass the reader by naming and describing minerals, the nature of which cannot be thoroughly understood without patient examination of specimens. The number of simple minerals found in the rocks of Vesuvius amount to 400 species.

In some of the ancient lavas of Vesuvius, there are decided indications of a concretional and prismatic structure, and a tendency to divide them into columns. Tuff designates beds formed of scoriæ, sand, and ashes, which have either been wafted by the winds, and fallen into the sea, or washed down by torrents on the plains, and agglutinated together. The conglomeration called peperino, and the lapilli or pisolitic globules of earthy watter, appear to have been formed by showers of rain falling through an eruption of fine volcanic sand. With this rapid notice of a few of the principal constituents of the products of volcanic eruptions, we must pass to the consideration of other phenomena connected with this subject.

The effects produced by lavas, and their slow or rapid progress, depend, of course, on their degree of incandescence and fluidity. Lava currents from Vesuvius have flowed a mile and a half in fourteen minutes; others have reached the sea in three hours from the summit of the mountain, a distance of 3200 yards. The lava stream which destoyed Catania in 1669, was fourteen miles long and five wide. In Etna, currents have been traced forty miles in length; and a stream that issued from Mount Hecla, in Iceland, is computed at ninety-four miles by fifty. Some streams are very sluggish, and diverted from their course by any considerable obstacle; many retain a high temperature for many years. A curious circumstance occurs when trees are enveloped by lava: the upper parts and the branches alone burst out into a flame, while the trunk is only carbonized; and, if subsequently removed, may leave its impression in a hollow, cylindrical tube within the solid rock. Such moulds are common in the Isle of Bourbon, in those lava currents that have extended their ravages through forests of palm.

*(To be Continued.)*

## ORNAMENTAL POTTERY AND MOSAIC WORK.

Mr. Richard Boote, of Burslem, Staffordshire, has recently patented some improvements in pottery and mosaic work.

The specification describes several methods of impressing devices on pottery, which are as follows. First, in order to produce a coloured design upon a ground of different colours; the device is first made in a mould of the form required, commonly called "figuring;" the devices or impressions thus obtained are then to be put into the mould in which the ware is to be made: the material of the ware when poured into the mould will be found to adhere very closely round the edges of the device, and the same will be embedded therein. The second method consists in cutting the device in pieces of paper or parchment, which are then to be put in the mould; the two halves of the mould are then fastened together, and the matter which is to form the ground of the ware is to be poured in; after having stood the necessary time, the parchment or paper forming the device is to be removed, and the colour intended for the device poured in, which will fill up the spaces previously occupied by the paper device. Thirdly, in order to produce raised figures of a different colour from the ground, the figures are first of all engraved or otherwise formed in low relief in a plaster mould: this being done, the colour intended for the raised figures is poured into those parts of the mould which form the figures: the halves of the mould are then put together, and the slop intended for the ground poured in and allowed to stand a sufficient time to form the body of the ware. If the slop is of an expensive nature it will only be necessary to let the slop remain a sufficient time to form a thin coating, after which it may be withdrawn and the subtratum filled in with a commoner slop.

Lastly, in producing devices of a mosaic character, the designs are fixed on the halves of the moulds with a composition of the required colour; the halves of the mould are then fastened together, and the slop intended for the body of the ware poured in; after having stood a short time, and the slop adhered the required thickness, the remaining liquor can be withdrawn.

## WORSTED MANUFACTURE.

*(Continued from Page 268.)*

Alderman Cockayne and other London merchants had sufficient influence with James I. (whose kingcraft, like that of his predecessor, delighted in granting monopolies) to obtain the prohibition of the export of white cloths, and the exclusive privilege of *dressing* and *dyeing* cloths. In consequence of this preposterous act, the Germans and Dutch immediately prohibited the importation of dyed cloths from England, and thereby gave so great a check to our export trade in woollens, that in a few years it fell to one-third of its former amount. The wool was also depreciated by this measure from 70 to 80 per cent. After having inflicted much misery on the country by this disgraceful piece of legislation, the government at length took off the restrictions, and left the export of white cloth free.

The first act of parliament which absolutely prevented the exportation of wool by making it a felony, which could not be set aside by a royal license, is the 12th of Charles II., which was passed soon after the Restoration. To escape from this and other legislative shackles, Thomas Telham of Warwickshire, and two thousand manufacturers, left the kingdom, in the year 1665, and established woollen manufactures in the Palatinate, under the wise patronage of the Elector. They were soon thereafter reinforced by a band of manufacturers from Herefordshire.

It deserves particular notice, that during the prevalence of monopolies and protections, from the reign of Elizabeth to the year 1668, the woollen manufacture remained quite stationary in England, while it was making remarkable advances, both in quality and extent, in the neighbouring nations. In that year, however, Brewer, with about fifty Walloons, came over to England, and received Royal encouragement in the working and dyeing of fine cloths from Spanish wool alone, without admixture of inferior wool,—arts unknown to this nation before, and indeed declared to be impossible. They produced them 40 per cent. under their former price. The backwardness of England in this important branch of trade has been accounted for by Huet as follows:—"It was owing to the municipal laws of England, and its usages towards strangers; who, besides being doubly rated at the custom-house, were excluded from all companies or fraternities of trade; and were not allowed to carry on manufactures as masters or partners, unless such as the natives were unacquainted with; so that none of the Flemish master manufacturers of fine cloth went thither, theirs being a mystery not accounted new, though very much superior to the cloth-working then known in England. It was only those who worked in new kinds of worsteds, serges, damasks, or stockings, who went thither."

In the year 1662, the Company of Merchant Adventurers declared, in a public memorial, that the white-clothing trade had abated from 100,000 pieces to 11,000! Such was the baneful result of impolitic legislation. An extremely foolish act of the lord-mayor and common-council of London was passed in 1678, "for the regulating the cloth markets of the city, and for *preventing foreigners buying and selling!*" "Foreigners" is here a term of most exclusive import, as it denotes all persons not free of the corporation. This emanation of selfish fatuity prohibits the sale of all woollen cloths sent to London, except at three specified halls, amerces them in certain duties, and forbids their removal for three weeks, unless they were meantime sold to some draper or other freemen of the city. The door-keepers were to attend strictly at the halls, and turn out all foreigners and aliens coming to purchase cloth. They further ordained, that every freeman of the city who should introduce such a stranger into the halls should forfeit, for the first offence, five pounds—for the second, ten—and for the third, fifteen pounds!

That the commercial senate of the metropolis should pursue a policy so idiotic as to expel purchasers from their public markets, would be incredible at the present time, did we not hear strange sophistry still employed by certain city sages in favour of the most absurd system of monopoly.

The American war gave a disastrous interruption to our old staple manufacture, and caused the price of wool to fall, towards its close, lower than ever it had been even when money was more valuable. A tod of twenty-eight pounds of the best Lincolnshire wool, for combing, fetched no more than nine shillings, and of inferior kinds only six shillings, that is from three-pence to fourpence per pound weight.

It does not appear that for upwards of a century and a half any very essential alteration or improvement had been made in the *processes* of manufacture, either for woollen or worsted fabrics, beyond the variations of colours and patterns, accommodated to the caprice of fashion. But fortunately for our clothiers, the ingenious mechanical inventions and arrangements of Arkwright, for the carding and spinning of cotton-wool, were soon modified to suit the two staples of sheep's wool, and produce an entire revolution in the woollen and worsted trade. Since this memorable era, the manufactures of heavy woollens and coarse worsted goods have been vitalized by mechanical power, have gradually expanded themselves in Yorkshire, Lancashire, and Gloucestershire, where, from cheapness of living, the industrious spirit of the inhabitants, the abundance of coal, and water-streams, they enjoy immense advantages over what they had possessed in mere hand-labour in the midland and western counties, were fuel is scarce. In the year 1738, the total number of pieces of broad and narrow cloths made in the West Riding of Yorkshire, was under fifty-seven thousand. In 1817 it amounted to upwards of four hundred and eighty-three thousand, having increased nearly ninefold, though our whole woollen exports were only doubled in the same interval. We thus see how the districts which were most forward in adapting mechanical inventions to the woollen trade have gained the ascendency in the manufacture over the ancient localities. About the year 1782, the quantity of British wool unsold, in the hands of farmers, was nearly equal to three years' annual growths,—a quantity too large to have been consumed by our manufacturers, had not the introduction of machinery enabled them to work it up with much greater facility than in former times, when few masters used more than one pack per week each, instead of one hundred, a not unusual quantity now. Mr. John Brooke, of Dewsbury, manufactures weekly about 110 packs of wool, in carpets and blankets, chiefly of the short-stapled foreign wool of moderate quality, because it is cheaper than the British. Under what a debt of gratitude have the agricultural interest been laid to the mechanical arts in this single branch of industry! How narrow must the mind of the landholder be who denounces and seeks to shackle factory labour!

In carpets, worsted yarn is used for the warps, and woollen yarn for the wefts. In Wilton carpeting, there is both a linen warp and a worsted warp.

Mr. Francis, of Heytesbury, Wiltshire, says, speaking of his own establishment in the year 1828, "the total quantity of our manufacture per week is 15,000 yards, and we are obliged to use entirely foreign wool, because the cloth made from the mixture of foreign and English sells so much less freely, and bears a less profit. The English clothing wool has altered for the worse in its quality for the last ten years. There is a difference of 1s. a yard between cloths made of the two wools at the same price. The English wool also wastes 5lbs. in the score, and the other only 2½lbs., by loss of animal grease."

"I could not make an article that would be merchantable at all, except of foreign wool. I am of opinion that the French cloth is not superior to ours in the manufacture or the dyeing. The great importation of foreign wool has, in my opinion, aided the price of British wool; it has aided it in some instances by a mixture with it. We could not have executed the whole of an order unless we had had the two. We export eight parts of British to one of foreign in our own works. There is very little demand at home now for British wool in clothing; but there is for it in blankets, bear-skins, and such articles."

Hence, by the plan of mixture, much low English wools are consumed in our cloth manufacture, that would otherwise find no market at all.

The Prussians manufacture cloth with much address, and are our most powerful rivals.

The following interesting particulars are extracted from the Lords' Committee's Report on Wool, in 1828.

"A yard of army clothing costs about 4s.; and weighs, in its finished state, one pound ten ounces. Five pounds' sterling worth of wool is worked into twelve pounds and ten shillings worth of cloth. The cost of manufacturing finer cloth for gentlemen from their own wool, is 9s. a yard.

"Nap coatings at about 3s. weigh 14 ounces, and consume about 24 ounces of wool at 9d. per pound, per yard.

"Duffils weigh per yard one pound ten ounces, and consume 2½lb. of wool, of low quality mixed with noils.

"Common worsted stuffs, made from long combing wool cost 15s. or 16s. a piece of 28 yards. Merino gown and shawl pieces of 28 yards, cost about 34s. The former weigh about 2¼ ounces per yard; and consume about four times that weight of fleece-wool.

"About an ounce of indigo is requisite to dye a yard of army cloth; and to complete the blue dye, or the red with madder, costs 7d. per yard.

"In consequence of the reduction of the duty on foreign wool from 6d. to 1d. per pound in 1824, and the speculating mania in 1825, the importation of German wool in these years glutted the market to such a degree, that our short-stapled wool fell from 1s. 3d. to 7d., and the long stapled from 1s. 2d. to 10d. In 1828 the prices began to rally, so that in 1833 Southdown wools fetched 1s. 2d.; our combing wools 1s. 4d.; and German wools, which had been so low as 1s. 6d., rose to

2s. 6d. Wools above 3s., however, have not advenced in price. The rise in foreign wools was owing, in a great measure, to the increase of the manufactures on the continent, especially in Belgium, and to the successful competition of the goods of the latter with the English in the Grecian Archipelago.

"Such has been the improvement in the course of the last twenty years in the quality of the best broad-cloths, that if a piece of Sheppard's celebrated Imperial cloth were now brought into the market it would not sell. The processes of art are better understood, and are carried on with superior machinery, as will presently be shown. The cropping or shearing-machine was contrived by a gentleman of the name of Lewis, in Gloucestershire, the idea of it having been suggested by the sight of an American invention for the same purpose.

"There is no wool which spins so well as the improved Australian does, in consequence of the length of its staple and its softness; and it has increased so much in quantity of late, that in the course of fifteen years it will probably suffice for the supply of all the import wool to our manufactures, to the exclusion of the Spanish and German wools. It is also better for combing purposes than any other description, and is at present altogether consumed in the finest worsted goods, such as merinos and cassinets. Some of it has fetched so high a price as 3s. 9d. a pound in the fleece. The German fleeces seldom sell here at more than 2s. 6d. or 2s. 9d.; but the finest usually come in an assorted state, and fetch 6s. 6d. per pound. The sad disclosures made by the Committee of the House of Lords in 1827, deterred the foreign wool-growers from sending it here, and caused the prices to rise in this country."

The following table gives the quantity of wool imported from Australia alone in pounds weight, on the authority of Mr. Henry Hughes:—

| Year. | New South Wales. | Van Dieman's Land. | Total Australia. |
|---|---|---|---|
| 1821 | —— | —— | 497 Bags. |
| 1827 | 320,683 | 122,075 | 5,531 |
| 1828 | 967,814 | 528,845 | 2,564 |
| 1829 | 913,322 | 925.320 | 6,865 |
| 1830 | 973,330 | 993,975 | 9,193 |
| 1831 | 1,134,134 | 1,359,203 | 11,598 |

England grows about 995,000 packs of wool, and imports 96,000 bags, a year.

*(To be continued.)*

## DRYING OF BRICKS AND TILES.

A Patent has lately been granted to John Ainslie, of Dalkeith, North Britain, farmer, for "A new or improved mode of drying bricks, tiles, retorts, and such like work made from clay and other plastic substances."

The object of this invention is to dry bricks, tiles, &c., made from clay, during the winter and unseasonable parts of the year, by means of artificial heat and a current of air, which removes the vapour from the tiles and bricks as it accumulates, thereby preventing the evaporation being checked. The bricks, &c., to be dried are placed upon carriages provided with shelves; these carriages, which may be placed upon a railroad, are then run into a closed shed or chamber, heated by means of flues passing underneath the floor, or by steam, or the circulation of hot water, or the admission of heated air through small apertures, to be about 80° Fahr. The close chamber being heated by any convenient means as above. Cold air may be admitted at certain apertures so as to regulate the temperature of the room; and in order to remove the vapour as it rises from the tiles, &c., an artificial current may be formed by means of a fanner, worked by steam or horse power, or other mechanical means, as will be well understood. The patentee prefers the current of air to be worked about six feet per second; but this, together with the temperature, may be increased, taking care that it be not too high, so as to crack the clay when drying.

## THEORY OF TERRESTRIAL MAGNETISM.

Since the earth is evidently a source of magnetic action, it becomes important to investigate the cause or causes from which it derives its origin, and what the nature of its magnetic condition may be.

Dr. Gilbert first suggested that the earth may contain within itself, and in a position nearly coinciding with its axis of rotation, a powerful magnet. If this were the case, that pole of the magnet which acts in our northern hemisphere, must have a southern polarity; and that pole in the southern a northern, the former attracting the north, and latter the south pole of the needle. The ordinary phenomena of terrestrial magnetism, may, agreeably to this hypothesis, be represented by placing a bar magnet within a terrestrial globe, and holding a small needle suspended by a fibre at different parts of its surface. When held in the northern hemisphere, it will always point to the north end of the enclosed magnet, exhibiting all the phenomena of the variation of the needle as usually observed: at the equator it will have no dip, each pole being equally attracted by the corresponding pole of the enclosed magnet; and at the poles, the dip will be 90°, as observed by Commander Ross, at the northern magnetic pole.

The phenomena of the dip are, however, more complicated than the hypothesis will allow us to suppose. Some observations of Hansteen, in Siberia, have led him to imagine that there is another magnetic pole in that country, which regulates the magnetic phenomena. In order to reconcile this with the theory of Gilbert, another magnet must be supposed to pass through the globe in the direction of a diameter, whose pole coincides with the Siberian magnetic pole; but even this addition would be adequate. The theory which has been long gaining ground is, that the magnetism of the earth is as that of a *spherical shell of iron*, on which magnetism is induced. In such a mass, and, indeed, in every mass of iron, either regular or irregular, solid or hollow, the centres of action are always coincident with the *centre of attraction of the surface of the mass;* whereas, the centres of action in *regular* magnets are placed *at*, or close to, their extremities. The magnetism of the earth, recent and numerous observations have shown, cannot be explained by the action of two magnetic poles at a distance from each other. On the contrary, Biot has observed, that the nearer the poles were taken to each other, the greater was the agreement between the computed and observed results. This idea has been adopted by almost every philosopher who has investigated the subject; and the only difficulty is to assign a cause for the induced magnetism. The following are the speculations of Hansteen:—

"For these reasons it appears most natural to seek their origin in the sun, the source of all living activity; and our conjecture gains probability from the preceding remarks on the daily oscillations of the needle. Upon this principle the sun may be conceived as possessing one or more magnetic axes, which, by distributing the force, occasion a magnetic difference in the earth, in the moon, and in all those planets whose internal structure admits of such a difference. Yet allowing all this, the main difficulty seems not to be overcome, but merely removed from the eyes to a greater distance; for the question may still be asked with equal justice, *whence did the sun acquire its magnetic force?* And if from the sun we have recourse to a central sun, and from that again to a general magnetic direction throughout the universe, having the milky way for its equator, we but lengthen an unrestricted chain, every link of which hangs on the preceding link, no one of them on a point of support. All things considered, the following mode of considering the subjects seems to be most plausible. If a single globe were left alone to move freely in the immensity of space, the opposite forces existing in its material structure would soon arrive at an equilibrium conformable to their nature, if they were not so at first, and all activity would soon come to an end. But if we imagine another globe to be introduced, a mutual relation will arise between the two; and one of its results will be a reciprocal tendency to unite, which is designated, and sometimes thought to be explained, by the merely descriptive word *attraction*. Now, would this tendency be the only consequence of this relation? Is it not more likely that the fundamental forces, being driven from their state of indifference of rest, would exhibit their energy in all the possible directions, giving rise to all kinds of contrary action? The electric force is excited not by friction alone, but also by contact, and probably also, although in a smaller degree, by the mutual action of two bodies at a distance; for contact is nothing but the smallest possible distance, and that moreover only for a few small particles. Is it not conceivable that magnetic force may likewise originate in a similar manner? When the natural philosopher and the mathematician pay regard to no other effect of the reciprocal relation between two bodies at a distance, except the tendency to unite, they proceed logically, if their investigations require nothing more than a moving power; but should it be maintained that no other energy *can* be developed between two such bodies, the assertion will need proof, and the proof will be hard to find.

"I reckon it possible, therefore, that by means of the mutual relation subsisting between the sun and all the planets, as well as between the latter and their satellites, a magnetic action may be excited in every one of those globes, whose material structure admits of it, in a direction depending on the position of the rotatory axis with regard to the plane of the orbit. Each of the planets may thus give rise to a particular magnetic axis in the sun; but as their orbits make only small angles with the sun's equator and each other, these magnetic axes would perhaps, on the whole, correspond with the several rotatory axes. Such planets as have no moons would, on this principle, have but one magnetic axis; the rest would in all cases have one axis more than they have moons, if those different axes, by reason of the small angles which the orbits of their several moons form with each other, did not combine into a single axis. The conical motions by which the rotatory axes of the planets are carried round the pole of the eliptic (the precession in the earth), joined to the revolving motion of the orbits about the sun's equator (which occasions the present diminution in the obliquity of the ecliptic), might perhaps, in this case, account for the change of position in the magnetic axis. It would greatly strengthen this hypothesis, if the above great magnetic period, after the lapse of which both axes again assume the same position, should in fact be found to coincide with the period of the procession, which, however, seems a little doubtful."

## ARTIFICIAL FUEL.

Ferdinand Charles Warlich, of Eccleston Street, Middlesex, gentleman, has recently obtained a patent for improvements in the manufacture of fuel.

The object of this invention is firstly, the submitting fuel composed of small coal, tar, pitch, or other bituminous matter to a high temperature in a retort. Secondly, the peculiar construction of retorts for effecting the same; and lastly, the application of an exhausting apparatus to such retorts, together with the introduction of air into retorts where fuel of the above description is undergoing the process of drying. The patentee commences by stating that it is not necessary to enter into any description of the manufacture, or mode of combining pitch, coal, tar, and other matter into fuel, as the invention does not apply to the compounding of such fuel: at the same time the inventor states that he prefers the compound of coal and bituminous matter to be as follows:—15 per cent of pitch and coal tar and 90 of small coal, in which may be employed a little "heavy oil" to the extent of from 2 to 5 per cent.; and in order to prevent smoke when such fuel is being consumed, about the same quantity of common salt may be added, or alum dissolved in water. The mixture after being moulded into convenient sizes, is placed in a retort for six or eight hours, and subjected to a heat of from 490° Fahr. and upwards, by which means gases and certain other matters are driven off, which, if permitted to remain, would produce prejudicial effects to which such fuel is said to be subjected.

The retorts, which are of the D form, are built of brick. and are provided with an aperture for the escape of gases, which pass off in the same manner as in the manufacture of gas into an hydraulic main, to which is connected a pipe leading to an exhausting apparatus, which consists of two cylindrical vessels suspended at each end of a beam, and inverted in a tank containing water, so that by raising and depressing the vessels in the water tank, the gases and vapours are exhausted from the retort or retorts, which gases pass off into the atmosphere. At the lower part of the retorts there are a number of apertures which admit a current of warm air, which previous to entering the retort passes through the furnace, so that as the gases are exhausted by the apparatus above described a fresh supply of hot air is continually admitted, which effectually drives off the damp air and vapours from the pieces of fuel, which appears to be the object of this invention. The inventor claims the submitting manufactured fuel, containing bituminous matter to a high degree of temperature; also the introduction of highly heated air, together with the exhausting the products from retorts when applying heat to manufactured fuel, which is placed and inclosed in the same.

## BITUMEN.

It is a very remarkable fact, in the history of the useful arts, that asphalt, which was so generally employed as a solid and durable cement in the earliest construction upon record, as in the walls of Babylon, should for so many thousand years have fallen well nigh into disuse among civilized nations; for there is certainly no class of mineral substance so well fitted as the bituminous, by their plasticity, fusibility, tenacity, adhesiveness to surfaces, impenetrability by water, and unchangeableness in the atmosphere, to enter into the composition of terraces, foot pavements, roofs, and every kind of hydraulic work. Bitumen, combined with calcareous earth, forms a compact, semi-elastic solid, which is not liable to suffer injury by the greatest alternations of frost, and thaw, which often disintegrate in a few years the hardest stone, nor can it be ground to dust and worn away by the attrition of the feet of men and animals, as sandstone, flags, and even blocks of granite are. An asphalt pavement, rightly tempered in tenacity, solidity, and elasticity, seems to be incapable of suffering abrasion in the most crowded thoroughfares; a fact exemplified of late in a few places in London, but much more extensively, and for a much longer time, in Paris.

The great Place de la Concorde (formerly Place Louis Quinze) is covered with a beautiful mosaic pavement of asphalte; many of the promenades on the Boulevards, formerly so filthy in wet weather, are now covered with a thin bed of bituminous mastich, free alike from dust and mud; The foot-paths of the Pont Royal and Pont Carousel, and the areas of the great public slaughter-houses, have been for several years paved in a similar manner with perfect success. It is much to be regretted that the Asphalt Companies of London made the ill-judged, and nearly abortive, attempt to pave the carriage-way near the east end of Oxford Street, and especially at a moist season, most unpropitious to the laying of bituminous mastich. Being formed of blocks not more than three or four inches thick, many of which contained much siliceous sand, such a pavement could not possibly resist the crash and vibration of many thousand heavy drays, waggons and omnibuses daily rolling over it. This failure, can afford, however, no argument against rightly constructed foot pavements and terraces of asphalt. Numerous experiments and observations have led me to conclude that fossil bitumen possesses far more valuable properties, for making a durable mastich, than the solid pitch obtained by boiling wood or coal tar. The latter, when inspissated to a proper degree of hardness, becomes brittle, and may be readily crushed into powder; while the former, in like circumstances, retains sufficient tenacity to resist abrasion. Factitious tar and pitch being generated by the force of fire, seem to have a propensity to decompose by the joint agency of water and air, whereas mineral pitch has been known to remain for ages without alteration.

Bitumen alone is not so well adapted for making a substantial mastich as the native compound of bitumen and calcareous earth, which has properly been called asphaltic rock, of which the richest and most extensive mine is unquestionably that of the *Val-de-Travers*, in the canton of Neufchâtel. This interesting mineral deposit occurs in the Jurassic limestone formation, the equivalent of the English oolite. The mine is very accessible, and may be readily excavated by blasting with gunpowder. The stone is massive, of irregular fracture, of a liver-brown colour, and is interspersed with a few bright spangles of calcareous spar. Though it may be scratched with the nail, it is difficult to break by the hammer. When exposed to a very moderate heat it exhales a fragrant ambrosial smell, a property which at once distinguishes it from all compounds of factitious bitumen. Its specific gravity is 2·114, water being 1000, being nearly the density of bricks. It may be most conveniently analysed by digesting it in successive portions of hot oil of turpentine, whereby it affords 80 parts of a white pulverulent carbonate of lime, and 20 parts of bitumen in 100. The asphalte rock of Val-de-Travers seems therefore to be far richer than that of Pyrimont, which, according to the statement in the specification of Claridge's patent, of November, 1837, contains "carbonate of lime and bitumen in about the proportion of 90 parts of carbonate of lime to about 10 parts of bitumen."

The calcareous matter is so intimately combined and penetrated with the bitumen, as to resist the action not only of air and water for any length of time, but even of muriatic acid; a circumstance partly due to the total absence of moisture in the mineral, but chiefly to the vast incumbent pressure under which the two materials have been incorporated in the bowels of the earth. It would indeed be a difficult matter to combine, by artificial methods, calcareous earth thus intimately with bitumen, and for this reason the mastichs made in this way are found to be much more perishable. Many of the factitious asphalt cements contain a considerable quantity of siliceous sand, from which they derive the property of cracking and crumbling down when trodden upon. In fact, there seems to be so little attraction between siliceous matter and bitumen, that their parts separate from each other by a very small disruptive force.

Since the asphalt rock of Val de Travers is naturally rich enough in concrete bitumen, it may be converted into a plastic workable mastic of excellent quality for foot pavements and hydraulic works at very little expense, merely by the addition of a very small quantity of mineral or coal tar, amounting to not more than 6 or 8 per cent. The union between these materials may be effected in an iron caldron, by the application of a very moderate heat, as the asphalt bitumen readily coalesces with the tar into a tenacious solid.

The mode adopted for making the beautiful asphalt pavement of the Place de la Concorde, in Paris, was as follows:—The ground was made uniformly smooth, either in a horizontal plane or with a gentle slope to carry off the water; the curb-stones were then laid round the margin by the mason, about 4 inches above the level of the ground. This hollow space was filled to a depth of 3 inches with concrete, containing about a sixth part of hydraulic lime, well pressed upon its bed. The surface was next smoothed with a thin coat of mortar. When the whole mass had become perfectly dry, the mosaic pattern was set out on the surface, the moulds being formed of flat iron bars, rings, &c., about half an inch thick, into which the fluid mastic was poured by ladles from a cauldron, and spread evenly over.

The mastic was made in the following way:—The asphalt rock was first of all roasted in an oven, about 10 feet long and 3 broad, in order to render it friable. The bottom of the oven was sheet iron, heated below by a brisk fire. A volatile matter exhaled, probably of the nature of naptha, to one-fortieth the weight of asphalt; after roasting, the asphalt became so friable as to be easily reduced to powder, and passed through a sieve, having meshes about one-fourth of an inch square.

The bitumen destined to render the asphalt fusible and plastic was melted in small quantities at a time, in an iron cauldron, and then the asphalt in powder was gradually stirred in to the amount of 12 or 13 times the weight of bitumen. When the mixture became fluid, nearly a bucketful of very small, clean gravel, previously heated apart, was stirred into it; and, as soon as the whole began to simmer with a treacly consistence, it was fit for use. It was transported in buckets, and poured into the moulds.

For the reasons above assigned, I consider this addition of rounded, polished, siliceous stones to be very injudicious. If any thing of the kind be wanted to give solidity to the pavement, it should be a granite or hard calcareous sand, whose angular form will secure the cohesion of the mass. I conceive, also, that tar, in moderate quantity, should be used to give toughness to the asphaltic combination, and prevent its being pulverized and abraided by friction.

*(To be continued.)*

## ADHESION OF NAILS.

The following is a table of experiments made by Mr. Bevan, exhibiting the relative adhesion of nails of various kinds when forced into dry Christiana deal at right angles to the grain of the wood.

Col. A contains the number of nails to the lb.; col. B, the length in inches: col. C, the depth forced into the wood in inches; and col. D, the force required to extract them in lbs.

| Nails. | A | B | C | D |
|---|---|---|---|---|
| Fine sprigs .............. | 4560 | 0·44 | 0·40 | 22 |
| Do. do................. | 3200 | 0·53 | 0·44 | 37 |
| Threepenny Brads.......... | 618 | 2·25 | 0·50 | 58 |
| Cast-iron nails............ | 380 | 1·00 | 2·50 | 72 |
| Sixpenny nails............ | 73 | 2·50 | 1·00 | 187 |
| Do. do............. | — | — | 1·50 | 227 |
| Do. do............. | — | — | 2·00 | 530 |
| Fivepenny nails........... | 139 | 2·00 | 1·50 | 320 |

The percussive force required to drive the common sixpenny nail to the depth of one inch and half into *dry Christiana deal*, with a cast iron weight of 6·275 lbs. was four blows or strokes falling freely the space of 12 inches; and the steady pressure to produce the same effect was 400 lbs.

A sixpenny nail driven into *dry elm*, to the depth of one inch across the grain, required a pressure of 327 lbs. to extract it: and the same nail, driven endways, or longitudinally into the same wood, was extracted with a force of 257 pounds.

The same nail driven two inches endways into *dry Christiana deal*, was drawn by a force of 257 pounds; and to draw out one inch under like circumstances, took 87 pounds only. The relative adhesion, therefore, in the same wood, when driven transversely or longitudinally, is 100 to 78, or about 4 to 3 in dry elm; and 100 to 46, or about 2 to 1 in deal; and in like circumstances, the relative adhesion to elm and deal is as 2 or 3 to 1.

The progressive depths of a sixpenny nail driven into dry Christiana deal by simple pressure, were as follows:—

| | lbs. |
|---|---|
| One quarter of an inch, a pressure of | 24 |
| Half an inch.................... | 76 |
| One inch...................... | 235 |
| One inch and half................ | 400 |
| Two inches .................... | 610 |

To extract a common sixpenny nail from a depth of one inch out of

| | |
|---|---|
| Dry oak required................ | 507 |
| Dry beech..................... | 667 |
| Green Sycamore ............ .. | 312 |

From these experiments, we may infer that a common sixpenny nail, driven two inches into dry oak, would require a force of more than half a ton to extract it by a steady force. A common screw, of one fifth of an inch, was found to have an adhesive force of about three times that of a sixpenny nail. The force necessary to break or tear out a half-inch iron pin, applied in the manner of a pin to a tenon in the mortice, the thickness of the board being 0·87 inch, and the distance of the centre of the hole from the end of the board, 1·05 inch, was 976 pounds.

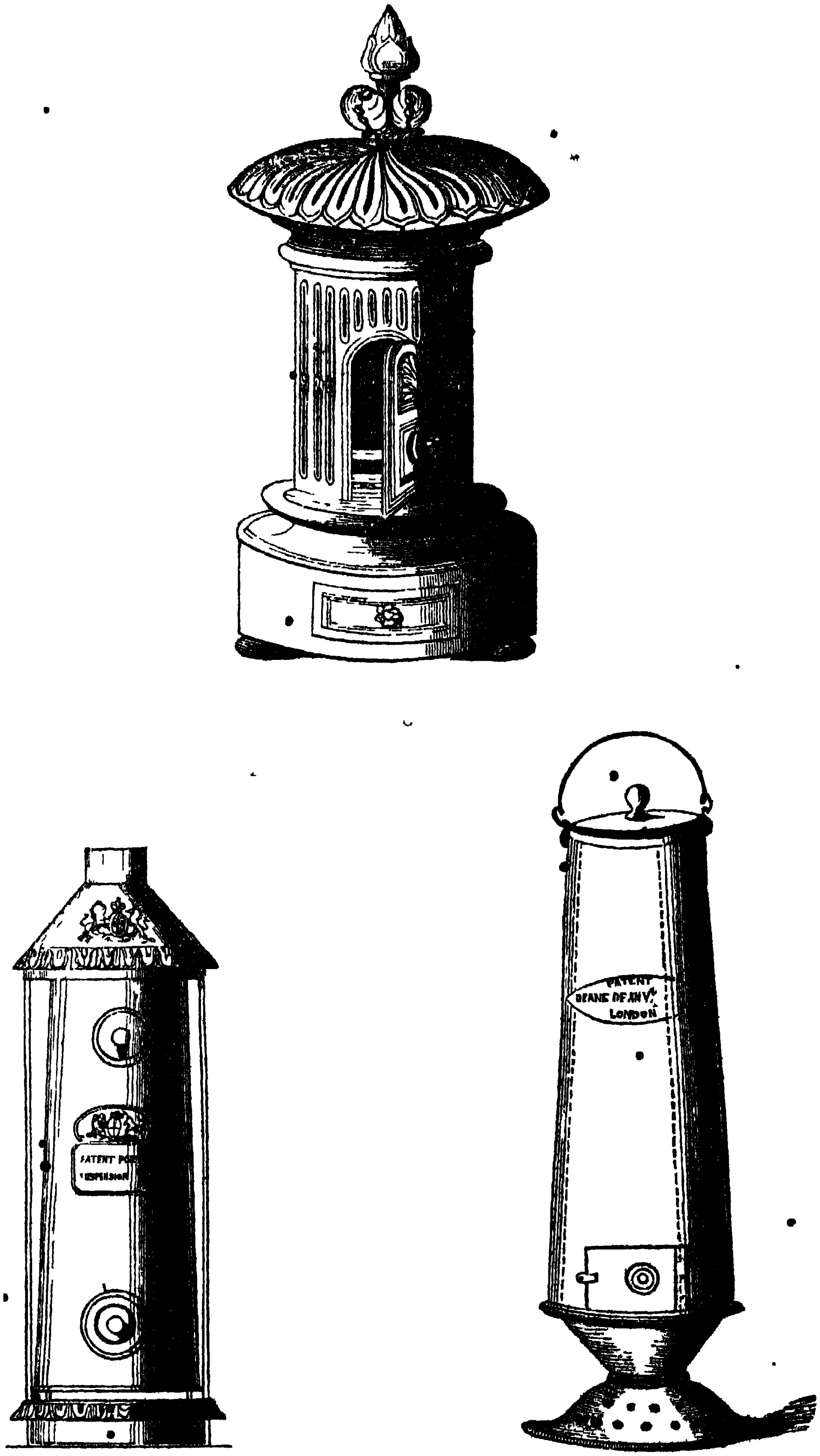
As the strength of a tenon from the pin hole may be considered in proportion to the distance from the end, and also as the thickness, we may, for this species of wood, obtain the breaking force in pounds nearly, by multiplying together one thousand times the distance of the hole from the end by the thickness of the tenon in inches.

## VARIETIES.

*An Air Hammer for boring Rocks.*—Mr. Brunton has communicated to the Polytechnic Society of Cornwall a very ingenious project for boring rocks by means of a hammer moved by a piston acted upon by compressed air—the hammer striking the boring instrument in the usual way. The size of cylinder proposed is 3 or 4 inches in diameter, and the weight of hammer 12 lbs., making about 200 blows in the minute. The condensed air is proposed to be brought into the mine by a gas-pipe, and to be connected to the cylinder by means of a flexible tube, so that the position of the instrument might be varied. We think very favourably of this experiment; it would not merely serve to convey the power of the engine to a distant locality in a convenient way, but would also aid in ventilating and cooling the mine, for the expansion of the air after it has performed its function would lower the temperature of surrounding bodies.

*Slate Furniture.*—The use of Slate, as a material for furniture has been recently introduced, and is increasing. Tables and sideboards, wash-hand stands, toilets, wine coolers, filters, and any similar articles, are now made of this material. Slate is also manufactured into panels for doors, finger-plates, paper weights, inkstands, &c. It is susceptible of much ornament, and is found to bear colours and gilding remarkably well.

*To Clean Oil Paintings.*—Take equal portions of oil of turpentine and spirits of wine, and mix well together; with this wash the painting over gently and carefully, using a sponge or cotton wool, and then with spirits of turpentine alone. Should you fail to remove the stains, an infusion of kali must be resorted to. When the surface is quite dry lay on a thin varnish composed of two ounces of mastic dissolved in six ounces of spirits of turpentine. At the end of a few days you may put on another coat of varnish sold by colourmen for the purpose.




PATENT STOVES.

## PATENT STOVES.

Among the innumerable stoves that have been described of late years, none deserves so much attention as the Arnott stove; a low temperature stove that combines extreme economy of fuel with great facility of attendance by those who take the trouble to make themselves familiar with the proper mode of constructing and using it, in cases where the nature of the chimney has not been properly adapted to the stove, or where it has been attempted to economize the fuel to an extreme degree, so that the products of combustion were cooled too much and lost their ascensionable power, or where the apartment in which it was placed was subjected to the exhausting influence of a passage or adjoining room, drawing air powerfully from it, then it is necessarily prone to smoke in the same manner as an ordinary fire, but in a greater degree from the more feeble ascending power of the current proceeding from it. One great objection, however, to the general use of these stoves is the large amount of heat which it detains, and the comparatively small quantity of air which is removed by combustion; hence it is not calculated to ventilate rooms like an ordinary fire, and the ventilation of the apartments must be attended to independently.

In the newly introduced Suspension Stove this objection is in a great measure removed, and the summer's warmth, with the summer's purity and freshness is combined with the great facility of removing it from one room to another, and it appears to possess the most agreeable and wholesome advantages, and is least troublesome.

The Paragon Stove, too, is another form of the same principle, emitting a genial warmth of a healthy quality and uniform temperature, and exhibits a steady, bright, and cheerful fire. It has also a radiating cylinder, which is encircled by an outer perforated case, rendering the stove a circulating as well as a radiating one.

## ON THE IMPORTANCE OF VENTILATION.

BY MR. P. SQUIRE.

I am induced to bring the subject of ventilation before our Society, from a conviction, founded on experience, that should it be generally adopted, not only will it add greatly to the comfort, but will operate most beneficially in preserving the health of those whose occupation is confined to the closed shop during the winter months, with scarcely any other means of supplying fresh air for respiration and combustion than the accidental opening of the street-door. Whilst oil and candles were employed as illuminating agents, the inconvenience was not so seriously felt as it is in the present day, when so much more heat is produced by lighting up with gas. I have long lamented the half-suffocating atmosphere thus produced, and it was not until about this time last year that I turned my attention to the subject with a view of remedying the evil. The chief cause of my commencing this was, the very interesting lecture delivered by Dr. Faraday at the Royal Institution, in April, proposing a plan of ventilating light-houses, and another for rooms, the Atheneum Club-house in particular, where, for want of ventilation, the vapour and acids from the gas-lights had destroyed the greater part of the binding of the books. One of these was a tube to dip into the gas glass or chimney, and induce all the products of combustion to ascend and escape by pipes through the ceiling: and the other—more complicated—was "the descending flue," formed by placing on the outside of the regular glass chimney a larger one, covered with a double plate of mica; the glass-holder, having an aperture between the two glasses for the down-current to pass into the bracket, and curving upwards, becomes the flue to carry off the air which has served for the combustion. This descending flue answers for an inner apartment, where a good draught can be depended upon; but, I am told, not where doors are frequently opened to the cold air. The expensive character of its fittings, too, is an objection to its general adoption, but its elegant light, and the products of combustion being most securely excluded from the apartment, recommend it strongly to the wealthy, or to societies and institutions whose funds may afford the outlay. The tube dipping into the glass chimney answers very well, and may be employed, when the unsightly appearance of the copper tube is of no consequence; it must, however, be borne in mind, that water will condense in this tube if it has far to travel before it delivers the products of combustion.

I now come to the form of apparatus which I employ, and which I think is perhaps the most simple and least costly of any that I can recommend for general adoption, taking all its advantages into the account: it consists of an iron gas-pipe, 1¼ inch in diameter, having a *diminishing connector* as it is called (capable of receiving a 2-inch pipe at one end, and connecting the other with a 1¼-inch pipe) screwed on to its aperture. This forms the cap to drop over the mouth of the glass chimney. Each of the lights will require one of these capped pipes, and it may approach the glass chimney within ⅛th of an inch, or drop close over it. These are connected with a pipe in the ceiling, which conveys through the joists the products of combustion into the nearest chimney; the pipe is surrounded by a circular tube of sheet iron, about nine inches in diameter, or if there are several lights, six inches may do for each, and they must be flattened, if they cross the joists to get to the chimney, as indeed mine do. This flue of sheet iron commences at the ceiling, passing the whole course of the pipe to the chimney, and answers admirably in carrying off the vitiated and heated air which collects under the ceiling. The iron pipe rising direct from the gas light to the ceiling, if left naked, radiates a considerable quantity of heat, and this can either be used as a warming agent, or the pipe can be cased with a loose tube of bronze, or better still by ornamental porcelain, or by opaque glass, which will stop half the heat. The heat by this arrangement draws up to the perforated ventilator which covers the opening of the sheet iron flue, and is thus got rid of: the iron gas tube retains the heat so well, that all the water produced by the combustion of the gas, is carried in the shape of vapour up the chimney. If the pipe is in the centre of the casing of sheet iron, it removes all possible qualms as to the probability of risk of fire—the inspector of the Phœnix informs me that my insurance is not affected by it. Thus the ceiling does not become blackened by the smoke from imperfectly burnt gas, nor does the water stream down the windows in cold weather, destroying every metallic, mahogany, or papered article, it may fall upon; for the unconsumed gas, the carbonic acid resulting from combustion, and the air which has been respired, are got rid of by these means. Means must be taken for the admission of fresh air, without which, it must be evident no ventilation can go on; and very much depends upon the manner in which this part of the plan is carried out, as the admission of a large undivided stream of cold air could not be borne in severe weather. I have made an opening in the wall, and my waste steam-pipe from the kitchen boiler traverses a series of pipes set in the opening, all terminating in a tinned copper vessel which receives the condensed water, and thus I employ that which was a nuisance in my kitchen chimney to warm the cold fresh air as it enters the apartment, and I gain by that arrangement about five gallons of distilled water daily, which, in small establishments, would be a sufficient supply, without the expense of a still, and be considered as one among the many inducements to ventilate. A perforated zinc plate, for the air thus warmed to pass through and diffuse itself into the apartment, completes the arrangement.

It is somewhat surprising that more progress has not been made in domestic life with regard to ventilation, the subject having been very ably handled by talented men for more than a century. Various plans for removing the vitiated air, and supplying fresh, have been suggested. In the *Philosophical Transactions* for the year 1735, Dr. Desguliers proposed a fanner, which, on the small scale, is called Clark's blowing machine; and the air-pump and bellows have also been applied. A very ingenious application of the former of these has lately been made by Dr. Arnott, which even measures the quantity, whilst it ensures a supply to any extent. The screw, patented by Mr. Day, is another means employed on many occasions. The window fan, or rotary ventilator, placed in windows, only serves to divide the stream of air, and so do the louvres made of plate glass.

Sir Humphry Davy applied a furnace to a flue at the roof of the house of Lords, and thereby caused the vitiated atmosphere to ascend and escape. The present House of Commons is exhausted by a furnace in a shaft, the fresh air being supplied through innumerable holes pierced through the oak floor, which is covered by an elastic hair carpet. The air, previous to its admission, is strained from blacks and floating impurities, by a veil forty or fifty feet long; it is then warmed to any required degree by hot water-pipes, and as the furnace sucks out the air from the roof, the warm and pure air rises through the whole of the floor.

The detail of this beautiful arrangement, together with an infinite variety of others, illustrated by hundreds of wood-cuts, will be found in Dr. Reid's book, just published, called *Illustrations of Ventilation*, a work full of valuable information, conveyed in a familiar and simple manner, and which cannot fail to interest any one desirous of being informed of its principles. Under the direction of Dr. Reid, are the ventilating arrangements of the new Houses of Parliament, which, from the description I have been favoured with by the doctor, I should think will be the most perfect, and upon a scale of course more extensive than anything this country at present possesses. I find several of the Club-houses are at this time incurring great expense for the purpose of ventilation; the Junior United Service Club has undergone great alteration to adapt it to the means required; the ceilings and floors have had tubes and flues placed in them similar to the plan I have adopted; but they rise behind the grate in the room above, opening to the chimney, instead of going into the chimney of a lower apartment through the joists. They have constructed also the best shaft the building will admit of, to carry off the foul air from all the apartments it can be connected with, the flue is heated by steam pipes. The Conservative Club, in St. James's Street, has the advantage of the ventilating arrangements being embodied in the architectural design, and the fresh air is heated by Perkins's patent water-pipes, and admitted under the columns or skirtings; the foul air is sucked out through the cornices, which are ingeniously designed for the purpose. Flues are sometimes heated by a furnace. Mr. Hazard, of Bristol, has a patent for this mode of heating air; but I think, if the pipes can be made secure, the hot-water plan is the best.

Mr. Grant (late of Her Majesty's ordnance department), has patented a plan of ventilating rooms, which is in this way:—Three or more conical glasses supported above each other in succession, and overlapping, convey the foul air from the lamp to the ceiling, where the last one enters a stone flue, which is placed between the floors, terminating in the chimney or open air: an outer tube of sheet-iron serves to carry off the heated and vitiated atmosphere of the room. He considers that by employing a succession of cones, he ventilates better and guards more completely against the downward current which sometimes takes place. The earthenware tube, he thinks, is decidedly superior to that of metal, because acquiring heat slowly it retains it longer, and ensures a more permenent current, the vapour passing without condensation. In this way he has ventilated the School of Design (Spitalfields branch), which can be inspected, by permission of the manager, on producing Mr. Grant's card, any evening from half-past seven to eight; the Adelaide Hotel, London Bridge; the Committee-room and the library of the Lecture Hall of the Greenwich Institution; the Board-room of the Union, Whitechapel, and several others, with uniform success. It is applicable for all kinds of lights and all descriptions of dwellings or shops, and is delivered over to the gas-fitter with the adaptations of unions and connections for his work at a very reasonable rate. I think well of Mr. Grant's plan. The stone-ware not radiating so much of the heat, conveys it into the chimney, where it is employed to warm the shaft and assist in keeping up the draught, and is less objectionable when in contact with wood.

*(To be continued).*

---

## LIGHTING MINES BY GAS.

James Murray, of the Garnkirk Coal Company, Lanarkshire, has lately patented a new method of using and applying artificial gas made from coal, oil, or other substances, for lighting and ventilating caverns, pits or mines, or other pits where minerals or metals are worked or extracted.

The patentee has two claims—firstly, for lighting; and, secondly, for ventilating pits, mines, &c., where minerals or metals are worked by means of artificial gas. The first claim the patentee proposes to accomplish as follows:—The gas may be made above ground, from coal, oil, or other substances from which gas can be produced, and conveyed through pipes into the mines and into the different workings; or it may be made below ground, and conveyed by pipes as aforesaid, along the workings at convenient distances; jets or burners may be used for burning the gas, which may be uncovered should the state of the mines or workings admit of this being done with safety, otherwise the flame may be covered in the manner in which lamps or lights n mines have heretofore been covered, or in any other suitable manner.

The second claim is for ventilating. The patentee states that the gas burning as above stated, will also have the effect, in whole or in part, of ventilating the mines, by gradually consuming fire-damp, foul air, or other noxious vapours. A current of air will also be created, by which the fire-damp, foul air, or other noxious vapours will be carried off, either in whole or in part, and replaced by a supply of pure air from the mouth of the mine, or from any other communication of the mine, with the pure atmosphere. By this mode of ventilating, the accumulation in large quantities of fire-damp, or other noxious vapours, will be either in whole or in part prevented, and the workers will be secure, or at least more so than at present, from the fatal or injurious effects of these noxious vapours, by instantaneous explosion or suffocation, or the fatal or injurious effects produced from inhaling such vapours.

---

## BITUMEN.

*(Continued from page 280.)*

In the able report of the Bastenne and Gaujac Bitumen Company, drawn up by Messrs. Goldsmid and Russell, these gentlemen have made an interesting comparison between the properties of mineral tar and vegetable tar: the bitumen composed of the latter substance, including various modifications extracted from coal and gas, have, so far as they were able to ascertain, entirely failed. This bitumen, owing to the qualities and defects of vegetable tar, becomes soft at 115° of Fahrenheit's scale, and is brittle at the freezing point; while the bitumen, into which mineral tar enters, will sustain 170° of heat, without injury. In the course of the winter, 1837-38, when the cold was at 14½° below Zero, C., the bitumen of Bastenne and Gaujac, with which one side of the Pont Neuf at Paris is paved, was not at all impaired, and would, apparently, have resisted any degree of cold; while that in some parts of the Boulevard, which was composed of vegetable tar, cracked and opened in white fissures. The French Government, instructed by these experiments, has required, when any of the vegetable bitumen are laid, that the pavement should be an inch and a quarter thick; whereas, where the bitumen composed of mineral tar is used, a thickness of three-quarters of an inch is deemed sufficient. The pavement of the bonding warehouse at Bordeaux has been laid upwards of 15 years by the Bastenne Company, and "is now in a condition as perfect as when first formed. The reservoirs constructed to contain the waters of the Seine at Batignolles, near Paris, have been mounted 6 years, and, notwithstanding the intense cold of the winter of 1837, which froze the whole of their contents into one solid mass, and the perpetual water pressure to which they are exposed, they have not betrayed the slightest imperfection in any point. The repairs done to the ancient fortifications at Bayonne, have answered so well, that the Government, two years ago, entered into a very large contract with the company for additional works, while the whole of the arches of the St. German and St. Cloud railways, and the pavements and floorings necessary for these works, are being laid with the Bastenne bitumen.

The mineral tar in the mines of Bastenne and Gaujac is easily separated from the earthy matter with which it is naturally mixed by the process of boiling, and is then transported in barrels to Paris or London, being laid down in the latter place to the company at 17*l*. per ton, in virtue of a monopoly of the article purchased by the company at a sum, it is said, of 8000*l*.

Mr. Harvey, the able superintendent of the Bastenne Company, was good enough to supply me with various samples of mineral tar, bitumen, and asphaltic rock for analysis. The tar at Bastenne is an exceedingly viscid mass, without any earthy impurity. It has the consistence of baker's dough at 60° of Fahrenheit; at 80° it yields to the slightest pressure of the finger; at 150 degrees it resembles a soft extract; and at 212 degrees it has the fluidity of Molasses. It is admirably adapted to give plasticity to the calcareous asphalts.

A specimen of Egyptian asphalt which he brought me, gave, by analysis, the very same composition as the Val de Travers, namely, 80 per cent. of pure carbonate of lime, and 20 of bitumen. A specimen of mastich, prepared in France, was found to consist, in 100 parts, of 29 of bitumen, 52 of carbonate of lime, and 19 of siliceous sand. A portion of stone called the natural Bastenne rock, afforded me 80 parts of gritty siliceous matter and 20 of thick tar. The Trinidad bitumen contains a considerable portion of foreign earthy matter; one specimen having yielded me 25 per cent. of siliceous sand; a second, 28; a third, 20; and a fourth, 30: the remainder was pure pitch. One specimen of Egyptian bitumen, specific gravity 1·2, was found to be perfectly pure, for it dissolved in oil of turpentine without leaving any appreciable residuum.

Robinson's Parisian Bitumen Company use a mastich made with the pitch obtained from boiling coal tar mixed with chalk. One piece laid down by this company at Knightsbridge and another at Brighton, are said to have gone to pieces. The portion of pavement laid down by them in Oxford Street, next Charles Street, has been taken up, Claridge's Company have laid down their mastich under the archway of the Horse Guards, and in the carriage entrance at the Ordnance Office; the latter has cracked at the junction with the old pavement of Yorkshire curb-stone. The foot-pavement laid down by Claridge's Company at Whitehall has stood well. The Bastenne Company has exhibited the best specimen of asphalte pavement in Oxford Street; they have laid down an excellent piece of foot-pavemen, near Northumberland House; a piece, 40 feet by 7, on Blackfriars' Bridge; they have made a substantial job in paving 830 superficial feet in front of the Guard-room at Woolwich, which, though much traversed by foot-passengers, and beat by the guard in grounding arms, remains sound; lastly, the floor of the stalls belonging to the cavalry barracks of the Blues at Knightsbridge, is probably the best example of asphaltic pavement laid down in this country, as it has received no injury from the beating of the horses' feet.

As the specific gravity of properly made mastich is nearly double that of water, a cubic foot of it will weigh from 125 to 130 lbs; and a square foot, three quarters of an inch thick, will weigh very nearly eight pounds. A ton of it will therefore cover 280 square feet. The prices at which the Bastenne Bitumen Company sell their products is as follows :—

Pure Mineral tar, 24*l*. per ton, or 28s. per cwt.

Mastich, 8*l*. 8s. per ton, or 10s. per cwt.

| Side Pavement. feet | | | Roofs & Terraces. per foot | per foot. |
|---|---|---|---|---|
| From 50 | to | 100 | 1s. 3d. | 1s. 6d. |
| 100 | | 250 | 1s. 1d. | 1s. 4d. |
| 250 | | 500 | 11d. | 1s. 4d. |
| 500 | | 750 | 10d. | 1s. 0d. |
| 750 | | 1000 | 9d. | 11d. |
| 1000 | | 2000 | 8d. | 10d. |
| 2000 | | 5000 | 7d. | 9d. |

Where the work exceeds 5000 feet, contracts may be entered into.

For filling up joints of brickwork, &c., from 1d. to 1½d., per foot, run according to quantity.

The prices are calculated for half an inch thickness, at which rate a ton will cover 420 square feet.

As the Val de Travers Company engage to lay down their rich asphaltic rock in London at 5*l.* per ton; and as a mineral tar equal to that of Seissel may probably be had in England at one fourth of the price of that foreign article, they may afford to lay their mastich three quarters of an inch thick per the thousand feet, including a substratum of concrete, at a rate of fivepence a square foot, instead of fifteenpence, being the rate charged under that condition of the Bastenne Company.

These charges are for London and its immediate vicinity.—*Ure.*

## WORSTED MANUFACTURE.

*(Continued from Page 277.)*

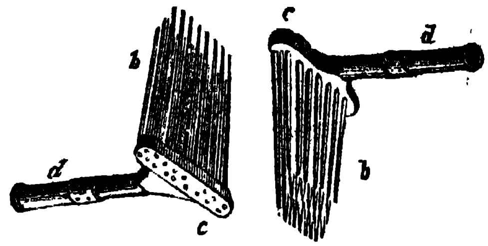
### *The Worsted or Long Wool Manufacture.*

The reason why a long-stapled, strong, and firm, though somewhat coarse wool, is best adapted for worsted stuffs, is because they require a fine smooth yarn, which shall have little or no tendency to shrink, curl, and felt, when made into cloth. Hence the fibres must not be entangled and crossed by carding, but, on the contrary, be disposed as nearly as possible in parallel lines, by a peculiar combing operation. The yarn thereby producible will be comparatively level, slender, and hard, fit for warping and wefting into finer and more compact goods.

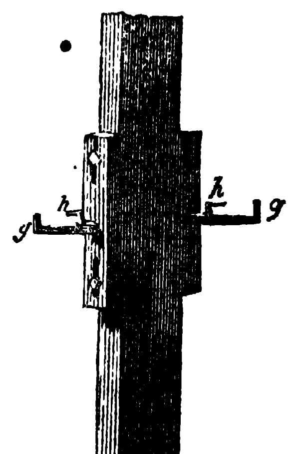
The first process to which the long wool is subjected in a worsted factory is washing, which is performed exclusively by men, with soap and water. They are paid by quantity, each man being attended by a boy, who receives the wool as it issues from between the two rollers in front of the washer, which squeeze out the greatest part of the moisture. The wool is then carried by the boy, in large baskets, to the drying room, where it is spread upon the floor. The drying room is generally placed over the boilers of the steam-engine, and is thus kept at a high temperature. The time during which the boy is exposed to this heat is inconsiderable.

After drying, the wool is removed to a machine called the plucker, which is always attended by a child, generally a boy of ten, twelve, or fourteen years. His business is to lay the tufts of wool pretty evenly, in an endless web, on an apron, which, as it travels forward, delivers the wool to a pair of spiked rollers, by which it is carried to the interior apparatus, which is somewhat similar to the willow employed in cotton factories, and thence it is blown out at the opposite side. The use of this mechanism is to clean and straighten the fibres of the wool and to prepare it for the next machine, the comb-card. In the old routine of the trade, and still for the finest description of work, the wool is not carded in the factory, but is given out to the wool-combers, who comb it by hand. This is very hard work, and is generally carried on in rooms which are close and hot, from their containing several stoves for keeping the combs at the high temperature requisite to increase the pliancy and ductility of the filaments. Boys are not set to learn this trade at an early age.

Three implements are in common use for comb-




ing long wool. 1. A pair of combs for each workman. 2. A post to which either of the combs can be fixed. 3. A comb-pot or small stove for heating the teeth of the combs. Each comb is composed of two rows of tapering, pointed steel teeth, *c* and *b*, disposed in two parallel planes, of which one row is longer than the other. They are fixed in a wooden stock or head *c*, which is covered with horn, and has a handle *d* fixed into it, perpendicular to the planes of the teeth range. The spaces between these planes is only one third of an inch at the bottom of the teeth. The combs used for the last combing have three rows of teeth. In the workshop a post, Fig. 2,




is fixed, in order to support the combs occasionally during the process. An iron stem *g* is fixed into it, which has an upturned point, for passing through a hole in the handle of the comb, while it has a staple pin *h* at its inner end, for entering into the hollow extremity of the handle, and by the two fixtures holding it fast to the post. The stove consists of a flat iron plate, heated by a fire or by steam, and surmounted by another plate, for confining the heat. Into a small space left between the two plates, the teeth of the combs are introduced.

In combing the wool the workman separates it into handfuls of about 14 ounces each; sprinkles it with oil, and rolls it up in his hands to smear it uniformly.

The proportion of oil varies from a fortieth to a sixteenth of the weight of the wool. Having fastened a heated comb to the post, with its teeth upwards, the workman takes one-half of that quantity of wool in his hand, and, throwing it over the points of the comb, draws it through them, and so repeatedly, a portion of wool remaining each time in the comb. When all the wool is gathered on the teeth, the comb is placed with its points in the stove, and the wool hanging on the outside receives a portion of the heat. The other comb, now hot, is fixed to the post, and filled, in its turn, with the other half of the four ounces of wool, and is then removed to the the stove, like the first.

When both combs are properly warmed, the comber holds one of them with his left hand, over his knee, as he is seated on a low stool, and with the other comb held in his right hand, he combs the wool upon the first, by introducing the points of the teeth of one comb into the wool contained in the other, and drawing them through it. This is repeated till the fibres are laid parallel. He always begins by introducing the points of the teeth of one comb first into the extremity of the fleece contained in the other comb, and he then advances deeper at each succeeding stroke, till, eventually, he works the combs as closely together as possible without bringing their teeth into collision; otherwise he could not draw the comb through the wool without breaking its fibres, or tearing the wool out of the teeth of the comb. The short wool which remains on the teeth of the comb at last, because it does not reach the place where the comber grasps it, is called *noyl*, and is unfit for worsted spinning; it amounts to about an eighth of the new wool by weight.

The wool which is drawn off from the comb forms a continuous sliver or band, with straight parallel fibres, but is still not ready for the spinning-machine, till combed again at a somewhat lower temperature. When the process is complete, the wool is formed into parcels containing ten or eleven slivers each.

*(To be Continued.)*

## BRICK MAKING MACHINE.

A PATENT has lately been enrolled by William Hodgson, of 42, King-street, Kingston-upon-Hull, for "A machine for making and compressing bricks, small paviors, floor bricks, flat tiles, ornamental bricks, &c., at one operation." The invention relates to certain arrangements of machinery or apparatus for making, or moulding and compressing, &c., bricks and tiles; that part of the invention which relates to the making or moulding of bricks, consists in having a mould constructed in such manner that all its sides shall fall down so that the brick can be removed. The sides and ends of this mould are covered with moleskin, which is turned over the upper edge, and fastened thereto by means of brass beading, or plates and screws; this mould when in use is placed within an outer mould, which during the making of the brick keeps the sides of the inner mould in a vertical position. The outer mould here spoken of is fixed upon a table, on the underside of which there are two or more treadles to suit the convenience of the workmen when on different sides of the table; these treadles communicate with a vertical spindle, the upper end of which passes through the table and is attached to the inner mould having moveable sides; the object of this arrangement being that when a brick has been formed in the inner mould, in the usual way of making bricks, such mould is raised from the outer one by placing the foot upon some of the treadles; the sides of the mould at the same time falling down admits of the brick being removed by means of a pallet-board in the ordinary manner. Upon the same table, and near the machine just described, is fixed the compressing apparatus, which forms the second part of the invention, and consists of a mould having its two sides attached to the bottom part by means of hinges, the ends of the mould being moveable and capable of approaching each other; this mould is made to drop within another similar to that just described, and over the mould is a pressing-box having inclined ends, which come in contact with the moveable ends. This pressing-box can be raised or lowered upon an arrangement of levers, the parts being so arranged that when the pressing-box is lowered for the purpose of compressing the brick, the underside of such box comes first in contact with the upper face of the brick. the inclined ends of the pressing-box coming at or near the same time into contact with the moveable ends of the mould cause the same to approach each other. and thereby compress the brick which is contained in the mould. The inventor claims the arrangement of making bricks by means of a mould having falling sides and ends, and also the arrangement for making and compressing bricks, paviors, and tiles by a mould with falling sides and moveable ends, as above described.

## VOLCANOES.

*(Continued from Page 275.)*

THE volcanic cone of Mount Etna, which is entirely composed of lavas, rises majestically to an altitude of nearly two miles, the circumference of its base exceeding 180. Compared with this prodigious mass of igneous products, Vesuvius sinks into insignificance; for while the lava streams of the latter do not exceed seven miles, those of Etna are from fifteen to thirty miles in length, five in breadth, and from fifty to one hundred feet in thickness. The grand feature of Etna is a zone of subordinate volcanic mountains, some of which are covered with forests, while others are bare and arid like those of Auvergne. The base, for an extent of twelve miles upwards, is richly cultivated, and abounds in vineyards and pastures, with towns, villages, and monasteries. The middle region is woody, covered with forests of oak and chesnut, and a luxuriant vegetation. From about a mile below the summit, all is sterility and desolation, and the highest point is covered with eternal snow. The crater, from which a column of vapour constantly escapes, is about a quarter of a mile high, and three quarters of a mile in circumference. The varied and picturesque scenery of this extraordinary mountain, the physical changes now in progress, as well as those which have taken place in periods far beyond all human history or tradition, but of which natural records still remain, are sketched by Mr. Lyell in his Principles of Geology with the vigour and fidelity which characterise all the productions of his pen.

The volcanic district of Puzzuoli and Cumæ, on the bays of Baiæ and Naples, called the Phlegrean Fields, and in which are situated Monte Nuovo, Monte Barbaro, the Solfatara, and the Temple of Serapis, presents a series of cones and crateriform basins; some of which contain lakes, as those of Avernus and the Lucrine. These volcanic mounds are formed of felspathic tufa, occasionally containing marine shells and carbonized wood, and are covered by beds of loose tufaceous conglomerate. They are supposed by Mr. Scrope to have been produced by numerous submarine eruptions, each from a fresh focus, on a shallow shore. The Solfatara constantly evolves aqueous vapour, with muriatic and sulphureous exhalations. The celebrated encrusting springs derive their properties from the carbonic acid gas, so largely disengaged by subterranean volcanic action on limestone rocks.

The Lipari Isles, between Naples and Sicily, lying, as it were, midway between Vesuvius and Etna, present a character very analogous to the district I have just described. The crater of one of the islands, Stromboli, has been in constant activity from the earliest historical period. The cliffs of St. Calogero, which are about two hundred feet high, extend four or five miles along the coast, and consist of horizontal beds of volcanic tuff. From the perennial emanation of sulphureous vapour, the rocks are decomposed; alum, gypsum, and other sulphuric salts are formed; muriate of ammonia and silky crystals of boracic acid are also to be found. The dark clays have become yellow, white, red, pink, chequered, and marked with stripes of various colours. Veins of chalcedony and opal occur, and pumice-stone and obsidian are abundant. Dykes and veins of trachyte intersect the tuff in every direction, and bear a striking resemblance to the similar intrusions of trap into the secondary strata.

We will conclude this account of active volcanoes in our next, by an account of a celebrated burning mountain in the Pacific.

(*To be Continued.*)

## SURFACE FOR PAINTING.

Elijah Galloway, of Nelson-square, Blackfriars-road, has just received a patent for certain combinations of materials, to be used as a substitute for canvass and other surfaces employed as grounds for painting; some of which combinations are applicable to other purposes.

This invention consists in the application of certain mixtures of compositions to canvass or other woven materials, to be used as grounds for painting, and to the surfaces of walls., &c., as hereafter described.

The mixtures consist of India rubber, combined with earthy, woody, or fibrous matter, and any insoluble substance capable of being reduced to fragments not coarser than sand or sawdust, and, in some instances, to a fine powder, The India-rubber is prepared by a well-known process (fully described in the specifications of other patents,) of grinding or crushing, in a vessel heated by steam. so as to bring it to a plastic or pasty state; the pulverized matter are then mixed with it, by a process resembling kneading or rolling, and the mass is reduced in a uniform thickness, by being passed between cast-iron rollers.

The mixtures, prepared in this manner, are to be attached to some other body, by India-rubber cement or other adhesive material; that is to say if intended to remain fixed, like cartoons or other decorations of walls, they are to be cemented to the walls, ceilings, floors, or other surfaces; but if they are to be moveable, like painting, they are cemented to canvass, net-work, or other coarse fibrous fabrics. For large paintings, the particles of pulverized matter may be of the coarser kind above mentioned; but for small works, chalk, dried clay, or similar materials, capable of being reduced to fine powder, are employed. When the mixtures are used for covering floors, and are to have ornamental designs painted upon them, finely-powdered cork is mixed with with the plastic India-rubber. In cases where they are employed out-of-doors, and exposed to moisture, mouldiness is prevented by the addition, to each hundred pounds of India-rubber, of half an ounce of corrosive sublimate, or other metallic salt which will resist vegetable decomposition.

These mixtures are also intended to be used in ship-building instead of felt, between the copper and planking of the ship; being made in thin sheets, which are cemented in their places, and then coated on the outside with cement, and before this becomes dry, the copper is fixed on in the usual manner. They are also made into blocks or masses of suitable forms, and applied to the purpose of filling the spaces between the timbers or planking of ships; being cemented to the wood, and to each other, so that the whole becomes impervious to water, For boat-building, the mixtures are formed into sheets, planks. or slabs, and used with or without timber courses.

A substitute for floor-cloth is formed, by rolling the material into large thin sheets the sides of which are cut parallel, and bevilled off to thin edges; these edges are rubbed over with India-rubber cement, and united by causing them to overlap, and then pressing them carefully together; when the cement is dry, the side that is not intended to be printed upon is coated with cement, and a piece of canvass, cloth, or other woven fabrics applied thereto; the substitute for floor-cloth, thus made, is now ready to be printed on.

For covering roofs, walls, or other surfaces, where it is required to exclude rain and moisture, the material is rolled into sheets, which are cemented to the surfaces to be covered, and to each other.

For paving or covering floors or roadways, the sheets or slabs are cemented to the "subsurface," nd to each other.

The patentee says, in conclusion,—"I hereby declare that I lay no claim to the invention of any of the mixtures herein referred to, nor to the method of preparing them; such mixtures, and the processes of preparation, being already known. But what I claim, as my invention, is, their application to the purposes herein described, in the manner I have pointed out; more particularly the cementing the said mixtures to some other body, and to each other, according to the respective purposes to which they are to be applied."

## SLATE COVERING.

A PATENT has recently been obtained by Mr. Robt. Martin, of Haverfordwest, for "certain improvements in the construction of slated .oofs or floors, tanks or cisterns or reservoirs for water, and in pipes, tubes, or channels of the same materials for the conveyance of water."

The invention consists firstly in the construction of roofs, flats, or floors, by combining squares or slabs of slate together, and attaching them to the boards or rafters in such a manner that the contraction of the timber will have no effect in disturbing the joints or junctions of the slate; and secondly, in combining slabs, and other forms of slate hereafter described, for the purpose of holding water and other fluids, and also for conducting the same from one place to another. The first claim consists of three methods of combining slabs or squares of slate together, by which means the contraction of the planks and rafters of a roof or floor is prevented from affecting the slate covering. The first method is by fastening on to the boarded roof square slabs or blocks of slate from ½ inch to ¾ inch thick. In the centre of these blocks a pin or trannel is cemented which projects out from the under side of the block, for the purpose of being inserted in a hole in the boards of the roof, this hole is of rather a larger diameter than the pin, to allow of the contraction and expansion of the wood. A series of squares of slate cemented together are then so placed on the boarded roof (after the blocks are inserted in the boards) that one corner of the adjoining slates comes immediately over the block of slate, and are there attached by pins or trannels which enter holes made about two-thirds of the way through the thickness of the block to receive them. The holes which pass from the upper to the under square of slate must be larger in diameter than the pins or trannels by a ¼ or ⅜ of an inch, and previously to placing the squares of slate upon the boarded roof these holes must be luted; the pins or trannels are likewise luted, and when inserted into the holes a cement or composition in a fluid state is poured down the holes, and uniting with the composition at the joints of the squares a perfect and indestructible mass is formed. Blocks and squares of slate arranged and cemented together as above described may be applied directly to the rafters of roofs, without using boards, and likewise to the joists and framing of flats or floors. By the second method a roof is constructed of rows of square slate, cemented together, with each row lapping over that which is below it, and the junctions of the slates arranged so as to break joint. The rows of slate are united together by pins or trannels passing through the laps of the slates into holes in the boards of the roof, as before explained. By the third modification longitudinal slabs of slate are laid with square blocks attached thereto by pins or trannels and cement. These slabs are affixed to the roofs by the pins or trannels which pass through the square blocks of slate and the slabs, and enter the wood as above explained.

The second claim relates to the construction of tanks and reservoirs for holding water, and pipes or channels for conveying the same, in the following manner. A number of square slabs of slate (cut to any required size) are connected together at their edges as before mentioned, and upon them are cemented other slabs of slate in such a manner as to break joint; four such combinations of slate being made form the sides of the reservoir or cistern and a similar one is to form the bottom. Around the bottom of the tank or cistern are grooves in which the sides are cemented. To the vertical edges of the sides, upright grooved pieces of slate are fixed by trannels and cement, and the other sides of the tank are secured thereto in like manner. Leaden rivets are passed through the bottom at the outside of the grooves to prevent the lamina from splitting. Continuous lines of trough, the sides of which form an obtuse angle to each other, are constructed on the same principle as the tank.

The third claim is for the construction of pipes, tubes, or channels for conducting water from one place to another in the following manner. Any suitable number of blocks of slate are hollowed into a semi-cylindrical form, and two of them are first joined together by means of cement and pins or trannels which run through both blocks. In the ends of the pipe thus formed a circular hollow is made and has an opening to the outside of the pipe, with vertical holes leading down to horizontal holes which are made to receive half the length of an iron rod or wire. Another couple of blocks being similarly prepared and joined together as above mentioned are ready to be connected to the former couple; this is effected by inserting the iron rods or wires into corresponding holes, and by pushing one part until it comes up flush with the other, by which means, the junction is effected; a fluid cement is then poured into the opening, and flowing round the circle the joint is made air-tight and impervious to the escape of water. Into the pin-holes melted lead is poured, which flowing into the holes firmly secures the pins in their place, and thus connects the pipes firmly together.

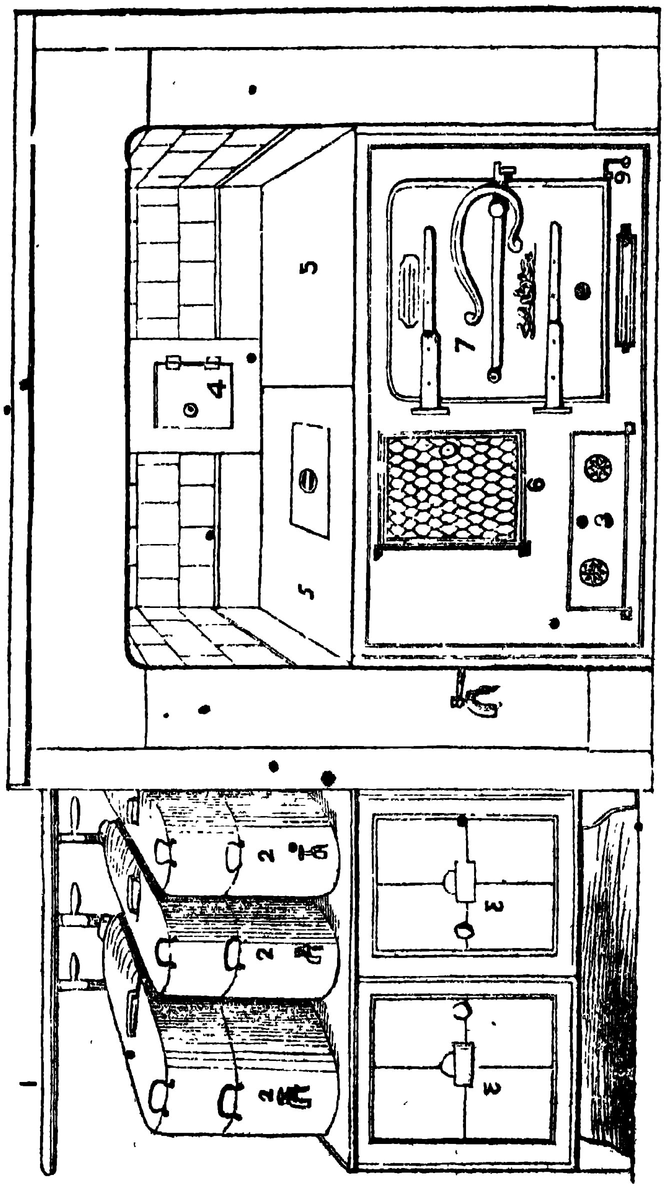
The composition which the patentee prefers for uniting the sections of slate employed for all the above described purposes, consists of equal portions of carbonized coal tar and resin, and a ninth part of linseed oil melted and mixed together.

## VARIETIES.

Potato brandy is known to produce deleterious effects upon the human frame, as delirium tremens, idiocy, &c. Not only is the rectifications of this spirit very carelessly conducted, but it is often obtained from potatoes which are either rotten, or have begun to germinate.

*Russian Stoves.*—In the north of Europe, close stoves are alone used for heating buildings. In Russia and Sweden the stove is generally made of brick, tiles, or stone, and it occupies a large space at one end of the room. It is usually either square or oblong, and is divided by partitions into different compartments, so as to increase the surface over which the smoke and heated gases pass before they finally escape into the chimney. The materials which compose the stove being slow conductors of heat, they retain the heat for a long time when once warmed; and these stoves seldom require replenishing with fuel more than once a day. They usually burn wood for fuel, and are supplied by a fire-door exterior to the room intended to be warmed. M. Guyton endeavoured to introduce these stoves into France at the close of the last century, and paid much attention to the best form of construction, and the comparative cost of fuel, the results of which were published in the "Annales de Chimie."

*Potato Wine.*—Wine of a tolerable quality may be made from frosted potatoes, if not so much frosted as to have become soft and waterish. The potatoes must be crushed or bruised; a wooden mallet answers the purpose. If a plank of wood is made hollow, in the manner of a shallow bowl, they may be bruised with a mallet or put into a cider press. A Winchester bushel must have ten gallons of water, prepared by boiling it mixed with half a pound of hops and half a pound of common white ginger. This water, after having been boiled for about half an hour, must be poured upon the bruised potatoes, into a tub or vessel suited to the quantity to be made. After standing in this mixed state for three days, yeast must be added to ferment the liquor. When the fermentation has subsided, the liquor must be drawn off, as pure as possible, into a cask, adding half a pound of raw sugar for every gallon. After it has remained in the cask for three months, it will be ready for use.—*Farmer's Magazine.*




DEANE'S SELF-ACTING KITCHEN RANGE.

*1. Steam Pipe:—2. Steam Saucepans:—3. Hot Closet:—4. Flue:—5. Hot Plate:—7. Oven—8 Ash Pit and Flue Door.*

## DEANE'S SELF-ACTING KITCHEN RANGE.

Following the remarks in our last week's Number on stoves, we proceed to notice the improvements which have been effected in kitchen ranges. In that of which we give a sketch, there are no advantages contemplated in the arrangements of any modern cooking apparatus, which do not seem to be realized in this, for all the facilities for roasting, baking, boiling, broiling, frying, steaming, stewing, are combined, and by its use, with suitable piping, a house or room may be warmed with hot water flowing from its boiler. To the emigrant it must be of immense advantage; for if coal be not to be had, its construction provides against that deficiency, enabling him, by means of a wood fire, to obtain al the comforts of a London kitchen and Newcastl coal.

## ON THE DIFFERENT METHODS OF TRACTION OR PROPULSION ON RAILWAYS.

### *Atmospheric Pressure—Tension of a Rope—Hydraulic—Locomotive Engines.*

As propulsion on railways is a subject which has excited, and will continue to excite, much attention in the engineering world, the consideration of the various means now in use, as well as those proposed to be employed, to effect this object, cannot, we think, be otherwise than interesting to a large proportion of our readers. With this view we subjoin an article from a correspondent of the Mining Journal. The writer sets out by stating, that there are four general methods of traction practised on railways, where steam is the motive power, viz. :—

1. By means of a rope passing over and wound up by a drum, which revolves by the action of the engine.—2. By means of a tube extending the whole length of the railway, and containing a solid piston, which is forced along by the air being pumped out of the tube by an engine, stationed at one end of it. —3. By hydraulic pressure.—4. By means of a locomotive engine, which turns the wheels on which it rests, and the friction of these with the rails carries the attached train forward.

Besides these four plans, a fifth, which has not been noticed by the writer of the articles in question, has been proposed: we are not aware that it has ever had a fair trial upon a large scale, but we understand that some experiments with models have given results that have astonished many engineers. If we are correctly informed, the plan consists in mounting pairs of wheels, at convenient distances, along the whole length of a line of railway, and causing these wheels (by means of any convenient mechanical contrivance) to revolve with considerable rapidity. The carriage, containing the goods or passengers, is a mere sledge, and when required to be moved onward, it is lowered down, or otherwise brought on to the pairs of wheels before mentioned, which, by their rotation, propel the carriage forward. The pairs of wheels are arranged at such distances apart, as will always allow of the carriages being supported by two pairs. Proper means must, of course, be adopted for keeping the carriages upon the line. We understand that, by this plan, model carriages have been propelled up very steep inclines, with ascents that could not have been surmounted by any of the ordinary means; but whether this can be effected upon a working scale, is a question that yet remains to be solved. The grand difficulty appears to us to lie with,—the means of actuating so many pairs of wheels—the expense of effecting this object —and the loss of power that must inevitably ensue. Not having had an opportunity of personally inspecting this plan of propulsion, we do not think it fair to enter into any further discussion of its merits, as we are not in a position to judge of how far the inventor has met or overcome the above objections, which most certainly are of great magnitude.

In each of these methods of tractition or propulsion, a part of the power of the engine is lost in the transference.

The author enters upon the examination of the four plans of railway tractition in the following manner: he says,

1. In tractition by a rope, some part of the power will be absorbed by the friction of the rope with the rod, or with the friction-wheels on which it is laid. Also, the part of the rope between each two friction-wheels will hang down in a curve; force will be expended in raising and strengthening these segments of the rope before the train can be put in motion. Moreover, if the rope possess elasticity, the engine must first stretch the rope to a certain extent before it can act on the train. It must be considered also that the engine starts not only the train itself, but also with equal rapidity a heavy rope, equal in length to twice the distance between the two railway stations. These causes would operate were the trains to move on rails perfectly even, but in practice obstacles occur at the joints of the rail and elsewhere, which communicate shocks to the train in motion. Hence will arise another abstraction of power; for at each shock the train will be slightly retarded, and then again accelerated, and consequently a vibrating motion will be given to the curvilinear segments of rope between the friction-wheels. The vibrations arising from this and similar causes will be very observable in the line of rails parallel to that on which the train is in motion; the maintenance of these vibrations is a fruitless expenditure of power. An exact illustration exists in the endless bands used for communicating motion in steam weaving and steam printing, and even in common knife-grinders' machines; the most casual observer must have noticed the rapid vibrations of the bands in these cases. The motion of the tow-ropes of river barges affords another example of those vibrations. From this cause, also, among others, steam-tugs tow vessels more efficiently when closely and rigidly lashed to their sides, than when connected by a long rope; and a garden-roller is moved over a rough gravel path more easily by pulling the handle than by pulling a long rope fastened to the handle. This last illustration suggests an experiment worth making, and easily made, by which the subject would be elucidated far more clearly than by written explanation. The alternate retardation and acceleration of the train will have another effect, which is due to the elasticity and weight of the rope; viz., that at each retardation the tension of the rope will be slightly increased, and at each acceleration diminished; the consequent stretching and unstretching is maintained by force, which contributes nothing to the motion of the train.

2. In considering the application of steam power by atmospheric pressure, it will be necessary to remove a very common error, which supposes that power is in some way gained by the intervention of air. Now, to refute this notion, it seems sufficient to state the general theorem, that "power is not gained, but only transferred by machinery;" or,

taking the most favourable case that could possibly exist—viz., that the exhaustion of air should be perfect, and effected by apparatus air-tight, and without friction, it may be seen that whatever pressure exists on that end of the locomotive piston open to the air, can only arise from, and will be exactly equivalent to, the power exerted in removing a corresponding pressure from the other end of the piston, so that, even in the hypothetical case, power would not be gained, but merely transferred. But it will be shewn that, in practice, the amount of power actually transferred is much less than that expended. The causes of the loss are many; among them are the friction and leakage of the locomotive piston in traversing the whole length of the tube, and the friction and leakage of the air-pumps. But these are trivial compared with the enormous waste, owing to leakage in the fissure extending along the top of the tube; and this cause will operate after every precaution has been employed. The apparatus also for closing this fissure will require an abstract additional power, which contributes nothing to the motion of the train. There is another cause of power being lost, which, as I have never seen it noticed, I shall discuss at some length, viz., that arising from the elasticity of the air, and analogous to the effect already alluded to, of the elasticity of the rope, where that means of tractition is employed. To determine more precisely the nature of the waste of force in atmospheric railways from the cause under consideration, we will imagine an atmospheric pressure of (suppose) 10 lb. to the square inch on the locomotive piston necessary to overcome the inertia of the train, and set it in motion with the requisite velocity. "The elastic force of air at a constant temperature varies inversely as the space it occupies;" or, in other words, the pressure lessens in proportion as the air is condensed. Now, to produce a pressure of 10 lbs, to the square inch on one end of the moving piston, we must (taking the ordinary atmospheric pressure at 15 lbs.) diminish the elastic pressure in the tube of rarefied air till it amounts to only 5 lbs, on the square inch—that is, the air in a tube some three miles long, must be rarefied five-fifteenths, or one-third its original density, before the train can be put in motion. And the force requisite for this purpose contributes nothing, be it remembered, to the *subsequent motion* of the train, since, to maintain its motion, the pumps must continue to be worked exactly as if this preliminary exhaustion had not been effected, for otherwise the advance of the piston would soon condense the air again. It may be considered that we have over-estimated the loss of power in stating that "the preliminary exhaustion contributes nothing to the subsequent motion of the train." It may be argued that the amount of pressure necessary to merely put the train in motion is much less than that necessary to maintain its full velocity. In practice, however, the train is never started till a great proportion of the exhaustion has been effected, and before the train has performed but a very small part of its journey, the maximum exhaustion is effected. Moreover, up to that point the waste of power will continue to operate, though, of course, not in so great a degree as when the train is at rest, and diminishing as the velocity increases, for this reason, that, until the full speed is attained, the vacuum increases in degree, and is, therefore, carried on with greater rapidity than corresponds to the mere progression of the train.

We must explain what is meant by "rapidity of exhaustion corresponding to the velocity of the train." When the rarefaction has reached that degree which is to be maintained without increase or diminution throughout the journey, the train will also reach its full speed. It will follow, therefore, that, while the degree of rarefaction remains unaltered, for every foot which the motive piston advances along the air-tube, a quantity of air equal to that contained in one foot of the air-tube, will be pumped out by the engine. If this exact correspondence in the rate of pumping the air, and of the motion of the train, were not maintained, the degree of rarefaction would not remain unvaried. If the air were pumped out more slowly than the motion of the propelling piston required, the air would tend to condense, and *vice versa*. Of course, in this explanation the supposition of leakage is excluded. The elasticity of the air affords a reservoir of force, which, towards the end of the journey, would keep the train in motion for some little time after the air pumps ceased to be worked. This circumstance might be considered another offset against our estimate, but that the train is never in practice allowed to come to rest gradually, but is stopped by the external force of breaks. On the whole, therefore, the amount of loss must be considered to be almost exactly that above estimated. The motive piston successively occupies every part of the air-tubes, consequently, supposing no leakage, the air-pumps must, before the journey can be completed, pump out a volume of air equal to the solid contents of the tube. Now, we have shown that, while the pressure is 10lbs. to the inch, the extraction of two-thirds of this bulk of air contributes nothing to the motion of the train. We may, therefore, state, without appreciable error, that with the above degree of pressure the preliminary exhaustion wastes two-thirds of the power of the engine. The immediate corollary to this statement is, that the train is propelled most economically with a low degree of exhaustion of the air-tube. Supposing the pressure on the propeller to be only 1lb., instead of 14lbs. to the square inch, the waste would be but one-tenth of that estimated above; that is to say, one-fifteenth instead of two-thirds of the power of the engine. It must be carefully noted, that the friction of the propelling piston is not an *immediate*, but an *ultimate* cause of loss of power. For any given diameter of the piston, the necessary degree of exhaustion increases as the resistance to the piston, from friction and other causes, increases. In other words, the amount of this waste is, in mathematical language, a function of two variables; that is, varies as the resistance to the piston and length of the tube conjointly. So much for the waste of power from preliminary exhaustion. Before discussing the next cause of loss of power, we may consider parenthetically another method of propelling railway trains, which, as it has never, I believe, been carried into practice, is only introduced for the purpose of explanation and comparison with existing methods.

3. This third method of traction was based on two hydrostatic principles—that the pressure of water is directly proportional to its depth—and that the pressure is communicated equally in every direction. Hence, if a cistern containing water communicate by a tube of any form whatever with a piston fixed in the tube, the pressure will not depend on the quantity of water in the cistern and

tube, but solely on the perpendicular altitude of the surface of the water in the cistern above the piston. In the case of the railway, the piston was attached to the train, and was to travel a horizontal pipe laid along the whole length of the rails. The above law of liquid pressure is, however, laid down on the supposition that the fluid is at rest—when the fluid is *flowing*, the pressure is not by any means so great, and diminishes as the velocity increases, a great proportion of the force being absorbed by the mutual action of the fluid molecules, and their friction with the surface of the tube. Hence we come to another important truth, viz., that the laws of fluid pressure are by no means the same for fluids at rest and fluids in motion. This truth applies as well to the atmospheric as hydraulic railway. In the former, a large portion of the atmospheric pressure would be absorbed, and the labour of pumping increased, by the friction of the air with the inner surface of the tube; and this loss will not appear inconsiderable, when we recall some familiar instances of this kind of action. A trumpet is sounded, that is, the whole mass of metal composing it is thrown into a state of rapid vibration by the friction of air. The friction of air in the nozzle forms the greatest resistance to the working of the common bellows. A peg-top when spun is brought to rest principally by the action of air—not by resistance of the air in the ordinary acceptation of the phrase (for that would require projecting surfaces,) but by the friction of it. A peg-top in vacuo has been known to continue spinning an hour and a half. If an inflated bladder have the mouth stopped, and only a small hole pricked in the side, it will take considerable force to drive out the air; the resistance is the friction of the air with the sides of the hole. It is impracticable to light two distinct towns with gas from one gasometer, the gas being obstructed in flowing by its friction with the internal surface of the supply pipe. Excepting this friction of the tubes, the comparison between the hydraulic and atmospheric railways seems greatly in favour of the former. Water being incompressible (nearly so, at least,) the loss corresponding to that form "preliminary exhaustion," is avoided in the hydraulic scheme; owing to water being much less subtle than air, the waste from leakage would also be much less. The hydraulic system affords also the convenience of a reservoir of power, for the power stored in the cistern may be employed at any distance of time after the cistern has been filled. The last effect of transmitting pressure by the intervention of air which we have to consider, may, like the preceding, be explained by analogy. In considering the rope traction, it was shown that obstacles on the rails would cause a constant stretching and unstretching of the rope, which would give rise to a waste of power. The reader will, on reflection, easily perceive that the same waste occurs in atmospheric traction, only proportionably increased, on account of the exceedingly greater elasticity of the material by which communication of power is effected.

4. In the fourth mode of traction, that by locomotive engines, the causes of loss of power differ altogether from the preceding: they arise from the power being employed in moving not only the train, but also the enormous additional weight of the engine and tender, which frequently amounts to fifteen tons; also from the occasional slipping of the wheels on the rails.

These, then, are the sources of the loss of force in the four methods of railway conveyance In making, however, an election between them, many other questions besides that of loss of power would have to be taken into account,—such as the danger of breaking the rope, where that kind of traction was used; and, on the other hand, the fact that locomotive engines, by the very nature of their action, become inoperative on rails not nearly horizontal. With respect, however, to the mere question of waste of power, there will be no difficulty in determining, from the above considerations, the particular mode of traction in which the loss immeasurably preponderates.—*Civil Engineer.*

## ON THE IMPORTANCE OF VENTILATION

BY MR. P. SQUIRE.

*(Continued from Page 283.)*

Mr. Rucker's mode of single ventilation deserves to be mentioned: it is a suspended light, having a globe screwed on the bottom of the brass-work supporting the burner, and the air glides down the sides of the globe, and is warmed before it has to support the combustion; it then passes up the hollow stem which suspends the lamp, and is the outlet for the spoiled air: there is one in operation at 320, Oxford-st.

Having pointed out the different plans for ventilation, we may take a survey of the different burners that are employed for gas lighting: the Bude, which once burnt oil and oxygen, now used for burning gas; the Boccius burner, a similar one to that of Gurney, both requiring a metal tube within the upper part of the glass chimney; these are for lighting on a large scale, and therefore not so frequently required as the argand burner, which has been made into all shapes; that by Leslie into a ring, gives a good light, and being a thin metal, does not detract from the heat at the point of combustion so much as the stronger made ones. Luntley's is a flattened ring, and the gas is burned at the very bottom of the glass chimney. Platow puts a cone in the glass-holder, pierced with holes at its base, the current of air thus passes between the hot surfaces of the brass, and is warmed and the flame is steady. Dochree's burner delivers the gas at four holes concealed in a groove, and the gas rises and ignites as a circular sheet of flame. The Scotch jet, called the fish-tail, appears to be the favourite for economy, and burns the gas most perfectly, requiring no regulation if it have but sufficient pressure. Warming the gas is a desideratum; and I think it is Mr. Smith's which brings the supply tube over the flame for that purpose. Dr. Reid brings the supply tube down the centre of his radiating light, which is a beautiful arrangement of the Scotch jet in a circle, so that the flat flames resemble the spokes of a wheel; a circular flue surrounds it, and the draught of air, rushing through the leaves of the flame, prevents the tube from becoming too hot, so that the gas comes highly heated to the point of escape without being decomposed—a beautiful light is obtained, together with ventilation, and no glass is required. Glasses are not only an additional expense to gas lighting, but some light is lost by their use, and when they become dirty from any cause, the loss is greatly increased; it is true they soften the light, but if the lights are placed high, and we get the reflected light from the walls the glasses may be dispensed with. There is a light of Dr. Reid's placed under the ceiling of the Speaker's room in the House of Commons, in the centre of a neat perforated zinc pendant, which gives a beautiful light to read by, though it is perhaps ten or twelve feet above your head—the pendant serves as the ventilator to the room, and the pure air is admitted appropriately near to the floor.

Naphthalizing the gas increases its illuminating power; that which volatilizes at a low temperature should be employed, and not too much introduced, otherwise you obtain a reddish flame instead of the star-like bright light.

The usual argand burner consumes about 5 cubic feet of gas per hour, producing rather more than 5 cubic feet of carbonic acid and half a pint of water.

Shops using thirty of these lights, therefore, in an evening of four hours, produce upwards of nine gallons of water, holding in solution the noxious products of the gas.

An argand lamp burning in a room twelve feet high and twelve feet square, containing 1728 cubic inches of air, with closed doors and windows produces sufficient carbonic acid in rather more than three hours to exceed one per centum, which is considered unfit for respiration, and when it amounts to ten per cent. it is fatal to life.

A man makes on an average twenty respirations per minute, and at each inspiration inhales sixteen cubic inches of air; of these 320 cubic inches inhaled thirty-two cubic inches of oxygen are consumed, and twenty-five cubic inches of carbonic acid produced.

These are data for our consideration; and I trust will lead many to think seriously about making their knowledge practically useful. The following extract from the pamphlet of Mr. Ritchie, published this year on the ventilation and warming of factories, puts in a very clear manner the importance of pure air. He says, "If the various convolutions of the air-cells of the lungs were spread out, they would present a surface *thirty times* as extensive as the surface of the body; that over this extensive surface, through exceedingly minute vessels, the entire blood of the body passes every three minutes; that we respire every twenty-four hours a quantity of air that would fill upwards of seventy-eight hogsheads, and the blood passes upwards of 500 times in the course of the day through the lungs, exposed to the enormous quantity of air which we respire. . . . Thus in proportion as the impurities exist, the air we breathe becomes a slow or more rapid poison.—*Pharmaceutical Journal.*

## FIRE-PROOF WAREHOUSES AT LIVERPOOL.

The noble pile of warehouses now being erected for Mr. Brancker, is unquestionably the largest yet erected in Liverpool, occupies the three fronts of Great Howard-street, Dublin-street, and Dixon-street, and covers 4,433 square yards of land, being only 107 yards less than an acre. It is divided into eleven warehouses, of something less than 400 square yards each, not including the walls. The external walls are 3½ bricks thick, and the division walls are three bricks. When completed, the warehouses will be 65 feeet high, and will have six stories of rooms, besides the basement or cellar story. Every window throughout the pile is to be glazed with large sheets of plate-glass, and each is protected by a strong wrought-iron shutter, secured to an iron frame. The floors are formed by iron girders or beams, resting on columns of great strength, and are all secured together by wrought-iron coupling-bars. The bearing-beams rest on large blocks, made of Welsh fire-clay, and brick arches of nine inches thick are to be thrown from beam to beam, the lateral thrust of the arches being counteracted by wrought-iron tie-rods, strongly secured to the beams, which are placed horizontally every 6 feet on the average. These connecting rods are 1¼ in. square, and are tested to resist a tension of thirty-five tons each. Every bearing-beam is also tested by a lever press at the building, to bear on its centre a pressure of thirty-eight tons, which is equivalent to a weight of four tons on each square yard. The floors of the whole structure are to be laid with Welsh fire-tiles, bedded in Terras mortar, there being an intervening stratum of sand to prevent the fracture of the arches, should heavy goods be thrown down upon them. The entrance doors are made double—that is, of two separate plates rivetted together, having a cavity of an inch between them, with six small air-holes so that if either side of the door beame heated, the other side would be comparatively cool. The various rooms have also iron double doors of communication, each door being placed on the internal face of the wall, so as to leave a space of two feet between them. The staircases are inclosed from the rooms by walls of two bricks thick. These staircases are 18 feet long, by 7 feet 6 inches broad, and all the steps are of Yorkshire stone. Each staircase is to be provided with an upright main, of 6 inches diameter, which is to be supplied with water from the mains about to be laid down by the Sewerage Commissioners, and which, from the pressure of the Low-hill reservoir, will always be full of water. On each landing there is to be a brass stop-cock screwed, to fit either the hose kept on the premises (60 feet long being appropriated to each room), or it will fit the hose of the Commissioners and Fire Police, so that in case of fire, there will be an abundant supply of water on each landing, and instantly available. Small apertures are provided through which the branch can be inserted, and as each room will be perfectly air-tight, it will be impossible, if a fire occurs, for it to break out into flame. The staircases are so admirably constructed, that if every room in the building was on fire, men may be placed in perfect security on each landing, and pour a continuous stream of water into every room. All the entrance doors are recessed back from the fronts of the building, and there are no projecting cat-heads or pent-houses beyond the line of the edifice. The roofs are all to be formed of wrought-iron trusses, covered with Welch slates; and parapet-walls are to be built between each warehouse for additional security. Great attention seems to be paid to the drainage, there being three large dry wells of 5 feet diameter and 20 feet deep, and barrel sewers are being carried from all parts into these wells. The whole of these magnificent buildings have been designed and are being erected, by Messrs. Samuel and James Holme.—*Liverpool Journal.*

## THE COPPER TRADE.

An article in the 'Swansea Journal' directs attention to the great and increasing importance of the copper trade with India. It appears that in "the years 1835-6, 1836-7, and 1837-8, the importation of this article amounted on an average to the value of 2,575,000 rupees (£257,500), but the last of these years had so heavy a proportion as to cause a glut in the market, which was felt to some extent in 1841, when the average of three years was 2,126,000 rupees, or £212,600. The trade then recovered rapidly, the average of 1841-2 and

1843-4 being 3,242,000 rupees, and the proportion of the latter year amounting to no less than 42 lakhs, or £420,000." The writer goes on to observe, that as "the only use to which copper is as yet turned, is in manufacturing the domestic utensils of the Hindoos, who no sooner emerge from abject poverty, then they hasten to exchange their earthenware, for dishes and water-pots of brass," an increase in the demand for copper shows an improvement in the social condition of the natives, which opens further prospects for British commerce. The writer adds, "that the increase in the copper trade may be set down by some persons as the result of mere temporary speculation; but he adduces the increase in the trade carried on with America in the same article as a proof that our export may be set down as legitimate. We find that the export trade, from reference to the table of exports in metals, iron, and steel has shared in the prosperity which has attended every branch of our commerce in 1844. The excess of the exports in metals (including iron, steel, copper, brass, and tin) over those of 1843 amounts to £730,300.

---

## NEW MOTIVE POWER.

M. Selligues, who some short time since reported to the Acadamiè des Sciences a discovery of a motive power which he then thought would be a substitute for steam, and which consists of combining atmospheric air with hydrogen gas, by which an explosion is produced when ignited, has at a recent meeting of the academy, made another communication, from which it now appears that the detonating power ceases under pressure. This phenomenon has proved an obstacle to the experiments of M. Selligues before the Committee appointed by the Academy. Notwithstanding the difficulties which have interposed themselves, M. Arago has convinced himself of the discovery, and has reported to the Academy that with so small a quantity as 3 to 5 litres (6 to 10 pints) of hydrogen gas, mixed with atmospheric air, a weight of 1000 kilogrammes (=2205 lb.) was rapidly raised to the height of 3 feet.

## FERMENTED LIQUORS.

Dr. Hull, of Upper Brook Street, has just obtained a patent for improvements in manufacturing or improving fermented and distilled liquors.

These improvements consist in passing a current of electricity through a quantity of wine, spirits, beer, or other fermented or distilled liquors, by means of an electrical apparatus. The object of this process is to improve the quality of the liquor so operated upon, by perfecting the fermentation, and thereby giving to the liquor a property similar to that usually acquired by age, and likewise affording a means of separating the acetous part of the liquor from the general mass. The most convenient mode of effecting this object is by placing the liquor in a close glass or glazed earthen vessel, and inserting the poles of a galvanic battery into the liquor, by means of which a current of electricity is carried through the liquor.

The quantity and intensity of the electric fluid required, will depend on the quantity and condition of the liquor to be operated upon, and the state to which it is desired to be brought; consequently, the space of time during which the process should be continued, must depend upon the same conditions. As these circumstances will necessarily vary in operating upon different matters, the patentee has considered it impossible to describe any defined scale of proportions, but he has given some general rules, by which operators may be guided. If, for instance, two gallons of new wine are to be acted on the patentee employs an ordinary galvanic battery, made on the principle proposed by Smee, with half a dozen pairs of plates, about six inches by two inches in area: one or two pairs of these plates are generally used, with a solution of one part of sulphuric acid to twelve of water; the poles are of platinum; the negative being made of fine wire, about 1-200th of an inch, and the positive a thin plate, one inch by three in area. In this case the poles should be about six inches apart: the positive being entirely immersed in the fluid (which is put into a close vessel of glass), and the negative insertod only about half an inch into the fluid. By an apparatus prepared with these conditions, the operation upon the wine should be continued for about a week, the effect being watched from time to time; and should the presence of gas appear at either pole, in any considerable quentity, it may be desirable to lessen the strength of the battery, by weakening the solution until little or no gas is perceptible. The requisite time for continuing this operation upon the wine can only be known by tasting it, as different qualities of wine will necessarily require different quantities and intensities of electricity.

In order to improve wine in any large quantity, an apparatus proportionably increased in power will be required. Beer is to be operated upon in the same way; but it will be found that malt liquors generally will require the process to be contined for a less time. Spirituous liquors will sometimes need to be operated upon for a longer time; but in all cases the flavour of the liquor, (occasionally tasted), must guide the operator.

It will require considerable caution, in operating upon different liquors, to prevent their natural briskness from being destroyed; which would be the case if the intensity of the battery were too great. By increasing the surface of either pole of the battery, the intensity of the electric fluid, at that pole will be diminished, and *vice versa;* and even sometimes the negative pole may be made to present the largest surface; and by bringing the poles closer together the effect will be increased. By the use of one pole of the battery only, the effect may be produced, but by a much slower process. The most acid condition of the liquor will always be at the positive pole, and from which any quantity may be drawn, in case the acid should be too redundant to be mixed up with the mass.

The elements of this improved process or mode of operating upon fermented and distilled liquors, being thus set forth, the details of which must be varied according to the quantities and conditions of the liquors; the patentee desires it to be understood that he does not intend to confine himself to the use of any particular construction or arrangement of electrical or galvanic apparatus, or to any definite precise dimensions of the conducting poles. But he claims the application of a current of electricity, passed through fermented or distilled liquors, by means of any suitable machine or apparatus, for the purpose of improving their condition, or giving them those qualities which have heretofore been wholly obtained by age, and allowing the acid portion of the liquor to be partially drawn off, if necessary.

## BISCUITS.

For the following account of the mechanical system of baking biscuits for the royal navy, I am indebted to the ingenious inventor, Thos. Grant, Esq. of Gosport.

Ships' biscuits are now made by machinery; and one of the reasons for this has been that the manual preparation of them was too slow and too costly during the last war. A landsman knows very little of the true value of a biscuit: with a seaman, biscuit is the only bread that he eats for months together. There are many reasons why common loaves of bread could not be used during a long voyage: because, containing a fermenting principle, they would soon become musty and unfit for food, if made previous to the voyage; while the preparation of them on board ship is subject to insuperable objections. Biscuits contain no leaven, and, when well baked throughout, they suffer little change during a long voyage.

The allowance of biscuit to each seaman on board a queen's ship is a pound per day (averaging six biscuits to the pound). The supply of a man-of-war for several months is, consequently, very large; and it often happened during the last war that the difficulty of making biscuits fast enough was so great, that at Portsmouth waggon loads were unpacked in the streets and conveyed on board ships.

We shall now describe the mode of making biscuits by hand; and afterwards speak of the improved method. The bakehouse at Gosport contained nine ovens, and to each was attached a gang of five men—the "turner," the "mate," the "driver," the "breakman," and the "idleman." The requisite proportions of flower and water were put into a large trough, and the "driver," with his naked arms, mixed the whole up together into the form of dough—a very laborious operation. The dough was then taken from the trough and put on a wooden platform called the break: on this platform worked a lever called the break-staff, five or six inches in diameter, and seven feet long; one end of this was loosely attached by a kind of staple to the wall, and the breakman riding or sitting on the other end, worked this lever to and fro over the dough, by an uncouth jumping or shuffling movement. When the dough had become kneaded by this barbarous method into a thin sheet, it was removed to the moulding-board, and cut into slips by means of an enormous knife; these slips were then broken into pieces, each large enough for one biscuit, and then worked into a circular form by the hand. As each biscuit was shaped it was handed to a second workman, who stamped the king's mark, the number of the oven, &c. on the biscuit. The biscuit was then docked, that is, pierced with holes by an instrument adapted to the purpose. The finishing part of the process was one in which remarkable dexterity was displayed. A man stood before the open door of the oven, having in his hand the handle of a long shovel called a peel, the other end of which was lying flat in the oven. Another man took the biscuits as fast as they were formed and stamped, and jerked or threw them into the oven with such undeviating accuracy that they should always fall on the peel. The man with the peel then arranged the biscuits side by side over the whole floor of the oven. Nothing could exceed (in manual labour alone) the regularity with which this was all done. Seventy biscuits were thrown into the oven and regularly arranged in one minute; the attention of each man being vigorously directed to his own department; for a delay of a single second on the part of any one man would have disturbed the whole gang. The biscuits do not require many minutes' baking; and as the oven is kept open during the time that it is being filled, the biscuits first thrown in would be overbaked were not some precaution taken to prevent it. The moulder, therefore, made those which were to be first thrown into the oven larger than the subsequent ones, and diminished the size by a nice gradation.

The mode in which, since about the year 1831, ships' biscuits have been made by machinery invented by T. T. Grant, Esq., of the Royal Clarence Yard, is this: the meal or flower is conveyed into a hollow cylinder four or five feet long, and about three feet in diameter, and the water, the quantity of which is regulated by a guage, admitted to it; a shaft, armed with long knives, works rapidly round in the cylinder, with such astonishing effect that, in the short space of three minutes, 340 pounds of dough are produced, infinitely better made than that mixed by the naked arms of a man. The dough is removed from the cylinder, and placed under the breaking rollers; these latter, which perform the office of kneading, are two in number, and weigh 15 cwt. each; they are rolled to and fro over the surface of the dough by means of machinery, and in five minutes the dough is perfectly kneaded. The sheet of dough, which is about two inches thick, is then cut into pieces half a yard square, which pass under a second set of rollers, by which each piece is extended to the size of six feet by three, and reduced to the proper thickness for biscuits. The sheet of dough is now to be cut up into biscuits, and no part of the operation is more beautiful than the mode by which this is accomplished. The dough is brought under a stamping or cutting out press, similar in effect, but not in detail, to that by which circular pieces for coins are cut out of a sheet of metal. A series of sharp knives are so arranged that, by one movement, they cut out of a piece of dough a yard square about sixty hexagonal biscuits. The reason for a hexagonal (six-sided) shape is, that not a particle of waste is thereby occasioned, as the sides of the hexagonals accurately fit into those of the adjoining biscuits; whereas circular pieces cut out of a large surface always leave vacant spaces between. That a flat sheet can be divided into hexagonal pieces without any waste of material is obvious.

Each biscuit is stamped with the queen's mark, as well as punctured with holes by the same movement which cuts it out of the piece of dough. The hexagonal cutters do not sever the biscuits completely asunder; so that a whole sheet of them can be put into the oven at once, on a large peel or shovel adapted for the purpose. About fifteen minutes are sufficient to bake them; they are then withdrawn, and broken asunder by the hand.

The corn for the biscuits is purchased at the markets, and cleaned, ground, and dressed at the government mills; in quality it is a mixture of fine flour and middlings, the bran and pollard being removed, The ovens for baking are formed of fire-brick and tile, with an area of about 160 feet. About 112lbs. weight of biscuits are put into the ovens at once. This is called a suit, and is reduced to about 110lbs. by the baking. From twelve to sixteen suits can be baked in each oven every day, or after the rate of 224lbs. per hour. The men engaged are dressed in clean check shirts and white linen trowsers, apron, and cap; and every endeavour is made to observe the most scrupulous cleanliness.

We may now make a few remarks on the comparative merits of the hand and the machine processes. If the meal and the water with which the biscuits are made be not thoroughly mixed up, there will be some parts moister than others. Now, it was formerly found that the dough was not well mixed by the arms of the workman; the consequence of which was, that the dry parts became burnt up, or else that the moist parts acquired a peculiar kind of hardness which the sailors called "flint:" these defects are now removed by the thorough mixing and kneading which the ingredients receive by the machine.

We have seen that 450 lbs, of dough may be mixed by the machine in four minutes, and kneaded in five or six minutes; we need hardly say how much quicker this is than men's hands could effect it. The biscuits are cut out and stamped sixty at a time, instead of singly: besides the time thus saved, the biscuits become more equally baked, by the oven being more speedily filled. The nine ovens at Gosport used to employ 45 men to produce about 1500 lbs. of biscuit per hour; 16 men and boys will now produce, by the same number of ovens, 2240 lbs. of biscuits (one ton) per hour.

The comparative expense is thus stated:—Under the old system, wages, and wear and tear of utensils, cost about 1s. 6d. per cwt. of biscuit: under the new system, the cost is 5d.

The bakehouses at Deptford, Gosport, and Plymouth, could produce 7000 or 8000 tons of biscuits annually, at a saving of 12,000*l.* per annum, from the cost under the old system. The advantages of machine-made over hand-made biscuits, therefore, are many, quality, cleanliness, expedition, cheapness, and independence of government contractors. —*Ure.*

## NEW METHOD OF CLEANSING METALLIC CLOTH,

***More particularly applicable to Davy's Safety Lamp.***

It is well known that the metallic cloth which surrounds the flame of the lamps used in coal mines becomes very foul, in consequence of a mixture of oil, soot, and coal dust insinuating itself between the meshes thereof; and as this clogging up of the meshes of the fabric causes a great diminution in the intensity of the light, it is found necessary to cleanse the same very frequently. For this purpose, the metallic cloth is exposed to the action of fire, which decomposes the oil and coal, and only leaves between the meshes a powder, which is easily removed by means of a dry brush. It is, however, impossible to heat metallic cloth to the degree required for decomposing the oil and coal, without bringing the same in contact with the air; by which means, in consequence of the oxidation of the iron, the wire is diminished in thickness, and the strength of the fabric consequently impared.

Moreover, when the coal is of a sulphurous nature (as is often the case), the sulphur contained therein, being very destructive to iron, always renders the wire more liable to break. The consequence of this is, that the safety-cover, becoming thinner and more fragile, is much more likely to break from a shock, or even by the action of the flame; and thus the probability of accidents, which are of such frequent occurrence in mines, is greatly increased.

The following method of cleansing these kinds of fabrics entirely obviates the above-mentioned inconveniences:—Take a given quantity of carbonate of soda of commerce (which may be procured at a very low price), and dissolve it in water in a cast-iron vessel. To this solution is to be added a sufficient quantity of quick-lime, to deprive the carbonate of soda of the carbonic acid contained therein, The quantity of lime may be easily calculated by means of a table of chemical formulæ.

By sufficient boiling, a perfect re-action is produced; the carbonic acid combines with the lime, and forms an insoluble carbonate, and the soda becomes caustic. It is only necessary to separate the carbonate of lime from the caustic soda by filtration. In this solution of caustic soda, which is diluted more or less, according to circumstances, the foul metallic fabric is to be immersed. After remaining a short time (a few minutes will suffice) in this boiling liquid, the oil deposited in the meshes will be converted into soap, and the soot and coal be removed by being partially dissolved. When the meshes of the fabric are cleansed, it is to be brushed with a hard conical brush, which penetrates the fabric, and afterwards washed in clean water, which removes any substances that might have adhered thereto; after which the metallic fabric is to be wiped inside and out with a wiper, made of a sponge wound upon a stick, and in order to prevent the formation of rust upon the fabric, it is exposed to the heat of a coke or other ardent fire, until perfectly dry. It will be seen that the method of cleansing above described is very simple, and founded upon upon a well-known chemical re-action, but it will be found to possess considerable advantages over the method now in use.

In pointing out the advantages presented by Mr. Mueseler's lamp, M. Devaux, Chief Engineer of the Mines, acknowledges that the method of cleaning by fire diminishes the duration of metallic fabrics by one quarter. If, therefore, the results of this method shall be found successful on being practically tried, a great saving will be effected in mining operations, which ought not to be overlooked.—*Bulletin de l' Industrie.*

## VARIETIES.

*To cure Foxed Beer.*—Add a handfull or two of hops to the diseased beer, with a little powdered alum.

*Qualities of Ivory.*—The African ivory, when in the most perfect condition, should appear, when recently cut, of a mellow, warm, transparent tint, almost as if soaked in oil, and with very little appearance of grain or fibre; it is then called transparent or green ivory, from association with green timber; the oil dries up considerably by exposure, and leaves the material of a delicate, and generally permanent tint, a few shades darker than writing paper. The Asiatic ivory is of a more opaque, dead-white character, apparently from containing less oil, and on being opened, it more resembles the ultimate character of the African, but it is the more disposed of the two to become discoloured or yellow. The African ivory is generally closer in texture, harder under the tools, and polishes better than the Asiatic, and its compactness also prevents it from so readily absorbing oil, or the colouring matter of stains when intentionally applied.—*Holt-*

*Fig. 1.*

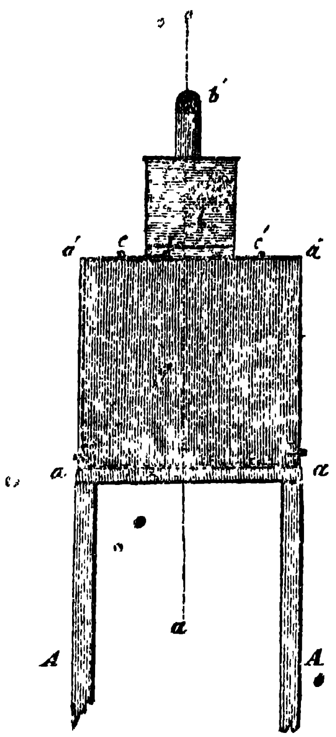


*Fig. 3.*

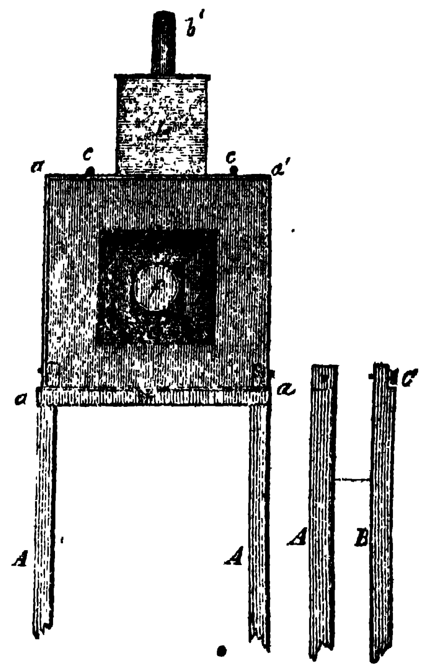
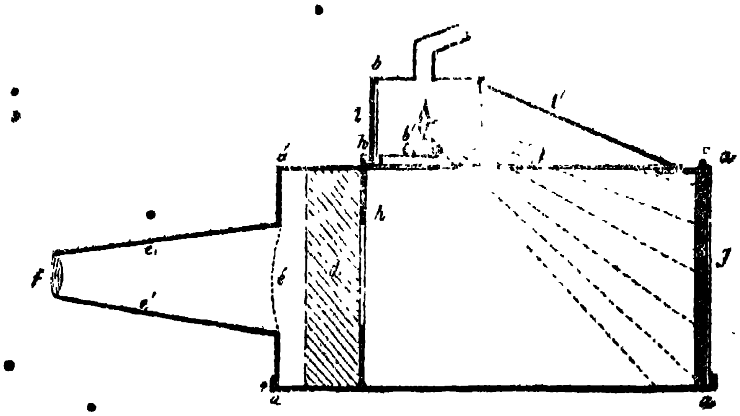


*Fig 2.*



PORTABLE COSMORAMA.

## PORTABLE COSMORAMA.

*Ipswich, Sept. 30th,* 1844.

SIR,—Enclosed I send you a descriptive drawing of a portable Cosmorama, which first succeeded with me; upon a trial, from the ideas received from a visit to the "Cave" in the Baker Street Bazaar, London. It has proved most successful and efficient, also as a means of illustrating the best description of Dioramic subjects. I think you will be conferring a favour by insertion, upon those, who, although fully appreciating the value of any species of Dioramic illustration, are unable to gratify their desire, from its usual machinery being over expensive, or its size too extensive, or even its casual observance too costly.

*Description of Figures*:—Fig. 1, exhibits a shaded elevation of the back of the Cosmorama, in which, the dotted line, shown at (a a') gives that of the horizontal lateral section, shown in fig. 2, which I will first explain: (a a a' a') fig. 2, represents a box, two feet long, one foot high, and one foot broad. Into the end designed for the front, a square tube, (e e') is inserted, equal to twelve inches in horizontal length, but declining in width from its junction with the box at (i), where its dimensions are six inches inside, to its termination at the lens (f) three inches in diameter, the wood being about half an inch thick. Then the focal length of the lens (f) being nearly equal to three feet, will extend itself to the inside of the back (g); here, then, must the object to be viewed be placed. To effect its exhibition, a slit is made in the upper part of the box, close inside (g), of sufficient width to admit of a frame (c) (on which the picture is stretched) having small handles for facility of removal at (c' c'), allowing the whole interior area of (g) to be taken up by the picture frame, excepting the bottom corners, into which intrude the shoulders of the supporting legs hereinafter mentioned.

And here I may notice, that the angles given to (e e'), in its quadrangular form, are drawn from the corner points of widest extension on the surface of the picture (c) up to, or near the periphery of the lens, in its fixed, available position. It now becomes necessary to place between the lens and view, a something, in order to cut off all apperrance of the interior of the box, irrespective of the scene; and this is effected by the broad wooden frame (d), close to which (next the picture) slides (h'); a card representation of a rocky cavern or delapidated archway, to be drawn out or put in by the small handle (h), its purpose being, that when a view of the picture is taken through the lens, no more light may reach the eye, but that proceeding direct from the picture itself; and which light will so diffuse itself in its proper degree through the box from the illuminating apparatus above. This apparatus is given at (b' b') and (l' l') with (k); and exhibits a box of the form given in the drawing, which, having communication, first underneath itself, with the lower one, is six inches high at its front nearest the lens, and having an opening then above, large enough to admit of the square-funnelled lamp-box and lamp belonging to it, (b' b') which lamp illuminates the picture, (c) the light passing through a faintly coloured tissue-paper screen, for the purpose of modification; while a piece of woo[illegible] r the lamp, and upon whose edge the frame o[illegible] paper-screen abuts, prevents the light fro[illegible] through any where else. Of course [illegible]red in close, excepting the orifice of the funnel for the heat to escape out of, with any smoke that may be generated.

I will further mention, that the modifying screen may be drawn in and out by means of a little nob, in order to substitute one, whose paper is of a different tint, as suiting a night, or day, evening, or morning view, &c.

The idea of fig. 1 and 3, will suggest itself upon a comparison with fig. 2. Fig. 3 is a front view of the Cosmorama, and fig. 1, a blank view, externally also. The supporting legs are seen distinctly at A and B; B showing the edge, and A the side view: being inserted into holes, one at each corner of the bottom of the instrument up to their shoulder. They are fixed through the sides of the box, by means of the screws C, and thus form a support to the instrument, of sufficient strength, and of an elevation adapted to the human eye, when a person standing becomes a spectator. The legs may be one inch thick and two inches broad.

I remain your old correspondent, most respectfully,

ÆGIDIUS.

---

## THE CHOCOLATE TREE AND ITS USES.

WHAT is generally called Cocoa is merely the berries of Theobroma Cacao, pounded and drank either with water or milk, or with both. Chocolate is a compound drink, and is manufactured chiefly from the kernels of this plant, whose natural habitation would seem to be Guayaquil, in South America, though it flourishes in great perfection in the West Indies. It grows also spontaneously and luxuriantly on the banks of the Magdalena. Mr. Schomburgk, in his recent expedition into the interior of British Guiana, found the country abounding in Cocoa, "which the Indians were most anxious to secure, as the pulpy arillus surrounding the seed has an agreeable vinous taste. Singular to say, however, they appeared perfectly ignorant of the qualities of the seed, which possesses the most delightful aroma. Mr. Schomburgk states, they evinced the greatest astonishment when they beheld him and Mr. Goodall converting these seeds and using them as Chocolate, which was the most delicious they had ever tasted." The height of the Cocoa shrub is generally from eighteen to twenty feet; the leaf is between four and six inches long, and its breadth three or four, very smooth, and terminating in a point like that of the Orange tree, but differing from it in colour; of a dull green, without gloss, and not so thickly set upon the branches. The blossom is first white, then reddish, and contains the rudiments of the kernels or berries. When fully developed, the pericarp, or seed-vessel is a pod, which grows not only from the branches, but the stem of the tree, and is from six to seven inches in length, and shaped like a Cucumber. Its colour is green when growing, like that of the leaf; but when ripe, is yellow, smooth, clear, and thin. When arrived at its full growth, and before it is ripe, it is gathered and eaten like any other fruit, the taste being subacid. Chocolate, so called, and so prized both in the Spanish Continent and in the West Indies, never reached Great Britain except as a contraband article, being, like nearly all colonial manufactured articles, prohibited by the Custom-house laws. What is generally drank under that name is simply the Cocoa boiled in milk, gruel, or even water, and is as much like the Spanish or West India Chocolate as vinegar is to Burgundy. It is, without any exception, of all domestic drink.

the most alimentary; and the Spaniards esteem it so necessary to the health and support of the body, that it is considered the severest punishment to withhold it, even from criminals; nay, to be unable to procure Chocolate, is deemed the greatest misfortune in life! Yet, notwithstanding this estimation in which it is held, the quantity made in the neighbourhood of Carthagena is insufficient for the demands of the population, and is so highly prized that none is exported but as presents! The signs by which good Chocolate or Cocoa is known are these:—It should dissolve entirely in water, and be without sediment; it should be oily, and yet melt in the mouth; and if genuine and carefully prepared, should deposit no grits nor grounds. That made in the West Indies and in some parts of Cuba is dark; but that manufactured in Jamaica is of a bright brick colour, owing to the greater quantity of anatto which is used in the preparation, and which, I think, gives it a richer and a more agreeable flavour. In an economical point of view, Chocolate is a very important article of diet, as it may be literally termed meat and drink; and were our half-starved artisans, over-wrought factory children, and rickety millinery girls, induced to drink it instead of the innutritious and unwholesome beverage called tea, its nutritive qualities would soon develop themselves in their improved looks and more robust constitutions. The price, too, is in its favour, Cocoa being 10d. per pound; while the cheapest black tea, such as even the Chinese beggar would despise, drank by milliners, washerwomen, and the poorer class in the metropolis, is 4s. a lb., or 310 per cent. dearer, while it is decidedly injurious to health. The heads of the naval and military medical departments in England have been so impressed with the wholesomeness and superior nutriment of Cocoa, that they have judiciously directed that it shall be served out twice or thrice a week to regiments of the line, and to the seamen on board Her Majesty's ships, and this wise regulation has evinced its salutary effects in the improved health and condition of the men. Indeed, this has been most satisfactorily established in Jamaica among the troops; and a remarkable fact corroborating this statement is, that by returns to the Horse Guards, it is shown that only one death took place at Newcastle Barracks, in that island, out of a force of 700 men, for the quarter ending Sept. 30, 1842; and the same may be asserted of other regiments in the West Indies, and of the seamen in Her Majesty's ships on the coast. But the excellent qualities of Chocolate were known not only to the Mexicans and Peruvians, from whom, as a matter of course, the Spaniards acquired a knowledge of its properties; but European nations also acknowledged its virtues. The Portuguese, French, Germans, and Dutch, considered it an exceedingly valuable article of diet, and Hoffman looked upon it both as a food and a medicine. In his monograph, entitled "Potus Chocolate," he recommends it in all diseases of general weakness, macies, low spirits, and in hypochondriacal complaints, and what since his time have been termed nervous diseases. As one example of the good effects of Cocoa, he adduces the case of Cardinal Richelieu, who was cured of eremacausis, or a general wasting away of the body, by drinking chocolate. Liebig and other chemists have demonstrated beyond question that no part of an organ which possesses motion and life is destitute of nitrogen:—"All parts of the animal body which have a decided shape, which form parts of organs, contain nitrogen;" and the chief ingredients of the blood contain 17 per cent. of nitrogen, and no part of an organ less than 17 per cent. It follows, therefore that nitrogen is that principle of the body which, being in the greatest quantity, and pervading all tissues, is that most frequently wasted, and most frequently in need of renewal. This must be admitted. It follows, then, that those substances which possess this principle in the greatest quantity in a given bulk, are those which must be best calculated to renew that which has been lost or wasted by the operations of the body. Now caffeine (the principle of Coffee), and theobromine (the principle of Theobroma Cacao), are the most highly nitrogenized products in nature, as the following analysis will show:—Caffeine according to Pfaff and Liebig contains—

| | |
|---|---|
| Carbon | 49·77 |
| Hydrogen | 5·33 |
| Nitrogen | 28·78 |
| Oxygen | 16·12 |

Theobromine, according to Woskreseusky, contains—

| | |
|---|---|
| Carbon | 47·21 |
| Hydrogen | 4·53 |
| Nitrogen | 35·38 |
| Oxygen | 12·80 |

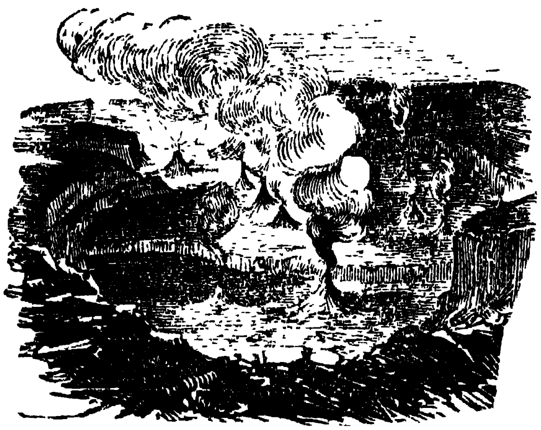
## SLIP OF CHALK AT EAST CLIFF, DOVER.

Every observer of the cliffs of Dover will behold the same weather-beaten face that terrified the army of Cæsar, with very little alteration, in this locality, till you come some fifty or seventy yards beyond the Jetty. The same flints, had they eyes, would have seen the glorious lord of day rise for the last 2,000 years. The builder of certain premises on the cliff, from an error in judgment, and following the example of others, continued the line of buildings, not observing or regarding the mound of loose chalk thrown down when the moat round the castle was enlarged; and, finding the foot or bottom in his way, removed it. Consequently, the late heavy and incessant rains, lodging on the top or table, so saturated it, that the part above slipped, and filled up the space which he had made, and on which a part of the building stood. I have been an accurate observer of the cliffs for half a century. There never has been, properly so called, a fall of the cliffs in that time, but virtual slips have been occasioned by the sea washing away the bottom, or by some excavations of man at the foot; otherwise the cliff cannot slip (or fall, if you please), but from one or other of these joint causes. I call the attention of the scientific, or my contemporary observers, as well to the present slip as to the different ones along the railroad—the great one at Shakspeare's Cliff in 1800, or thereabout, and the one on the 12th of November, 1810, when the pig that survived for months under the ruins was buried. Here not only was the foot of the cliff cut away, but a piece of ordnance was placed immediately above, the plane and mounds of which retained the rains, and occasioned the slip. It will be found universally that a greater quantity of earth or loose soil is found at the top of all slips of chalk that retain the rains, which, by the joint action of gravity and the attraction of the sun, descend on inclined planes which they form; and if that inclined plane reaches the face of the cliff before it gets to the base, there, and there only, can a slip of our far-famed cliffs happen.

I consider all the houses in the locality of East Cliff, facing the sea, as safe as Snargate-street; for it would require a great projectile force to send from the apex of the cliffs any portion thereof. The nine tons of gunpowder, used at the great blast at Rounddown, did not project farther. I am informed that a Government survey has been made, and that it is their intention to remove the objectionable points, and then every part of that locality will be safe.—*Dover Chronicle.*

## VOLCANOES.

(*Continued from Page* 287).



THE VOLCANO OF KIRAUEA, IN HAWAII.

Of the existing volcanoes, that of Kirauea in Hawaii, (formerly called Owhyhee,) so graphically described by Mr. Stewart and Mr. Ellis, exhibits volcanic action in the most sublime and imposing aspect. The whole island, which covers an area of 4000 square miles, is a complete mass of volcanic matter in different states of decomposition, perforated by innumerable craters, and rising to an altitude of 16,000 feet. It is in fact a hollow cone, with numerous vents, over a vast incandescent mass, which doubtless extends beneath the bed of the ocean; the island forming a pyramidal funnel from the furnace beneath to the atmosphere. The following account of a visit to the crater, affords a striking picture of the splendid but awful spectacle which it presents.

"After travelling over extensive plains, and climbing rugged steeps, all bearing testimony of volcanic origin, the crater of Kirauea suddenly burst upon our view. We found ourselves on the edge of a steep precipice, with a vast plain before us, fifteen or sixteen miles in circumference, and sunk from two hundred to four hundred feet below its original level. The surface of this plain was uneven, and strewed over with large stones and volcanic rocks; and in the centre of it was the great crater, at the distance of a mile and a half from the precipice on which we were standing. We proceeded to the north end of the ridge, where, the precipice being less steep, a descent to the plain below seemed practicable; but it required the greatest caution, as the stones and fragments of rock frequently gave way under our feet, and rolled down from above. The steep which we had descended was formed of volcanic matter, apparently of light-red and grey vesicular lava, lying in horizontal strata varying in thickness from one to forty feet. In a few places the different masses were rent in perpendicular and oblique directions, from top to bottom, either by earthquakes, or by other violent convulsions of the ground connected with the action of the adjacent volcano. After walking some distance over the plain, which in several places sounded hollow under our feet, we came to the edge of the great crater. Before us yawned an immense gulf in the form of a crescent, about two miles in length from north-east to south-west, one mile in width, and 800 feet deep. The bottom was covered with lava, and the south-west and northern parts were one vast flood of burning matter. Fifty-one conical islands of varied form and size, containing as many craters, rose either round the edge or from the surface of the burning lake. Twenty-one constantly emitted columns of grey smoke, or pyramids of brilliant flame: and at the same time vomited from their ignited mouths streams of lava, which rolled in blazing torrents down their black indented sides into the boiling mass below. The existence of these conical craters led us to conclude, that the boiling caldron of lava did not form the focus of the volcano; that this mass of melted lava was comparatively shallow; and that the basin which contained it was separated by a stratum of solid matter from the great volcanic abyss, which constantly poured out its melted contents through these numerous craters, into this upper reservoir. We were farther inclined to this opinion from the vast columns of vapour continually ascending from the chasms, in the vicinity of the sulphur banks and pools of water, for they must have been produced by other fire than that which caused the ebullition in the lava at the bottom of the great crater; and also by noticing a number of small craters in vigorous action high up the sides of the great gulf, and apparently quite detached from it. The streams of lava which they emitted rolled down into the lake and mingled with the melted mass, which, though thrown up by different apertures, had perhaps been originally fused in one vast furnace. The sides of the gulf before us, although composed of different strata of ancient lava, were perpendicular for about 400 feet, and rose from a wide horizontal ledge of solid, black lava, of irregular width, but extending completely round. Beneath this ledge the sides sloped gradually towards the burning lake, which was, as nearly as we could judge, three or four hundred feet lower. It was evident that the large crater had been recently filled with liquid lava up to this black ledge, and had, by some subterranean canal, emptied itself into the sea, or upon the low land on the shore; and in all probability this evacuation had caused the inundation of the Kapapala coast, which took place, as we afterwards learned, about three weeks prior to our visit. The grey, and in some places apparently calcined sides of the great crater before us; the fissures which intersected the surface of the plain on which we were standing; the long banks of sulphur on the opposite sides of the abyss; the vigorous action of the numerous small craters on its borders; the dense columns of vapour and smoke that rose out of it, at the north and south ends of the plain, together with the ridge of steep rocks by which it was surrounded, rising three or four hundred feet in perpendicular height; presented an immense volcanic panorama, the effect of which was greatly augmented by the constant roaring of the vast furnaces below."

*Stewart's Visit to Kirauea.*—In June, 1825, Mr. Stewart, accompanied by Lord Byron, and a party from the Blonde frigate, went to Kirauea, and descended to the bottom of the crater.

"The general aspect of the crater," observes Mr. Stewart, "may be compared to that which the Otsego Lake would present, if the ice with which it is covered in winter were suddenly broken up by a heavy storm, and as suddenly frozen again, while large slabs and blocks were still toppling, and dashing, and heaping against each other, with the motion of the waves. At midnight the volcano suddenly began roaring, and labouring with redoubled activity, and the confusion of noises was prodigiously great. The sounds were not fixed or confined to one place, but rolled from one end of the crater to the other; sometimes seeming to be immediately under us, when a sensible tremor of the ground on which we lay took place; and then again rushing on to the farthest end with incalculable velocity. Amost at the same instant a dense column of heavy black smoke was seen rising from the crater directly in front, the subterranean struggle ceased, and immediately after flames burst from a large cone, near which we had been in the morning, and which then appeared to have been long inactive. Red hot stones, cinders, and ashes, were all propelled to a great height with immense violence; and shortly after the molten lava came boiling up, and flowed down the sides of the cone and over the surrounding scoriæ in most beautiful curved streams, glittering with a brilliancy quite indescribable. At the same time, a whole lake of fire opened in a more distant part. This could not have been less than two miles in circumference, and its action was more horribly sublime than any thing I ever imagined to exist even in the ideal visions of unearthly things. Its surface had all the agitation of an ocean; billow after billow tossed its monstrous bosom in the air; and occasionally those from different directions burst with such violence, as in the concussion to dash the fiery spray forty or fifty feet high. It was at once the most splendid and fearful of spectacles."

*(To be continued.)*

## CABINET FIRE-ENGINE.

An ingenious and useful description of engine, for the suppression of fires occurring suddenly in dwelling-houses, &c., has lately been invented, which from its compactness, its extraordinary power, and the facility with which it can be brought to bear in cases of emergency, is deserving of public notice. In outward appearance the engine in question resembles a small cabinet or ornamental chest of drawers upon casters. Upon removing the mahogany top, however, a complete powerful fire-engine is discovered worked by a folding handle, and ready fitted with a hose long enough to reach from the first floor to the garret, or to the basement of a large house, and also furnished with pipes and all necessary apparatus, so contrived as to be available at a moment's notice, and when not in use to be easily stowed away upon the partition which divides the water from the external covering of the cabinet. The reservoir of this engine contains nearly a hogshead of water; and the whole affair, which may be easily worked with merely the strength of one woman, another directing the stream of water, does not occupy a space exceeding four feet square. It admits of being made and fitted up in any ornamental shape which may be desirable, and may be kept ready charged within a room or in any passage or corridor, where it would assume the appearance of rather a handsome piece of furniture, and from whence it can be wheeled in a minute, and in another minute be distributing such a stream of water as would effectually drown any incipient fire whatever. As a proof of its powers a small engine, not exceeding three feet square, and worked by a lad, threw a powerful stream of water completely over the house of the inventor, Mr. Merewether, of Long-

## NEW USES OF INDIA RUBBER.

About three years ago its chief and almost only use was in the manufacture of Macintosh's waterproof cloth, the fabrication of some surgical apparatus in which elasticity and pliability were the objects desired, the rubbing out of black-lead pencil-marks from paper, and a few other minute and unimportant applications. Now, however, this substance is employed in some highly important branches of our manufactures, and has become a valuable agent in the arts and sciences—showing what an extensive field and rapid advance of science may open up for the appliance of materials hitherto considered as next to useless. From its peculiar elasticity, its impermeability to air and water, it being soluble only in naphtha, and from its great durability, it has been successfully employed in the fabrication of various cloths, besides that of Macintosh; for air cushions, safety-belts and jackets; ligaments and bandages for gloves, stockings, braces, and other articles of dress; for boots, stoppers for bottles, and numerous other purposes. With these appliances most of our readers may be familiar; but few may know, or might expect, that it would be employed as a pavement for stables, lobbies, public halls, and the like; that it is now being used in the construction of life-boats; and that it is also proposed to use it extensively in the fitting up of our men-of-war. The Elastic Pavement Company have lately erected machinery for the preparation of the material for these important purposes, and can produce it, it seems, at a price sufficiently moderate to admit of its general adoption. As a pavement for stables, the caoutchouc preparation is said to be unequalled, preventing the lodging of stale matters, and their consequent noxious exhalations; requiring little litter, and preserving the knees and other parts of the horse from injuries which are apt to be received in stone-paved stables. By a little precaution, the ammonia, which now exhales to the injury of the horses' health, may be collected and sold as a manure, at from 2l. to 3l. per horse per annum. The stables of the Commissioners of Woolwich dockyard have been paved with this material for upwards of two years, and are allowed to be superior in point of cleanliness, freedom from smell, and healthiness, to what they were previous to the laying down of the elastic pavement. It has also been laid down in the Admiralty courtyard, and the carriage entrance court to Windsor Castle, where it has given much satisfaction. "With respect to its application to marine purposes," says the *Railway Gazette*, "a life-boat is now being constructed on the Company's premises (34 feet length of keel, and 12 breadth of beam), which, with the exception of the keel and some iron braces, will be entirely formed of India-rubber and cork planking. She will weigh but one ton and a half, an ordinary life-boat weighing three tons; and it is the opinion of all naval men and engineers who have seen her, that it will be almost impossible to sink her under ordinary circumstances, and that, when driven on a rock by the action of the waves, she will rebound like a ball, without fracture. It is also proposed to use the caoutchouc preparation for an inner lining between the guns in war-vessels, to prevent the effects of splinters; for hammock-nettings and bulwarks, to save the crew from canister, grape, &c.; and for other useful though less obvious purposes." Such are the numerous purposes to which human ingenuity can apply a single, and to all appearance an insignificant substance—the exuded sap of a tree; showing that science not only supplies our more obvious wants, but creates others, and calls into use hitherto neglected materials to supply them. Nothing in nature is useless; if we cannot now see its value, let us rest assured that the time will come for its profitable application.

## THE TOPOSCOPE

### *A New Instrument to determine during the Night the true position of a Fire.*

A curious instrument, the invention of M. Schwilgué (the mechanist of the far-famed clock of Strasburg Cathedral), is about to be established on the platform of the same edifice; its object being to determine, during the night, the true position of lighted objects in the distance, false impressions on the subject being often of disastrous effect, as, for example, in the case of conflagration. The apparatus in question, to which the inventor has given the name of *toposcope*, is a compound, according to the description, of two graduated circles, with subdivisions marked by an infinity of numbers. These circles, by their rotary movement in inverse directions, furnish a multitude of numerical combinations. A telescope, moving with the upper circle, is fitted to the apparatus; and, on directing this to the place of the disaster, the instrument itself furnishes, in measured numbers, its distance from Strasburg Cathedral.

## THE HYDRAULIC RAM.

This useful machine, the principles of which are but partially understood and valued, and but little used, is now exciting some attention, on account of the efforts which are making in its improvement, and from its extensive availability to all purposes where Hydraulic power is applicable or desirable, some account of the same may not be unacceptable or uninteresting.

To bring the Hydraulic Ram into operation, it is necessary that there should be a head or body of water, as a pond supplied from a spring, or a running stream from which a fall can be obtained. The ram is an hydraulic machine composed of a body at the end of which is a valve called the pulse-valve, which is closed by the momentum of the running water. On the top of the body is placed an air vessel, in the neck of which is another valve. The water forcing with an obstruction in the closing of the pulse-valve, makes its way through the valve into the air vessel. The air in the air vessel becoming compressed, the valve leading into it closes, and thus liberates the pulse-valve. The same action takes place again with the pulse-valve, as also with the valve that leads to the air vessel. This continuous action takes place, and at each time a portion of water is so forced into the air vessel. When the air in the vessel is compressed, so as to be enabled to overcome the resistance in the pipe leading to the cistern which it is intended to supply, the water flows over, and continues to do so as long as the ram remains in action. Notwithstanding the simplicity of the construction, great care must be taken in its manufacture to get the balance of the valves equal, as unless the pulse-valve is upon an equilibrium with the other valve upon which it has to act leading to the air vessel, the weight of both columns being taken into consideration, no power can make them work. Most persons acquainted with hydraulics are aware that a column of water weighs equal to the base, that is to say, that a pipe of one inch square, resting on a base of four inches square, will weigh sixteen times more than if it only rested on a base of one inch square. That is indeed the principle of the action of the ram. I suppose it is required to raise water 100 feet high from a six foot fall, the ram must be made in that proportion, so that the pulse-valve must close so as to counteract the pressure of the rising column. If the valve leading to the air vessel is not along with this constructed with the utmost care, as above stated, the machine will not work. The younger Montgolfier introduced into the neck of the air vessel, a small air valve, which opened and shut with the pulse-valve. The valve was intended to supply the air vessel with fresh air in case of high pressure. I am still making experiments in the above machine, which I trust will enable me to throw a greater quantity of water with less waste, as the most which I have hitherto been enabled to do with a two inch supply to the ram, has been to throw five quarts of water per month to a height of 150 feet, consuming eleven parts out of twelve.

With regard to this useful and ingenious invention, the following description is given by Dr. Jamieson. "Ram in Hydraulics is a machine for raising water to any given height by means of the momentum of a stream of water flowing through a pipe. The passage of the stream being stopped by a valve, which is raised by the stream as soon as its motion becomes sufficiently rapid, the whole column of water concentrates on the valve, and acts as a single solid, so that it must resist any pressure. Now if the valve opens into a pipe leading into an air vessel, a certain quantity of water will be forced into it, so as to condense the air more or less rapidly to the degree that may be required for raising a portion of the water contained in it, to any given height."—*Fulman Roe.*

## IRON HOUSES.

The late frightful earthquakes in the West Indies, in which the brick and stone buildings of whole towns have been levelled with the ground, and the wooden ones consumed by the fires which usually burst out after the overthrow of the other buildings, have drawn the attention of many persons residing in districts subject to those awful visitations to the advantages of houses constructed of iron, which have been found to stand the shocks of the severest earthquakes uninjured, and which are, of course, proof against such conflagrations as that which swept away at Point-a-Pitre, in Guadaloupe, all that the earthquake had spared. Mr. W. Laycock, of Liverpool, who recently built an iron palace for one of the chiefs of the African coast, has just completed an iron cottage for the use of two maiden ladies, residing in the island of St. Lucia. It consists of three rooms, each 9 feet high—viz. one room 20 feet by 14 feet, and two rooms 12 feet by 10 feet. There are six large jealousy windows and two small ones over the front and back doors; these and the floor are the only parts made of wood. There is an inside ceiling of iron in panels, and the roof is in a wrought-iron frame and covered with galvanized plates of iron. The walls are formed of double plates of iron, with a thin stratum of air between them, an arrangement which will prevent the passing of the solar heat into the interior of the building, at least through the walls, and keep the interior delightfully cool. The weight of the building is 14 tons, and the cost rather more than 200*l*.

## LIGHTHOUSE ON THE GOODWIN SANDS.

Mr. Bush has at length established in his caisson upwards of 20 feet of the iron shaft or column on the summit of which the lighthouse will be placed. It is now above high water mark, and there is nothing to prevent its being finished and ready to be illuminated by the 1st of January next. This shaft penetrates through the various iron chambers of the caisson, and is firmly sustained in its perpendicular position by two iron plumber blocks of great strength. It is also further secured by iron stays or braces, which are bolted to the outer part of the caisson, and attached to the top, as well as the centre of the column. The new light is proposed to have an elevation of 33 feet above high-water mark, and to be approached by a light, iron spiral stair, winding round the exterior of the column, within an octagon of about 10 feet diameter, surmounted by a plate-glass lantern. It appears that the caisson, which is 30 feet in diameter, has remained undisturbed in the same position in which it was sunk, when occurred the untoward accident of the American bark being driven against it, shortly after Mr. Bush had partially fixed it, which completely frustrated his original plan of making the superstructure of solid masonry. The caisson is, however, to be filled up with blocks of stone and concrete; the naval authorities of Deal have reported to the Admiralty that they expect mainland will be formed, the caisson forming a nucleus for accomplishing this most desirable object.

## IMPROVEMENTS IN THE MANUFACTURE OF WIRE CARDS, &c,

A patent has lately been granted to Richard Kitson and John Garthwaite, of Leeds, for certain improvements in wire cards, for carding cotton, wool, silk, flax, and other fibrous substances; and for producing tow and yarn from line and tow-yarn waste, which comes from the spinning frames, commonly called "hard waste."

The first part of this invention consists in forming the back of wire cards of those descriptions of leather called sheep-skin, bazil, and roan-bazil, cemented to woven fabrics.

The leather preferred by the patentees is the light and dark brown bazil; and when its thickness is sufficient for the kind of wire card required, the proper fillets and sheets are made by cementing one thickness of such leather on to a strong woven fabric (by preference, linen,) with the flesh side of the leather next the fabric: in setting the wire teeth, the crowns of the staples should come against the leather; and when at work, the fabric should be upwards. In joining the edges of the leather, isinglass is employed; but, for cementing it to the linen or other fabric, a composition is used, which is formed by dissolving half a pound of Irish moss in six quarts of water (removing the stalks when the moss is dissolved,) and then dissolving eight pounds of the best glue therein. In some cases, particularly when the leather is thin, a piece of woven fabric is cemented between two thicknesses of the leather, the flesh sides of both being inwards; and, in addition to this, a piece of fabric may be applied to the outer surface of one or both pieces of leather.

The second improvement relates to the waste fibres produced in the process of spinning yarn from flax and tow, and called "hard waste;" it consists in boiling such hard waste in soap and water, and subjecting it to the action of machinery, in order to clean, unravel, and render the fibres of tow again suitable for spinning into yarn.

The fibres of the hard waste are first opened and unravelled, by means of a "devil;" they are then boiled in water, with soft soap, (in the proportion of two pounds of soap to one hundred-weight of hard waste), for four or five hours, and are afterwards passed between pressing-rollers, and dried. The fibres are next submitted to a breaker carding-engine, and then to a finishing carding-engine, the sliver from which is drawn through a screw-gill, and then passes to the roving and spinning-frames.

The patentees do not confine themselves to the use of the machines just referred to, as others, acting in a similar manner, might be employed. They claim, Firstly,—the mode, herein described, of manufacturing wire cards, by applying the above descriptions of leather, combined with woven fabrics, as the backs of such cards. Secondly,—the making of tow-yarn, by employing the tow obtained from line or tow-yarn waste, called hard waste, as herein described.

## PLAITED FABRICS.

Mr. Mertens, of London, has recently obtained a patent for Improvements in the manufacture of Plaited Fabrics.

This invention consists in producing plaited fabrics, by weaving strands or threads of India-rubber into them, at such intervals apart, that, when acted on by the contracting property of the India-rubber, the fabric, between two adjacent strands, shall be of sufficient width to form a complete plait or fold.

The India-rubber strands are used in the extended and nonelastic state, and either covered or uncovered; but when uncovered strands are employed, the operator should cover them in the act of weaving. The stands are introduced either amongst the warp threads or weft threads, or sometimes amongst both, leaving square intervals of fabric, so that, on the application of heat, the fabric will be plaited in squares.

The patentee claims the mode of manufacturing plaited fabrics, by causing India-rubber strands or yarns to be interwoven at distant intervals, and in such a manner, that the fabric will become plaited, when the elasticity is restored to the India-rubber, by heat.

---

## VARIETIES.

*On the Advantage of the Use of Carbonate of Soda in the Preparation of Coffee* (by Professor Pleischl).—It is a fact well known in Prague, that the water of the wells in that town is better adapted for use in making coffee than the river water; comparative analyses of the water indicate that this depends on the carbonate of soda contained in the former. Pleischl found this opinion corroborated by the fact, that a small quantity of the salt added to Coffee improves its flavour, and advises consequently the addition of 43 grains of the pure carbonate to each pound of roasted Coffee, as an improvement to the flavour and also to the therapeutic effects of this beverage, as it neutralises the acid contained in the infusion.

*A New Style of Paper Hanging* has been introduced at Liverpool, from Switzerland. The character of the design is Florentine; the ground-work is white satin; the walls are divided into compartments by rich gold-coloured styles, representing intricate carving; the panels are niches, with drawings of deer, lions, swans, &c., each forming a complete picture in gorgeous gold borders, somewhat in the Louis Quatorze style; the alternate panels are filled with fillagree work, interspersed with flowers and gems; and altogether of exquisite design and execution. An exceedingly rich border runs round the top and bottom of the room.

*Case-hardening by Prussiate of Potash.*—A new substance for the case-hardening process, but containing the same elements as those more commonly employed, has of late years been added, namely, the prussiate of potash, (a salt consisting of two atoms of carbon and one of nitrogen,) which is made from a variety of animal matters. It is a new application without any change of principle. The time occupied in this steelifying process is sometimes only minutes instead of hours and days; as, for example, when iron is heated in the open fire to a dull red, and the prussiate is either sprinkled upon it or rubbed on in the lump, it is returned to the fire for a few minutes and immersed in water; but the process is then exceedingly superficial, and it may, if needful, be limited to any particular part upon which alone the prussiate is applied. The effect by many is thought to be partial or in spots, as if the salt refused to act uniformly; in the same manner that water only moistens a greasy surface in places.—*Holaztpfell.*

*Mace.*—Mace is the reddish membrane surrounding the shell which contains the nutmeg. It is dried previous to packing tight in bags. Its general qualities are the same as those of nutmegs; it has an agreeable aromatic odour, and a hot biting taste According to Mr. Henry it contains a small quantity of volatile oil; a large quantity of a yellow, odorous, fixed oil, soluble in ether, but insoluble even in boiling alcohol; a nearly equal quantity of a red odorous fixed oil, soluble both in ether and alcohol; a gummy matter forming nearly a third of the weight of the mace; and a small quantity of woody matter.—*Encyc. of Domestic Economy.*

*Smoking of Meat.*—This process consists in exposing meat previously salted, or merely rubbed over with salt, to wood smoke, in an apartment so distant from the fire as not to be unduly heated by it, and into which the smoke is admitted by flues at the bottom of the side walls. Here the meat combines with the empyreumatic acid of the smoke, and gets dried at the same time. The quality of the wood has an influence upon the smell and taste of the smoke-dried meat; smoke from beech-wood and oak being preferable to that from fir and larch. Smoke from the twigs and berries of juniper, from rosemary, peppermint, &c., imparts somewhat of the aromatic flavour of these plants. A slow smoking with a slender fire is preferable to a rapid and powerful one, as it allows the empyreumatic principles time to penetrate into the interior substance, without drying the outside too much. To prevent soot from attaching itself to the provisions, they may be wrapped in cloth, or rubbed over with bran, which may be easily removed at the end of the operation.—*Ure's Dict.*

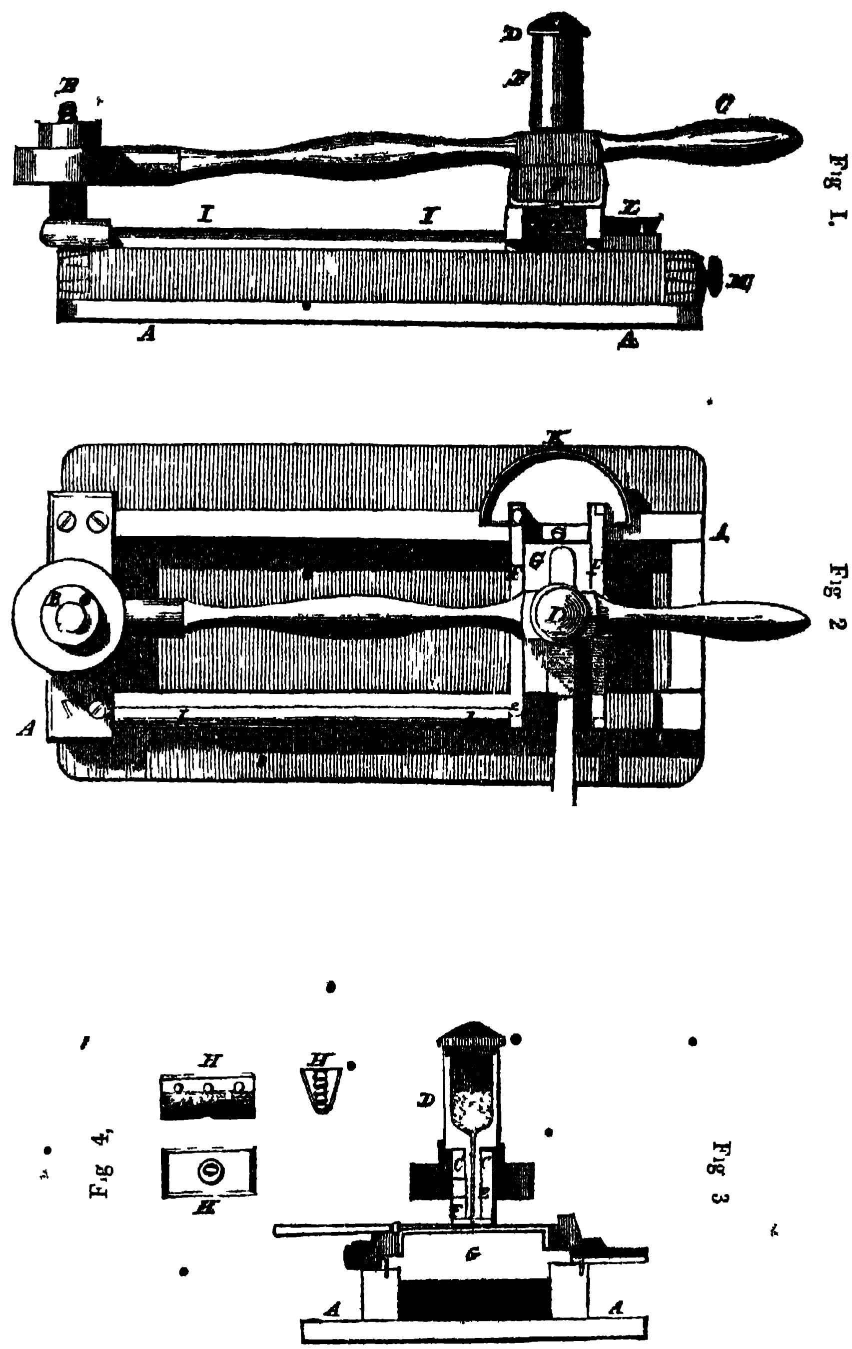
*To prepare Hung Beef.*—This is preserved by salting and drying, either without or with smoke. Hang up the beef three or four days, till it becomes tender, but take care it does not begin to spoil: then salt it in the usual way, either by dry salting, or by brine with bay salt, brown sugar, and saltpetre, with a little pepper and allspice, afterwards roll it tight in a cloth, and hang it up in a warm, but not in a hot place, for a fortnight or more, till it is sufficiently hard. If required to have a little of the smoky flavour, it may be hung for some time in a chimney corner, or smoked in any other way; it will keep a long time.

*To make Hung Beef in the Dutch way,*—Take a lean piece of beef; rub it well with treacle or coarse sugar, and let it remain for three days, turning it frequently; after that, wipe it dry, and salt it well with common salt and saltpetre, well dried and beaten fine; turn it every day for a fortnight; roll it quite tight in a coarse cloth, and put it into a cheese press, or under a heavy weight for a day; hang it then to dry in the smoke of wood or turf, but turn it upside down every day.—*Encyc. of Domestic Economy.*

*Preserving Vegetables by Salt.*—Any vegetables may be preserved in a strong brine made by dissolving four pounds of salt in a gallon of water: the vegetables are put into this, and kept quite covered with it. French beans, artichokes, olives, samphire, and barberries are often preserved in this manner. In Holland and Germany, where large quantities of French or kidney beans are salted in every family, a machine is used for cutting them expeditiously, which greatly resembles a turnip slicer. The sliced beans are immediately put into a cask, with alternate layers of salt, and a weight being put upon them, they are pressed till they begin to ferment slightly; the salt liquor is then poured off, and they are covered up and put into the cellar as store. Before cooking, they are steeped in fresh water, and are found to be an excellent corrective of the oily qualities of animal food. They are preserved thus for sea store.—*Encyc. of Domestic Economy.*

*Cassia.*—Cassia is a bark brought chiefly from China and Ceylon, possessed of the usual properties of cinnamon, and was once supposed to be the produce of another tree; but it is now certain, from the observations of Mr. Marshall, that it is only the bark from the trunk and larger branches of the cinnamon tree; it is of a flat shape, much thicker, and has the mucous integument of the bark remaining, which is cleared off from the proper cinnamon. It has the same qualities as cinnamon, only in an inferior degree. According to Vanquelin, cinnamon contains volatile oil, tannin, mucilage, a vegeto-animal colouring matter, an acid, and woody fibre. The oil of cinnamon is prepared chiefly from cassia and from the chips of cinnamon: eighty pounds yield about two ounces and a half of the oil, worth in England a guinea per ounce.

*Disinfection of Sewers, Cesspools, &c.*—M. Siret finds that a mixture of copperas, charcoal, and gypsum, in the following proportions, if thrown into a sewer or cesspool, will purify it to a remarkable degree:—sulphate of iron (green copperas), 200 lb.; sulphate of zinc (white copperas), 25 lb.; vegetable charcoal (common or wood charcoal), 10 lb.; sulphate of lime (gypsum), 265 lb.




HALFPENNY'S KNIFE CLEANER.

## HALFPENNY'S KNIFE CLEANER.

The following is a description of a new machine invented and patented by Mr. Halfpenny for cleaning knives and forks, as shewn in the figures 1, 2, 3, and 4, which represent different views of the machine drawn (in these figures) to a small scale. Fig. 1. is a side elevation; fig. 2. a plan view; fig. 3. a transverse section taken through the vessel D in figs. 1 and 2. At fig. 4. are detached views of some of the parts, and having similar letters of reference placed on corresponding parts in all the figures; AA is a framing of wood or metal, at one end of which a screw B is secured in a vertical position, and is a fulcrum for the lever C to turn upon; D is a hollow vessel to contain brick-dust or other material of like character used to clean knives, &c., and which passes through a hole formed through the centre of the screw E, and in the direction of its length, as seen in fig. 3; FF is a piece of wood having a screwed hole at its centre connecting it to the screw E. This piece of wood is supported by a cross piece G fixed to the framing, as shewn in figures 2 and 3. Its upper surface is covered with chamois or buff leather, as well as the under surface of the piece F; this piece has a slot in the direction of its length to allow the material to pass freely from the receptacle D. The figures 2 and 3 represent a knife placed upon the cross piece G. Now motion being given to the lever C, will distribute the material contained in the vessel D over the surface of the knife or other article to be cleaned; and the friction acting with the application of the material by the traversing motion of the handle has the effect of cleaning. For cleaning forks, a piece H is substituted for the piece F. The projecting piece I I, on the framing is likewise covered with chamois or buff leather, and is designed to be used for cleansing such parts of a knife, fork, or other like article as may not conveniently be operated upon by the other part of the machine. K is a tray, L a brush, and M a drawer for the reception of the knives and forks. The proportions of the pieces F and G will, in practical construction, always depend upon the dimensions of the knife or article to be cleaned.

## HATS.

The body of a beaver hat is made of fine wool and coarse fur mixed and felted together, then stiffened and shaped; the covering consists of a coat of beaver fur felted upon the body. Cheap hats have their bodies made of coarse wool, and their coverings of coarse fur or fine wool. The body or foundation of a good beaver hat, is at present made of 8 parts of rabbit's fur, 3 parts of Saxony wool, and 1 part of lama, vicunia, or red wool. About two ounces and a half of the above mixture are sufficient for one hat, and these are placed in the hands of the *bower;* his tool is a bow or bent ashen staff, from 5 to 7 feet long, having a strong catgut string stretched over a bridge at each end, and suspended at its middle by a cord to the ceiling, so as to hang nearly level with the work-bench, and a small space above it. The wool and coarser fur are laid in their somewhat matted state upon this bench, when the bower, grasping the bent rod with his left hand, and *by means of a small wooden catch plucking the string with his right* makes it vibrate smartly against the fibrous substances, so as to disentangle them, toss them up in the air, and curiously arrange themselves in a pretty uniform layer or fleece. A skilful bower is a valuable workman. The bowed materials of one hat are spread out and divided into two portions, each of which is compressed first with a light wicker frame, and next under a piece of oil cloth or leather, called a hardening skin, till by pressing the hands backwards and forwards all over the skin, the filaments are linked together by their serrations into a somewhat coherent fleece of a triangular shape. The two halves or "bats" are then formed into a cap; one of them is covered in its middle with a 3-cornered piece of paper, smaller than itself, so that its edges may be folded over the paper, and by overlapping each other a little, form a complete envelope to the paper; the junctions are then partially felted together by rubbing them hard, care being taken to keep the base of the triangle open by means of the paper; the second bat being made to enclose the first by a similar process of folding and friction. This double cap, with its enclosed sheet of paper, is next rolled up in a damp cloth and kneaded with the hands in every direction, during which it is unfolded and creased up again in different forms, whereby the two layers get thoroughly incorporated into one body; thus, on withdrawing the paper, a hollow cone is obtained.

In a great hat factory women are employed, at respectable wages, in plucking the beaver skins, cropping off the fur, sorting various qualities of wool, and plucking and cutting rabbits' fur, shearing the nap of the blocked hat, picking out unseemly filaments of fur, and in trimming the hats; that is, lining and binding them.

The annual value of the hats manufactured at present in the United Kingdom is estimated at 3,000,000*l.* sterling. The quantity exported in 1840, was 22,522 dozens, valued at 81,583*l.*

With regard to the *stiffening* of hats, I have been furnished by a skilful operator with the following valuable information:—"All the solutions of gums which I have hitherto seen prepared by hatters, have not been perfect, but in a certain degree, a mixture, more or less, of the gums, which are merely suspended, owing to the consistency of the composition. When this is thinned by the addition of spirit, and allowed to stand, it lets fall a curdy-looking sediment, and to this circumstance may be ascribed the frequent breaking of hats. My method of proceeding is, first, to dissolve the gums by agitation in twice the due quantity of spirits, whether of wood or wine, and then, after a complete solution, draw off one half the spirit in a still, so as to bring the stiffening to a proper consistency. No sediment subsequently appears on diluting this solution, however much it may be done.

"Both the spirit and alkali stiffenings for hats made by the following two recipes, have been tried by some of the first houses in the trade, and have been much approved of:—

*Spirit Stiffening.*

7 pounds of fine orange shellac.
2 pounds of gum sandarac
4 ounces of gum mastic.
Half a pound of amber rosin.
1 pint of solution of copal.
1 gallon of spirit of wine or wood naphtha.

"The shellac, sandarac, mastic, and rosin, are dissolved in the spirit, and the solution of copal is added last.

*Alkali Stiffening.*

7 pounds of common black shellac.
1 pound of amber rosin.
4 ounces of gum thus.

4 ounces of gum mastic.
6 ounces of borax.
Half a pint of solution of copal.

"The borax is first dissolved in a little warm water (say 1 gallon); this alkaline liquor is now put into a copper pan (heated by steam) together with the shellac, rosin, thus, and mastic, and allowed to boil for some time, more warm water being added occasionally until it is of a proper consistency; this may be known by pouring a little on a cold slab somewhat inclined, and if the liquor runs off at the lower end, it is sufficiently fluid; if, on the contrary, it sets before it reaches the bottom, it requires more water. When the whole of the gums seem dissolved, half a pint of wood naphtha must be introduced, and the solution of copal; then the liquor must be passed through a fine sieve, and it will be perfectly clear and ready for use. This stiffening is used hot. The hat bodies, before they are stiffened, should be steeped in a weak solution of soda in water, to destroy any acid that may have been left in them (as sulphuric acid is used in the making of the bodies). If this is not attended to, should the hat body contain any acid when it is dipped into the stiffening, the alkali is neutralized, and the gums consequently precipitated. After the body has been steeped in the alkaline solution, it must be perfectly dried in the stove before the stiffening is applied; when stiffened and stoved it must be steeped all night in water, to which a small quantity of sulphuric acid has been added; this *sets* the stiffening in the hat body, and finishes the process. A good workman will stiffen 15 or 16 dozen hats a day. If the proof is required cheaper, more shellac and rosin must be introduced."—*Ure.*

## PHOSPHORIC LIGHT EMITTED BY FLOWERS.

In the garden of the Duke of Buckingham, at Stowe, on the evening of Friday, September 4th. 1835, during a storm of thunder and lightning, accompanied by heavy rain, the leaves of the flower called Ænothera-macrocarpa; a bed of which is in the garden, immediately opposite the window of the manuscript library at Stowe, were observed to be brilliantly illuminated by phosphoric light. During the intervals of the flashes of lightning, the night was exceedingly dark, and nothing else could be distinguished in the gloom except the bright light upon the leaves of these flowers. The luminous appearance continued uninterruptedly for a considerable length of time; it did not appear to resemble any electric fluid; and the opinion, which seemed most probable, was that the plant, like many known instances, has a power of absorbing light and giving it out under peculiar circumstances.

## THE COTTON PLANT AND ITS CULTIVATION.

BY GEORGE JOHNSON, ESQ.

*From Simmond's Colonial Magazine.*

The cotton plants belong to the Monodelphia Dodecandria class and order of Linnæus, and are distinguished in botany by the generic name of *Gossypiu.* They may be divided into three groups: —1st. The herbaceous; 2nd. The shrubby; and 3rd. The arboraceous.

1. The herbaceous, is a single species of *Gossypium herbaceum* of Willdenow and Roxburgh, although there are many varieties marked by only slight differences in the eye of the botanist, but of considerable importance in a commercial point of view.

This species is biennial; it is very generally cultivated in India, as well as in North America, China, and elsewhere. Its heighth varies between six two feet; leaves, palmate, five-lobed, hoary, green, and brown veined; lobes, sub-lanceolate flowers, pale yellow, five-petaled; seed-pod or capsule, irregularly triangular, ovate, pointed, and three-celled: not longer than a filbert, brown when ripe, and bursting, exposes a globe of cotton, white or yellowish, in three locks, enveloping and adhering strongly to the seeds, which resemble those of the grape in form, but are much larger; stipules, falcate-lanceolate; leaves of outer calyx, dentate. This must not be confounded with the *Gossypium herbaceum* of Pluck. In Hindostan it is known by various names; it is karpassee in Sanscrit; rewee in Hindostanee; kapass in Bengalee; pati-chatoo in Telinga; upum punthee and upum pirati in Canara; kootu in Arabic; parratti in Malabar; banga in Central India.

Dr. Roxburgh thought that the cotton from which the Dacca muslins are made was produced from a variety of this species, but later information and research certainly raises a legitimate doubt upon the point. At all events this species is in general cultivation by the natives of Hindostan, and the distinguished botanist just named concluded that there are three principal varieties—the Dacca, the Berar, and the China.

The Dacca variety differs from the common *Gossypium herbaceum* in the following respects:—

1st. In the plant being more erect, with fewer branches, and the lobes of the leaves more pointed.

2nd. In the whole plant being tinged of a reddish colour, even the petioles, and nerves of the leaves, and being less pubescent.

3rd. In having the peduncles which support the flowers longer, and the exterior margins of the petals tinged with red.

4th. In the staple of the cotton being longer, much finer, and softer.

These are the most obvious points of difference, but whether they will prove permanent I cannot at present say. The most intelligent people of that country (Decca) think the great difference lies in the spinning, and allow little for the influence of soil.

Berar cotton I call the second variety; it is in cultivation over the Berar country, and is from thence imported into the Circars, or northern provinces, by Sada Balawansa, &c., to Yourma-goodum, in the Musulipatam district. With this cotton the fine Madras more properly, northern Circars "long-cloth" is made. It differs from the two before-mentioned sorts in the following respects:—1st, In growing to a greater size, in being more permanent, or living longer, and in having smooth and straight branches; 2nd. In having the leaflets of the exterior calyx more deeply divided, and the wool of a finer quality than in the first variety.

China cotton is cultivated in the country whence it derives its name, and its wool is reckoned 25 per cent. better than than that of Surat. It differs from the former sorts:—1st. In being much smaller, with but very few short branches; 2nd. In being, so far as my experience goes, annual; 3rd. In having the leaflets of the exterior calyx entire, or nearly so.

2nd. The shrubby cottons are—

*G. vitifolium*, vine leaved cotton, in flower and seed the whole year, but not profitable, because the produce is scanty. Dr. Royle identifies it with *G. Barbadense*, and thinks the *Sea-island cotton* is produced from a variety of this species.

*G. hirsutum*, hairy-branched cotton, found in the hottest districts of South America.

*G. religiosum*, nankeen cotton, found in Surinam, and elsewhere. Flower, uniformly yellow; allied to *G. hirsutum*, if not merely a variety. Wool, tawney, This is occasionally grown in Burmah, and is called *wa-nee*.

*G. latifolium*, broad-leaved cotton, a native of the West Indies, and differing but little from *G. vitifolium*.

*G. Barbadense* is the kind cultivated chiefly in Barbadoes. It is known here as the Bourbon cottou and is productive for several years.

There are two sorts cultivated in the Isle of Bourbon:—1st, *Black-seeded*, which is easily separated from the cotton. 2nd, *White-seeded*, a whiteness which seems to arise from the ends of the fibres of the cotton remaining adhering to, and requiring to be torn from them with considerable force.

*G. Peruvianum*, a native of Peru.

*G. acuminatum* is easily distinguished by its superior size, and large black seeds adhering firmly to each other, but easily separating from the wool; said to be a native of the mountains to the north and west of Bengal. Dr. Wallich describes a specimen brought from the Nuzeerabad, where it seems to be common. He says that it is very productive, and that the cotton is readily and completely separable, milk white, long staple; and although that grown in the Botanic Garden was harsh and woolly, yet the variety seems improvable by culture, because the specimen from Nusseerabad was soft and silky.

It appears to me that this variety is specifically the same as the *Brasil* or *Kidney cotton-tree* recommended to notice by Mr. Rundell in 1819. He describes it as growing to the height of ten or twelve feet it produces at least six hundred large pods, each containing from six to ten conglomerated seeds, enveloped in very fine and valuable wool. It thrives well on the margin of water; lasts about seven years; requires pruning occasionally of its dead branches, &c., and during very hot weather should be watered at least twice a week. An acre will contain about five hundred trees. Two hundred and thirty pods usually weigh one pound, and yield from four to five ounces of clean cotton.

If this be the *Pernambuco cotton-tree* (and that town is we know in Brasil), it has an additional claim to attention for cultivation in the interior districts of Hindostan, inasmuch as it is found to improve the quality the farther it recedes from the sea.

Plants of this species differ from the herbaceous not only in stature, but in the form and size of their pods, which are oval and larger. In addition to these distinctions they are longer lived, for, although in the most temperate climates capable of growing cotton they frequently become annuals, yet in the most torrid localities they become perennial; whilst in the West Indies they are either biennial or triennial; and in Egypt, &c., they live for six or even ten years.

The Persian cotton shrub on the sea coast lives for twenty or thirty years, but in the interior it is cultivated as an annual.

The influence of climate and soil upon the plant is evinced in another phenomenon, for Mr. Tucker shows that the colour of the seed varies with the soil and situation where the plant is grown. The Sea-island cotton has black seeds, but if taken to the back or upland districts the seeds become green, and the staple of the cotton undergoes a great change.

*G. obtusifolium*, a native of Ceylon, producing a small quantity of ash-coloured wool; not cultivated.

*G. micranthium*.—This was raised in the Paris Garden from seed produced in Persia.

3, The arboraceous cotton plant, *Gossipeum arboreum* grows to a height varying between twelve and twenty feet. It is indigenous to Hindostan, China, Egypt, and some parts of America and Africa. Dr. Roxburgh says it is not cultivated for its wool, but Dr. Royle states that some produced by this species at Sahanapore was pronounced by a competent judge to be of the best description, as both fabric and staple were good. It appears worthy, he adds, of being the subject of further trials, particularly to ascertain its productiveness; for of the fineness and silky nature of its staple there can be no doubt, as it is employed by the natives for making the finest muslins only. It was cultivated like the common Indian cotton, and gave its produce, in the first year, during October and November, and a second crop in February.

To ascertain which of the species are best suited to the various climates, is a most important consideration for those interested in the introduction of this source of wealth into India, because, however, judicious the culture, yet, if it be expended upon a species physically unsuited to the climate, it is labor and time uselessly bestowed. My own inquiries lead me to the conclusion that the *Gossipyum acuminatum* is in every respect worthy of more attention than it has yet received. It has the advantage of being indigenous, and, therefore, not liable to the changes and difficulties unavoidably incident to acclimating exotics. It most delights in inland localities, and is, consequently capable of more extensive cultivation than those species which affect maritime situations, and being a perennial, its culture is attended with very much less expense. To these highly important qualities are to be added those of being far more productive than the sorts usually cultivated, and of producing, in the most suitable soils and climate of India, a cotton long, fine, and silky. I have my suspicions that it will be identified with the perennial species noticed lately at Decca.

The result of the experiments on the Agricultural Society's farm at Akra warranted the committee of management in reporting very strongly in favour of cultivating in India, the Upland Georgia variety. This opinion is sustained by subsequent experiments in various other districts, and there can be no doubt, experience shows, that every effort ought to be made to introduce it generally. There are some districts, however, as, the sea-coast and its vicinity, where this variety would not flourish; and in these it is most desirable to try that kind so generally and so advantageously known as the Georgia Sea-island cotton.

In mentioning this very superior variety as suitable to maritime districts, I by no means intend to express an opinion that it must be *confined* to such localities; for although it delights and requires to have common salt within reach of its roots, yet this might be supplied by adding that saline manure to soils situated far from the sea. This is no mere theoretical notion, for I have seen strictly maritime plants grown a hundred miles inland by supplying them judiciously with salt, and amongst the number I would particularise one of the most intractable, the rock samphire.

The kinds which it has been endeavoured to introduce here are :—Sea-island cotton, Barbados cotton, Brazil cotton, Bourbon cotton (both black and green seeded), and China cotton. To this list may be added a variety called "the vine cotton," a very superior kind, from *Jamaica*, the extraordinary fault of which was its having a staple *too long*. The seeds were distributed to Captain Jenkins at Gowhatty, and to a gentleman going to Mirzapore, but with what result does not appear.

Mr. Piddington has ingeniously suggested that new varieties could be raised by cross impregnation, as was successfully practised with the pea by the late Mr. Knight. This might, doubtless, be done in some instances, and is worthy of attention, because, although the kinds at present known are sufficiently excellent if cultivated, yet they are not so perfect as to prohibit the hope of improvement.

Much, observes Dr. Royle, may be effected by introducing into India the different species and varieties which are already successfully cultivated in other countries; and here let us not restrict ourselves to too small a number of varieties, because they happen to be those which at present produce the best kinds of cotton. Not contented in America with possessing already the best kinds, they have tried those of other countries to ascertain if there are any among them suited to the peculiarities of their country and climate.

*Districts best suited for Cotton.*—As some one of the several species of cotton plants may be found in every district of Hindostan, from Cape Comorin to the Himalayan mountains, it is not an untenable position to assume that no portion of the globe, of similar extent, is capable of yielding so large a quantity of this peculiar produce. Indeed, from the earliest ages, cotton has been mentioned as the special production of India.

Now it is a fact in the history of vegetables, to which I remember no exceptions, that where the wild stock flourishes naturally, there the improved varieties succeed best. Examples occur in the English apples and the French pears; for in no country does the crab abound more than in England, nor the wild pear than in France. The inference I would draw from this observation is, that Hindostan ought eminently to excel in the production of cotton, and the comparatively limited experience we have yet had of the results of applying superior capital to this object, encourages rather than represses the opinion.

That no part of India has a climate unsuited to the production of superior cotton is demonstrated by the fact that the best samples are produced in Guzerat, at the north-western extremity; in Behar, the very centre; and at Tinivelly, on the most southern point.

It appears to me that it is the generally dry silicious nature of the soil of Guzerat, as much as the dryness of its climate, that is so extremely favourable to the growth of the cotton plant. It flourishes there even in the most sterile districts, though necessarily not so luxuriantly as in the more fertile soils.

The same observation applies to the neighbouring province of Surat, where good cotton is produced; but the best in that part of India is grown in the districts of Jambooseer and Ahmood, and, indeed, throughout the Broach Pergunnah. This is stated, by a Government report, to be very superior to the Nagpore or any other cotton grown on the eastern side of India.

Mr. Owen Potter, who was extensively employ in shipping cotton from the above district in 18 stated some very interesting relative facts in a paper which he submitted to the Manchester Chamber of Commerce. He says that, "The chief cotton ports are Surat, Baroche, Tankaria Bunder, Gogo, and Bownugger." All these ports are within a short distance of each other. The extent of cotton cultivation in their vicinity is very great.

*(To be continued.)*

## THE "RETRIBUTION" STEAM FRIGATE.

This noble steam-ship of war is now lying in the basin of the East India Docks at Blackwall, where she has attracted a good deal of attention from nautical and scientific men, and has been visited by many persons capable of estimating her merits. She is a remarkably fine vessel, and a perfect model for ships of her class and build. She is of 1641 tons burden; her length, between perpendiculars, is 220 feet, her extreme breadth 71 feet, the depth of the hold being 26 feet, 4 inches. She has not got her masts stepped, nor her armament on board, but her paddles and engine are fixed. The engine has been manufactured at the establishment of Messrs. Maudslay and Field, Lambeth. It is constructed after the patent of those gentlemen, called the patent double cylinder marine steam engine, and is of the collective power of 800 horses. The diameter of the cylinder is 12 feet; the length of the stroke 8 feet; and the number of strokes 15. The diameter of the wheel is 33 feet, the breadth 13 feet, draught of water 7 feet, the length of the engine-room 75 feet. The great saving of space by the introduction of these engines is one of the principal advantages obtained by their use. The Admiralty have adopted them in several steam-ships of war besides the Retribution, and there is one on board the Rattler Archimedean steam-ship.

## TIN PLATE.

The only alloy of iron interesting to the arts, is that with tin, in the formation of *tin-plate*, or *white-iron*

The sheet iron intended for this manufacture is refined with charcoal instead of coke, subsequently rolled to various degrees of thinness, and cut into rectangles of different sizes, by means of a shearing-machine driven by a water-wheel, which will turn out 100 boxes a day, or four times the number cut by hand labour. The first step towards tinning, is to free the metallic surface from every particle of oxide or impurity, for any such would inevitably prevent the iron from alloying with the tin. The plates are next bent separately by hand into a saddle or Λ shape, and ranged into a reverbatory oven, so that the flame may play freely among them, and heat them to redness. They are then plunged into a bath, composed of four pounds of muriatic acid diluted with three gallons of water, for a few minutes, taken ont and drained on the floor, and once more exposed to ignition in a furnace, whereby they are *scaled*, that is to say, cast their scales. The above bath will suffice for scaling 1800 plates. When taken out, they are beat level and smooth on a cast-iron block, after which they appear mottled blue and white, if the *scaling* has been thoroughly done. They are next passed through *chilled* rolls or cast-iron cylinders, rendered very hard by being cast in thick iron moulds, as has been long practised by the Scotch founders in casting bushes for cart-wheels. After this process of *cold rolling*, the plates are immersed, for ten or twelve hours, in an acidulous lye, made by fermenting bran-water, taking care to set them separately on edge, and to turn them at least once, so that each may receive a due share of the operation. From this lye-steep they are transferred into a leaden trough, divided by partitions, and charged with dilute sulphuric acid. Each compartment is called a *hole* by the workman, and is calculated to receive about 225 plates, the number afterwards packed up together in a *box*. In this liquid they are agitated about an hour, till they become perfectly bright, and free from such black spots as might stain their surface at the time of immersion. This process, called pickling, is both delicate and disagreeable, requiring a good workman, at high wages. The temperature of the two last steeps should be at least 90° or 100° F., which is kept up by stoves in the apartments. The plates are finally scoured with hemp and sand in a body of water, and then put aside for use in a vessel of pure water, under which they remain bright and free from rust for many months, a very remarkable circumstance.

The *tinning* follows these preparatory steps. A range of rectangular cast-iron pots is set over a fire-flue in an apartment called the *stow*, the workman stationing themselves opposite to the narrow ends. The first rectangle in the range is the tin-pot; the second is the wash-pot, with a partition in it; the third is the grease-pot; the fourth is the pan, grated at bottom; the fifth is the list-pot, and is greatly narrower than any of the rest; they are all of the same length.

The prepared plates, dried by rubbing bran upon them, are first immersed one by one in a pot filled with melted tallow alone, and are left there for nearly an hour. They are thence removed, with the adhering grease, into pot No. 1, filled with a melted mixture of block and grain tin, covered with about four inches of tallow, slightly carbonized. This pot is heated by a fire, playing under its bottom and round its sides, till the metal becomes so hot as nearly to inflame the grease. Here about 340 plates are exposed, upright, to the action of the tin for an hour and a half, or more, according to their thickness. They are next lifted out, and placed upon an iron grating, to let the superfluous metal drain off; but this is more completely removed in the next process, called *washing*.

Into the wash-pot, No. 2, filled with melted *grain* tin, the workman puts the above plates, where the heat detaches the ribs, and drops. There is a longitudinal partition in it, for keeping the drop of tin that rises in washing from entering the vessel where the last dip is given. Indeed, the metal in the wash-pot, after having acted on 60 or 70 boxes, becomes so foul, that the weight of a block (300 cwt) of it, is transferred into the tin-pot, No. 1, and replaced by a fresh block of grain tin. The plates being lifted out of the wash-pot, with tongs held in the left hand of the workman, are scrubbed on each side with a peculiar hempen brush, held in his right hand, then dipped for a moment in the hot tin, and forthwith immersed in the adjoining grease-pot No. 3. This requires manual dexterity; and though only three-pence be paid for brushing and tin-washing 225 plates, yet a good workman can earn six shillings and three-pence in twelve hours, by putting 5625 plates through his hands. The final tin-dip is useful to remove the marks of the brush, and to make the surface uniformly bright. To regulate the temperature of the tallow-pot, and time during which the plates are left in it, requires great skill and circumspection on the part of the workman. If kept in it too long, they would be deprived to a certain extent of their silvery lustre; and if too short, streaks of tin would disfigure their surface. As a thick plate retains more heat after being lifted out of the washing-pot, it requires a proportionally cooler grease-pot. This pot has pins fixed within it, to keep the plates asunder; and whenever the workman has transferred five plates to it, a boy lifts the first out into the cold adjoining pan, No. 4; as soon as the workman transfers a sixth plate, the boy removes the second; and so on. The manufacture is completed by removing the wire of tin left on the under edge of the plates, in consequence of their vertical position in the preceding operations. This is the business of the *list-boy*, who seizes the plates when they are cool enough to handle, and puts the lower edge of each, one by one, into the list-pot, No. 5, which contains a very little melted tin, not exceeding a quarter of inch in depth. When he observes the wire-edge to be melted, he takes out the plate, and, striking it smartly with a thin stick, detaches the superfluous metal, which leaves merely a faint stripe where it lay. This mark may be perceived on every tin-plate in the market.

The plates are finally prepared for packing up in their boxes, by being well cleansed from the tallow, by friction with bran.

Mr. Thomas Morgan obtained a patent, in September, 1829, for clearing the sheet-iron plates with dilute sulphuric acid in a *hole*, instead of *scaling* them in the usual way, previous to their being cold rolled, annealed, and tinned; whereby, he says, a better article is produced at a cheaper rate.

## BORING FOR HOT WATER.

An attempt is actually being made to obtain a supply of hot water by boring, for the purpose of heating the greenhouses and manageries in the Jardin des Plantes at Paris. It is an ascertained fact, that the temperature increases as we descend into the bowels of the earth, according to the observations of Arago and others, at the rate of one degree for every 45 ft. after passing the first 60 or 70, which may be influenced by the external atmosphere. It is therefore intended to bore to the depth of nearly 3000 feet, where it is expected that water will be obtained of the temperature of about 100 degrees of Fahrenheit, and being conducted by pipes, will communicate a more equal supply of warmth than either air or steam flues, which will be maintained, after the original cost of procuring it, as long as the internal heat of the globe remains the same, without further expenditure.

---

## NITRIC ETHER.

The best method of preparing nitric ether is by mixing equal weights of alcohol and the strong fuming acid, prepared by distillation from two parts by weight of sulphuric acid with three of nitre. The large quantity of nitrous acid which it contains re-acts on the alcohol, and converts it into ether in a day or two, which floats on the top of the remaining liquid, and may be easily removed by a small syphon. Pure nitrous acid, prepared by distillation from the nitrate of lead, would do still better, but it is not so easily obtained. Two or three ounces of alcohol will be sufficient to show the process, the alchol is put into a bottle first, and small quantities of the acid poured into it at a time by a funuel with a long stem, which passes to the bottom of the bottle, mixing them thoroughly after each addition of acid, and then placing the bottle in cold water to prevent any violent reaction taking place. A drachm or two of the acid may be added every quarter of an hour in this manner, till it is all mixed with the alcohol. The bottle should be provided with a conical stopper to allow the gas that accumulates in it to be disengaged; it is forced up in the same manner as the stopper in Nooth's apparatus, and returns to its place when the excess of gas has passed by it.

Other methods for the preparation of nitric ether have been proposed. The Dublin College directs the alcohol to be mixed with sulphuric acid in a flask, and the mixture to be poured over bruised nitre in a retort, mixing a pound of the acid with nineteen ounces of alcohol by measure, and using three parts by weight of nitre for every two of sulphuric acid employed. The retort must be placed in a bason of cold water to prevent the action becoming too violent, and it should not be filled more than a third full of nitre. I have seldom found it necessary in repeating this process at ordinary temperatures, to apply any heat to commence the action, as is usually recommended. The sulphuric acid combines with the potash, and the nitric and nitrous acids acting on the alcohol in its nascent state produce the ether, which must be condensed in a large tubulated receiver kept very cold, when a large quantity is required, a second tubulated receiver should be connected with it, and the gaseous products allowed to escape by another bent tube. The first method of preparing nitric ether will be found preferable, however, as the reaction often becomes very turbulent when this process is adopted, though every precaution is taken to prevent it.

In all experiments with nitric acid and alcohol, great care must be taken not to mix a large quantity of acid with the alcohol at once, as the gaseous products that are immediately produced are apt to throw out the whole of the mixture with explosive violence. Though a small quantity of acid may be added to a large quantity of alcohol without any particular action being observed, a small quantity of alcohol cannot be mixed with a large quantity of acid without being completely decomposed, as the particles of the alcohol are surrounded by the acid on every side, which affords oxygen more readily to the inflammable elements that enter into its composition. To see the truth of this, all that is necessary is to pour a little alcohol and acid into different glasses, and pour a few drops of the acid into the alcohol, and then of the alcohol into the acid, when the appearances described will be observed.

Nitric ether always contains a little acid as it is procured at first, which may be removed by potash or lime. It has a very pale lemon yellow colour; a pleasant smell similar to that of apples, and a strong penetrating taste. It is heavier and more volatile than sulphuric ether, burns with a rich flame, and soon becomes acid by keeping. When it is purified by distillation, the operation should always be carried on with a very gentle heat, as it is decomposed when distilled quickly at a higher temperature.

Its atomic composition is still disputed, but it is admitted to contain a portion of nitrogen in addition to the other elements which exist in sulphuric ether.

## RAILWAY INDICATOR.

There has just been published in Paris an account of an instrument for indicating the speed of trains, and registering any undue excess; this, it is expected, will act as a wholesome monitor to engine-drivers, and lessen the risk of railway travelling, by rendering it impossible to escape detection where a dangerous velocity has been attained. This contrivance consists in a governor, such as is commonly used in steam-engines, and set in motion by the customary gearing from one of the axles of the locomotive. To the verticle sliding portion of the governor an index is attached, which passes along a graduated vertical scale, and by the height to which it reaches shows the degree of speed attained; any excess of speed produces a further elevation, and brings into play a second index, which is unconnected with the first, and which on the fall of the governor remains at its maximum height—a standing testimony against the negligence and recklessness of the engineer. As a further precaution, it is arranged that one of the balls of the governor carries a hammer, which strikes a bell, and loudly calls for the attention of the driver. To prevent tampering with the indications of the instrument, the second tell-tale index is locked up, and the key remains in the possession of some superior officer, who alone, at the termination of a journey, can replace it in its original position, ready for a new indication.

The first index, which only takes a cognizance of speed within the regulatad limit, is open to the inspection of all in its neighbourhood; and, if this be neglected or concealed, the bell protests most clamorously against the danger and the wrong.

## VARIETIES.

*Softening of Water for Domestic Use.*—It is calculated that the softening of the London water for domestic use by the precipitation of its lime would effect a saving of £200,000 a year in soap alone.

*New Zealand Coal.*—Some interesting specimens of coal have been recently brought over from New Zealand. The coal traverses, in seams, the seagirt rocks of the island, and the specimens that have come to hand are nodules of a moderate size, composed of carbonate of baryta, coal, and sulphuret of iron. The coal itself is exceedingly black, clean, and glistening, is easily frangible, and appears to be little, if anywise, inferior in quality to the best Wallsend or Lambton Main samples in the London market, and far superior to the Burdwan coal of India. The proportion of coal to baryta and sulphuret of iron, in the above samples, is as 13 to 20.

*New Life Boat.*—A new life boat, invented by Lieutenant Walter, R.N., was submitted a few days since to the authorities of Woolwich dockyard, by order of the Admiralty. The inventor attended and explained the nature and advantages of the materials of which she was built. It appeared that the keel, gunwales, and alternate ribs only have been constructed of oak, the planking and stems being composed of the Kamptulicon, or flexible material composed of cork and India rubber formed into planks by mechanical means. The shape of the boat was greatly admired, and deservedly as its appearance is very pleasing to the eye. Both ends are alike, in outward form somewhat resembling the boats used in whale fishing, and it is constructed to pull and sail very fast, and to surmount the heaviest seas. Sixty-five men entered the boat after the lugs were unscrewed to let the water in to represent her being filled by a heavy sea, and she still possessed a buoyancy by the aid of air-boxes equal to about $3\frac{1}{2}$ tons, exclusive of the buoyancy of the boat, which only weighs $2\frac{1}{2}$ tons, although 34 feet in length and 12 feet in breadth, and capable of carrying on an emergency 100 persons. The advantage of submitting new inventions to practical men was fully shown during the experiment, Commodore Sir F. Collier having suggested to Lieutenant Walter, the propriety of adding pontoon pipes and an iron keel outside to render it impossible to upset the boat under any circumstances, and which the inventor intends to apply before any further experiments are made.

*Novel Feat.*—A Plymouth correspondent furnishes the following aquatic novelty :—" A great deal of curiosity and surprise has been manifested during the past week by those who have witnessed the manner in which one of the officers of the Caledonia flag-ship, now lying in Hamoaze, comes on shore. He descends the ship's side to the water's edge, puts on a mackintosh dress, and inflates it with air by means of a small pair of bellows. He then steps into the water, and immersed nearly up to the breast, with two small paddles very rapidly works himself on shore. As soon as he lands he takes off his dress, and throwing it across his arm, it being very light, attends to his duty or his pleasure, as it may be. On Monday last he landed twice at the dockyard in the way described; and he now laughs at the idea of taking a boat. During the time the Caledonia was in the Sound, he left the ship in a similar manner, and unattended by a boat, landed at the admiral's-yard, Stonehouse, a distance of three miles. He carries the bellows with him, in case of too rapid an exhaustion of air. It has been told me that, during the trial-cruise of the ships in the Channel, he passed, by this extraordinary means, from one ship to the other. I cannot vouch for this fact, but the truth of the rest may be relied on. Should it be generally adopted, it will be a very amusing trip for half a dozen to take round the Eddystone Lighthouse.

*Nutmeg.* — The exterior part of the fruit is a pulpy substance sometimes brought to table in India as a preserve; within this is a thin shining black shell surrounded by membranous layers, which constitute another of our spices—the mace, and within the shell is the nutmeg. To prepare them the pulp is cleared off, and the mace separated by a knife; the nuts are then dried in the sun, and afterwards by the fire; by this the shell becomes brittle, and the kernel within shrinks, which admits of the nuts being broken without injuring the nutmeg. They are then soaked in sea water, and impregnated with lime, to destroy the vegetating power and keep away insects; but Mr. Crawford observes, that the natives if left to themselves transport them in the shell, which is by far the best mode. There are two sorts of nutmeg; one wild, which is long or oval-shaped, and much inferior; the cultivated nutmeg is nearly round: the best are firm, hard, and of an unctuous consistence, the odour strong, aromatic, and agreeable; taste, hot and acrid. When cut across, they appear full of dark veins, which contain much volatile oil. This oil is yielded by distillation, and it posseses the flavour of the nutmeg in perfection, two drops being nearly equal to a pound of the powder; this is made from the broken kernels, and it is said that the nutmegs are sometimes punctured and boiled for the purpose of extracting the oil, the holes being filled up with sassafras; it is one of the few oils of tropical climates that are lighter than water.

*Testing an Iron Bridge in Ireland.*—The lattice bridge which is built over the Royal Canal, on the Dublin and Drogeeda Railway, and whose span is 144 feet 6 inches, was the subject of an interesting experiment on the 13th inst. After taking out all the wedges under the two west beams, by running one engine and three carriages across three times, the greatest deflection was two-tenths of an inch, and each time the bridge resumed its original position. The bridge was tested a second time the same day by running a coupled engine across, the weight of the tender, eight carriages, and three trucks, averaging from eighty to ninety tons. This train of carriages and engine was allowed to stand upon the bridge until Mr. Hamilton, Sir J. Macneill, and Mr. M'Cormick, measured the deflection, which was two-tenths of an inch, and when the train moved off the bridge, it resumed its original position.

*Indestructible Carbonic Paint.*—A patent has recently been taken out in America by J. Weisman, of Philadelphia, for an indestructible anti-corrosive pigment. The patentee says, " The nature of my invention consists in combining the metal of carbon, or purified graphite, with caoutchouc and shellac, together with a small portion of acetate, or sugar of lead; the ingredients being mixed with linseed oil and spirits of turpentine." What he claims as his invention, and desires to secure by letters patent, is the combination of carbon, or pure graphite, with caoutchouc and shellac, together with acetate of lead, linseed oil and spirits of turpentine, for the purpose set forth, forming a perfectly indestructible pigment, which also serves the purposes of anti-attrition.

*Pure Water.*—It is, perhaps, too much to expect that people will be induced to return to the natural beverage, so long as it is supplied to them in the impure state in which it reaches the inhabitants of London, and of most large towns in this country—in fact, such water is neither palatable nor wholesome, and it is one of the evils affecting the public health which calls most loudly for correction, and the remedy for which is by no means difficult. Filtering does not purify water, as it can only remove the impurities which are mechanically suspended in it, and not such as are in a state of solution. Filtering cannot be successful in depriving it of its deleterious properties; we might as well attempt to remove the poison from a solution of arsenic by filtering.

*Extraordinary Brickmaking.*—Mr. Hobson's patent machine for making bricks is truly wonderful when compared with the amount of labour it is capable of accomplishing, and the perfect manner in which it completes its work. The stock-brick dies will throw off four thousand bricks in a day, equal in all respects to the first-rate article in the market; whereas the ordinary number of bricks produced by one man in a day, in the usual mode of making them, is eight hundred!

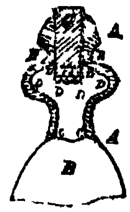


Fig. 1.

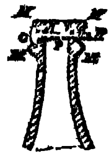


Fig. 7.

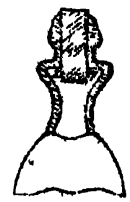
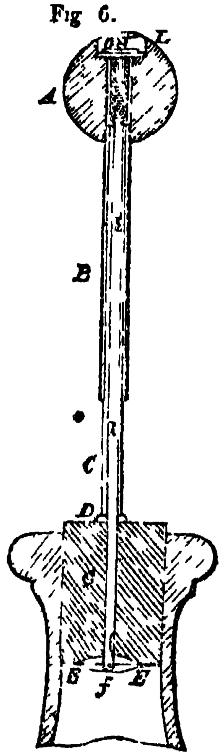


Fig. 3.

Fig 6.



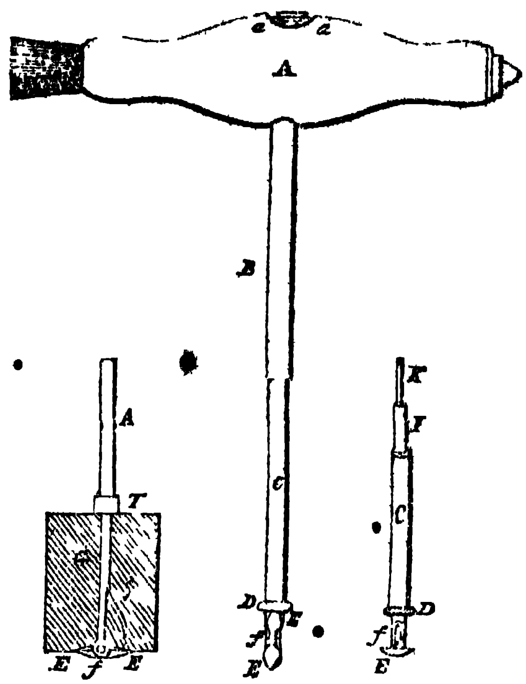


Fig. 8.

Fig. 5.

Fig. 7.

Fig. 9

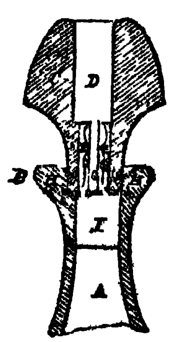


Fig. 10.

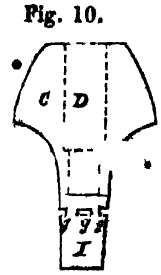
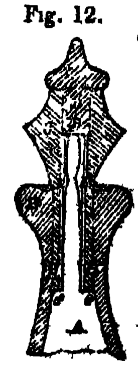


Fig. 12.



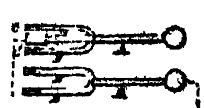


Fig. 11. Fig. 13.

IMPROVEMENTS IN THE MANUFACTURE OF GLASS, &c.

## IMPROVEMENTS IN THE MANUFACTURE OF GLASS, &c.

A patent has lately been granted to Alexander Southwood Stocker, *for improvements in the Manufacture of glass and other vessels as regards the application of corks, and the effectual retention of the same, for effervescing liquids; and in an apparatus for extracting such corks.*

The patentee declares the nature and intention of his invention to consist, firstly, in the manufacture of bottles of improved forms, with reference to a more beneficial mechanical character obtained for them by such improved forms, and as applied to all the varieties as in common acceptance are considered, in their practical and domestic use, to belong to that class of vessels; secondly, in the manufacture and production of a more effective mode of securing the corks, or stoppers, applied to the purpose of closing such bottles; and thirdly, in an apparatus for the more effectively withdrawing the corks and stoppers from such vessels.

Figure 1 represents a vertical cross section of the upper portion of a bottle, or glass vessel, marked A A, adapted to effervescing liquids, as soda water, and other compounds of similar chemical character; B B is a partial outer view of the same. It will be seen that the diametral dimension of the neck of the vessel contracts at C C, as in the ordinary vessels used for such purposes, but at a small distance above this point the diametral dimension begins to increase at D D, and such increase is continued, until it projects or swells to a dimension of about double the first dimension, and from the large dimension such dimension begins to decrease in an upward direction, and when such decrease has again arrived at the point D D, then the diametral dimension of the neck of the vessel is decreased to the lesser dimension shewn at E E. Into this smaller portion, or neck of the vessel, the cork G H is passed, its lower portion H protruding below the portion E E of the neck into the larger space. Figure 3 represents, in a vertical cross section, a modification of the mechanical character as regards the form of the upper portion of a vessel applied to the same purpose, in which the increased portion of figure 1 has the form and configuration shewn at I I. The figure 4 represents a form or configuration of the upper part of the necks of bottles, being in other respects of the ordinary and known forms and configurations. It consists in forming in the enlarged or thickened portion of the neck, M M M M, a counter-sunken indentation N N, in which can be applied, in a new manner, the known method of securing the cork, or stopper, to the neck of the vessel, by the insertion of a metal pin through holes made in the opposite sides of the neck, the metal pin passing through a diameter of the cork, or stopper, as shewn the figure at P. The head of the pin at Q, and its point at R, being thus placed within the diametral dimension of the projecting rings M M M M, and so admitting the application of a capsule, or external cover, to the cork and the opening or mouth of the vessel.

The figures 5, 6, represent the apparatus for withdrawing the corks or stoppers from such vessels. The figure 5 represents a compound instrument by which such withdrawal is effected. Figure 6 is a longitudinal section of the figure 5, in which the corresponding parts are marked with the same letters of reference. A is a handle of the form generally adopted in the corkscrews of common use. B is a metal external tube attached to the handle A and passing through the same in a hollowed channel to its opening or mouth on the upper side of the handle A A, at *a a*. C is a smaller metal tube sliding freely within the tube B, and carrying at its lower extremity a stop plate D; within the inner sliding tube B there is also a metal tube or hollow cylindrical rod I, (to be seen only in the figure 6; the rod I carries on its lower extremity a doubly fluked arm E E, which moves freely on a pin *f*, forming the fulcrum or centre of motion; the sliding rod I, figure 6, being also hollow and tubular, it allows a small solid metal rod to slide within it. This is shown at K, in the figure 7, with the tubes C and I, with the stud or stop plate D, one of the flukes E and the centre of motion *f*, of the fluked arms E E.

The action of this instrument, and its application to the withdrawing the corks or stoppers of bottles is thus:—In the figure 6, G represents a cork or stopper, supposed to be inserted in the neck or opening of a bottle; the instrument having the stud or plate D in the position shown in the figure 5 where it holds the fluked arm E E closed, is in that state thrust by the point of the lower fluke into the cork; the stud D is thus forced up as the tubular rod I penetrates the cork, and the fluked arm is at liberty to open on its centre pin *f*, when they have passed through the cork, as in the figure; this effected, the small circular plate L, at the top of the handle, and which is fixed on the upper extremity of the inner and solid metal rod K, is pressed down till it reaches the bottom of the cavity O, cut in the handle A; this presses the lower extremity of the rod K against a short inclined rib, formed on the inner side of the fluked arm, it forces it to take a position at right angles to the position in which it was made to penetrate the cork G, and then standing in the position represented in the figure 2, at E E; a small helical spring under the circular plate L, is attached to the head of the rod K, and operates to release it from the fluked arm, the arms holding the cork G on its under side as shown in figure 6; the operator withdraws the cork from the mouth of the bottle with facility and precision.

The figure 8 represents a more simple construction of this instrument. A is a solid metal stem having the usual cross handle; G is the cork to be withdrawn; the fluked arms E E, set on the lower extremity of the rod A, is held in a closed position, in which it can be made to penetrate the cork, the vertical position being insured by a holding socket T, sliding freely on the rod A. When the arm enters the cork, the socket T is forced to quit the arm, and so releases a small steel spring S, which then throws the flukes into a position enabling it, on its exit from the cork at its lower face, to take the horizontal position shown in the figure, and so enables the operator to withdraw the cork.

The figure 9 represents a secure mode of closing the opening in a glass or other bottle or vessel by a stopper, which cannot be withdrawn but by the operation of its particular key. The figure shows the vertical section of a glass vessel, in which A is the body, B the mouth of its neck, C a stopper, having a cylindrical hollow space formed in its centre and through its length; E E the cylindrical cavity continued but of smaller diameter, and the stopper terminating in a solid portion, I, fitting closely in the neck of the vessel, as in the usual constructions. In the cavity E E, and attached to the stopper, a branched spring, G G G, is placed, whose tension being outwards from the centre of their assemblage, their bent extremities *g g g* are thrown by that tension into corresponding cavities formed in the portion I, (as shown at *g g g* in the figure 10,) and also afterwards under a shoulder or grooved bearing formed in the neck of the vessel at H H in figure 12.

Figure 10 is an exterior view of the stopper in elevation.

Figure 11 is a view in side elevation of the key with which this stopper is released in order to be withdrawn, in which A is its stalk or stem, B B its arms, of which C C are the extremities. Its action is produced by inserting its arms B B within the cylindrical aperture E E of the stopper in figure 9, and pressing its extremities C C downwards against the shoulders *g g* of the springs closes them towards the centre and so withdraws them from their position of holding in the neck of the vessel; the stopper can then be withdrawn by hand.

Figure 12 shows a modification of this principle of construction and a stopper of security. A represents a portion of the body of the vessel; B its mouth, in which is inserted a stopper C; through the c ntre of the stopper C, a cylindrical cavity is formed through its entire length, at F, a circular metal plate resting by its entire circumference on a bearing shoulder formed in the solid part of the stopper C. To the centre of the plate E are fixed the springs F F; these have a small portion of their lower extremities turned outwards, and at right angles to their length, as shown at G; these portions pass under the lower surface of the stopper C, and beyond that under a projecting ledge H, formed in the solid part of the neck of the vessel, and the extremities G of the springs therefore are thus held by the projecting ledge, and are prevented from rising by their expanded state as shown in the figure, and thus the vessel is securely stopped. The stopper cannot be withdrawn until the extremities of the springs be released from their expanded position, which is effected by the application of a key to the springs. A key for this purpose is shown at figure 13; its arms are passed through holes made for that purpose in the plate E, and by this action of the key, the limbs F F of the springs are compressed until their extremities G G are released from the projecting ledges H H; the stopper may then be withdrawn. D is a smaller stopper, which is placed over the plate E, more completely to stop the mouth of the vessel.

Fig. 13.

Fig. 14.

The figure 14 represents a different construction and combination to effect the inviolability of bottles; this is effected by a peculiar construction of the vessel itself, and of its stopper, and by combinations operating to hold the vessel and its stopper securely together, and only to be separated, or the stopper be withdrawn, by the agency of a detached key.

A A represents a longitudinal section of the upper part of a bottle fitted with the stopper B, thus constructed :—C C is a cylindrical passage, formed concentrically through its entire length, as shewn at figure 14, 15 and 16, for the purpose of receiving the male screw E, cut upou one part of the vertical rod F.

Fig. 15.

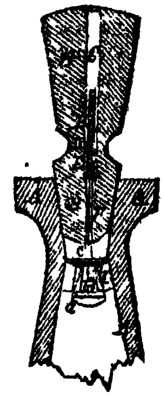
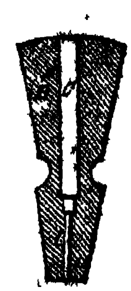


Fig. 16.



## ON CHICORY, OR WILD SUCCORY.

THE term *Chicory* is an anglicised French word, the original being *Chicoree*. Its introduction into our language was quite unnecessary, seeing that we already possessed an English name for the substance in question, namely, *wild Succory*.

The plant is known to botanists by the name of *Cichorium Intybus*, and belongs to the natural order *Compositæ*, tribe *Cichoraceæ*. It is an indigenous plant with a perennial root, and flowers in July and August. Its stems are two or three feet high and branched. The flowers (which are about the size of those of the dandelion) are handsome, and bright blue with blue anthers and stigmas. A variety of the plant has white flowers.

The root, the *radix chicorii* of pharmacologists, is spindle-shaped, with a single or double head: externally, it is whitish or greyish yellow; internally whitish, fleshy, and milky. The roots grown in this country are smaller, or more woody or fibrous than those which are imported.

Wild Succory, or Chicory, is cultivated in various parts of England. Surrey (near Godalming), Bedfordshire, and Yorkshire, have been mentioned to us as places where it is now grown. But whether it be that the soil is inferior, or that the farmers do not know the best mode of cultivating it, certain it is British Chicory is much inferior to the foreign. We have heard one dealer complain that the British cultivators do not cut off the tails of the roots before sending them to market. New seed (fruit) we have been told, always yields more woody, and, therefore, inferior, roots than old seed. In point of price English farmers cannot compete with the foreign cultivator. Foreign Chicory may be bought, in bond, for from £5 to £10 per ton, while British Chicory fetches about £18; but as the foreign Chicory pay a duty of £20 per ton, the British grower is protected to this amount.

Chicory is cultivated in Prussia, Belgium, and in France. The Prussian is the best, being more fleshy than the other kinds. It is imported by way of Hamburgh, while the Belgium and Flemish come to us from Antwerp. There is no official return of the quantity which is annually imported, but an extensive importer estimated it at about one thousand tons, which will yield a revenue of £20,000 per year. The duty on roasted Chicory is £56 per ton, which acts as a prohibition, so that Chicory is imported in the raw state.

The dried roots are roasted in this country like Coffee, the loss during roasting is from twenty-five to thirty per cent. The roasters generally introduce into the roasting machine about two pounds of lard for every hundred weight of Chicory. The reason assigned for this practice by one dealer, was, that the lard gave the Chicory a better face; while another dealer declared that it was done to render the powder less hygrometric. Inferior kinds of Chicory are artificially coloured with *Venetian red*. Some roasters introduce this into the lard before the latter is put into the Chicory when grinding it, after the roasting.

*Venetian red* is essentially the sesquioxide of iron, obtained by calcining common copporas (sulphate of iron). The different colours of the product depend on the temperature to which the sesquioxide is subjected. When it has been exposed to an intense white heat its colour deepens, and it is then termed *purple-brown*. The lighter tint of Venetian red is produced by adulteration. Our informant (a manufacturer) told us that Venetian red was "adulterated to suit the various prices of the market." We did not think it expedient to pry into the nature of the adulterating ingredient, but a friend suggests that it is *reddle*, the substance used for marking sheep.

Venetian red is, we believe, the principal substance at present used for colouring Chicory; occasionally other agents have been employed. A dealer tells us that he once bought a quantity of Chicory which contained 20 p er cent. of logwood and mahogany dust.

Chicory is extensively adulterated with roasted pulse (as peas and beans), damaged corn, and coffee husks (*coffee-flights* as they are technically called), and coloured by Venetian red. We have also heard of parsnips having been roasted, ground, and mixed with Chicory. *Hambro' powder*, which is used as a fictitious chicory, consists of roasted pulse (peas usually) coloured with Venetian red. Treacle is sometimes introduced into fictitious chicory, to give the caramel or saccharine odour possessed by real Chicory. There are four characters by which adulterated Chicory may be distinguished from the genuine.

1st. It yields to cold water a much weaker colour. In using this test it is necessary to have a sample of genuine Chicory for comparison.

2dly. A decoction of Chicory, containing either roasted grain or pulse, yields, when cold, a purplish or bluish black colour with a solution of iodine; whereas a corresponding decoction of genuine Chicory is merely coloured brown by iodine.

3rdly. The microscope detects, in adulterated Chicory, the torrefied starch grains of either corn or pulse. That they are starch grains is shown by the action of a solution of iodine, which blackens them.

4thly. The odour and flavour will sometimes detect adulterations.

Roasted and ground Chicory attracts water from the air, and thereby increases in weight and becomes clammy. The grinders are accustomed to return as much by weight of ground chicory as they receive of the unground root: for the loss which the root suffers by grinding is more than compensated for by the absorption of water from the air. We have been informed, that some dealers put up their packages of powdered Chicory somewhat short in weight, and then place them in a damp cellar, in order that they may absorb water and thereby acquire their proper weight.

The principal use of Chicory is for the adulteration of coffee; besides lowering the price, it, in the opinion of some persons, improves the flavour of coffee. The substance sold as *Taraxacum Coffee* is, we are told, made with British Chicory. Chicory has also been used for adulterating snuff and colouring beer (porter).—*Pharmaceutical Journal.*

## MAGNETIC EFFECTS OF THE ELECTRICITY OF THE EARTH.

It has been found that bars and other pieces of iron, on remaining a long time in one situation, have become magnetic; sometimes even when, from their so tness, they were not capable of permanent magnetism. At the same time these bars have been observed to become harder. The former of these phenomena may be attributed to the effects of the electric currents of the earth, but the latter to some hitherto unascertained change in the properties of iron.

An oblong piece of iron, made red hot, and left to cool in the direction of the magnetic meridian, also becomes in some degree magnetic, acquiring this power whilst hot and soft, from the electric currents, and on hardening in cooling it retains it.

In drilling, filing, and hammering, iron frequently acquires a considerable degree of magnetism. This may be drawn partly from the earth, but it arises in a very considerable degree from the electric excitation produced during these processes.

Many other phenomena are caused by the electric currents of the earth. But the most remarkable, perhaps, is the magnetism induced or generated in the loadstone, which, as is well known, is an iron ore mixed with different ingredients.

A very natural question arises on this last instance. If the electric currents of the earth induce magnetism in some iron ores, why not in all? This is the reason—it is not under every circumstance that an electric current will enduce magnetism in iron. But an electric shock through this metal always renders it in a greater or less degree magnetic; and as it is certain that there are electric currents and discharges in the earth, so the magnetism of the loadstone is developed by the discharge of the fluid through it, or by induction.

For magnetism is generated by induction; and when an electric shock takes place in the earth through any stratum, a shock or current is induced in all surrounding strata. To prove this, wind, some copper wire round a cylinder of wood as a helix, preventing the different spires from touching by a thin interposing twine; cover this helix with calico; then wind a second wire in the same manner. To one of these wires attach a hollow helix from round a glass tube, introduce a steel needle into the tube, and make contact between the galvanic battery and the other or inducing wire. On removing the needle before the battery contact is broken, it will be found magnetized. When the battery contact is first made, then an unmagnetized needle introduced into the hollow helix, and lastly the battery contact broken, the needle is magnetized to an equal degree apparently with the first; but the poles are of the contrary kind. When an unmagnetized needle is put into the hollow helix, before the contact of the inducing wire with the battery, and remains there until the contact is broken, it exhibits little or no magnetism, the first effect being nearly neutralized by the second. Notwithstanding, some magnetism remains, and to the operation of these and similar principles we may attribute the origin of the loadstone. For a shock passed through the inducing wire will produce the same results as a current.

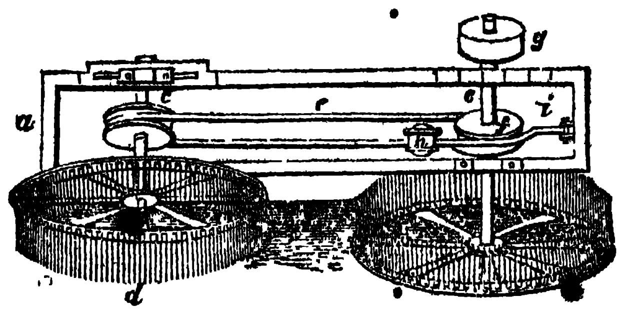



Fig. 1.

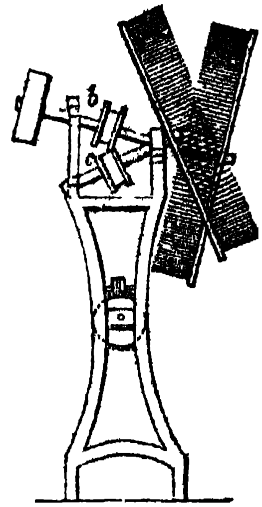



Fig 2.

## WORSTED MANUFACTURE.

(*Continued from Page* 286.)

A great many self-acting machines have been contrived for performing the wool-combing operations. As the limits of this work do not allow us to give an historical account of them, we shall content ourselves with describing, briefly, one of the latest. It was made the subject of a patent by Mr. John Platt, of Salford, in November, 1827, being an invention communicated to him by a foreigner residing abroad. This machine is intended to comb wool by means of two revolving combs or heckles. Fig. 1 is a horizontal representation of the machine. It consists of a square frame of iron (a a), mounted upon legs, as exhibited in the end elevation, fig. 2. (b) and (c) are two axles, upon each of which one of the circular combs (d d) is mounted. These axles, (b) and (c), are not placed in horizontal positions, but are inclined at acute angles to the horizon, and in directions crossing each other. The two circular combs, which are fixed upon these axles, consequently revolve in planes considerably inclined to the perpendicular, as well as to each other. These combs are made in the form of ordinary wheels, with arms, of which the nave is attached to the axle by screws. The points or teeth are set in the edge of the rim, at right angles to the axis of the wheel, and are made to revolve in opposite directions by means of a crossed or twisted strap (e e) running over a pulley (f) on each axle; these being driven by a band and rigger, or power-pulley, on the end of the axle (b).

As the comb-wheels go round, they are made to approach each other slowly. This approach is caused by mounting the bearings of the axle (c) in slots, which allow of their sliding, and enable that axle and its circular comb to be brought towards the circular comb on the axle (b). This traverse movement is effected by an endless screw and toothed-wheel, or snail-work, connected to the under part of the frame, as shown at the centre of fig. 2. This mechanism gradually moves the axle (c) in a lateral direction, while the twisted strap (e), which connects the two axles, and drives (c), by the rotation of (b), is kept at its proper tension, as the circular combs approach each other, by means of a heavy roller (h), which hangs on a jointed lever (i), fig. 1.

In putting this comb into operation, the proper quantity of wool, in its entangled state, is to be stuck between the teeth, and when the wheels are set in rapid rotatory motion, the loose ends of the fleece will, by the centrifugal force, be thrown out in the direction of radii, and will catch against the points of the teeth of the other revolving comb, whereby the fibres will be drawn out and straightened. The operation is to commence when the comb-wheels are at their greatest distance apart. As they slowly approach each other, the ends or fibres of the wool will be laid hold of by the teeth points, at progressively increasing depths, until the wheels come near together, by which time the whole length of the staple will have been combed out smooth, and will be then drawn from the comb, by throwing the driving-belt, as usual, on a loose pulley (not shown here). The *noyls*, or short refuse wool, which remains entangled among the teeth, being removed, the machine is charged for another operation.

Large machines of this kind are now at work in Leeds. In one of them the comb-wheels are ten feet in diameter, and are furnished with hollow iron spokes filled with steam, which keep the whole apparatus at a proper combing heat. These wheels are made to revolve slowly, while a boy, seated on the ground, dresses one of them with wool. They are then made to revolve with great rapidity, by shifting the driving-belt on the proper pulley, during which revolution they gradually approach each other. This being a work of simple superintendence, and not of effort and skill, like the hand-combing business, is now discharged by young children; and shows, in a striking point of view, the effect of automatic mechanism, in embodying handicraft dexterity and intelligence in a machine, and thereby substituting cheap and docile labour for what is dear, and sometimes refractory. Such machines will probably, ere long, supersede the hand comb altogether. Care should be had to keep the joints steam-tight, so as to prevent wetting the children employed at the machine, and to give due ventilation; for hot air, if pure, is not insalubrious.

*(To be continued.)*

## THE COTTON PLANT AND ITS CULTIVATION.

*(Continued from page 309.)*

At Omrawutte, cotton is grown at the rate of two pounds for twopence, in moderately favourable seasons; and did good roads exist, this article could be delivered at Bombay at a handsome remunerating price. It is now carried on the backs of bullocks, and the extra cost thus incurred amounts to a penny a lb. more. This cotton is but little inferior to that grown in Guzerat, which is looked upon as the garden of the western side of India.

In the Deccan the production of superior cotton is not confined to the vicinity of Nagpore, for it can be obtained abundantly much further to the north, at Calpee, as well as in the districts of Currah, Carah, and Etawah.

Cotton produced in the southern extremity of the Peninsula at Tinnivelly and Coimbetore, has been highly approved in the English market.

At Tinnivelly, where Mr. Hughes has been long engaged in the cultivation of the Bourbon cotton, that gentleman considers the vicinity of the sea, or situations to which the influence of the sea air extends, are on every account to be preferred. A dry soil, and a dry atmosphere, from March to May, and from July to September, seem almost essential to the good quality of the wool, as well as to the productiveness of the plant. The freest circulation of air, and of light winds, are of the greatest benefit to a perfect culture.

On the other hand, Mr. Heath, a gentleman also experienced in the cultivation of the same description of cotton, states that his experience differs from that of Mr. Hughes with respect to the influence of vicinity to the sea; for he found the cotton come to perfection at the distance of one hundred and fifty miles from its shore.

I quote these results of experience as evidence that in India local climate is not particularly influential upon the cotton plant. All districts are suitable, but of course this circumstance has no reference to the importance of a free circulation of air and the penetration of light among the plants.

In Burmah, cotton is cultivated very extensively, chiefly for the China market, though the accounts are too discrepant (varying from 7,000,001 to 37,000,000) to allow of a satisfactory estimate being given of the annual amount. The greatest quantity is produced in the neighbourhoods of Ava and Prome; but that produced at Bankok and that in the Mataban province (known as Tenasserim cotton), appears to have the longest staple.

It was even supposed that cotton was conveyed from Burmah to Decca, to be employed there in the manufacture of its muslins; but this supposition, unsustained even by probability, is contradicted by the Decca custom-house returns, which show that scarcely more than twenty maunds were imported during the four years, 1828 31.

*Soil and Situation.*—To arrive at a just conclusion as to the soil and situation best suited for the growth of superior cotton in Hindostan, it is most important to ascertain accurately the nature of those which have been practically found the most favourable in Georgia and elsewhere. This point being satisfactorily settled, and due consideration had as to the object to be attained by the cultivation, viz., the full development of the parts of fructification, we shall be able, with considerable probability of success, to point out those localities which will be found most productive in the different districts and elevations of India.

Of the nature of the soils where the best cotton is grown, we have information from Mr. Piddington. He describes a specimen of one of the best of the Georgia Sea island cotton soils, as appearing "like a mixture of fine dark grey sand and charcoal dust, with fragments of shells, wood, twigs, leaves, and even the shells of cotton seeds, the wood being in all states, from dry to charred, as if the rubbish of the cotton bushes had been burnt on the spot. Upon sifting nine ounces of the soil, taken fairly from the specimen sent, through muslin, it was found that eight ounces of it was fine sand, mixed with dark charcoal-looking dust; and the remaining ounce coarse sand, with a few fragments of sandstone in thin horizontal layers, shells in fragments, with wood and vegetable rubbish as described above.

The wood and twigs were evidently the remains of cotton plants, and suggest that the specimen was taken from the surface. The nature of the subsoil on which it rests was not, unfortunately, made known. The black particles are certainly carbonaceous, and Mr. Piddington states reasons to justify his suspicions that they are finely-divided lignite. The fragments of shells were not sufficiently abundant to entitle the soil to be considered calcareous, but their slow decomposition would furnish a supply for centuries.

One hundred parts of the finely divided which pass through muslin, Mr. Piddington states to consist of—

| | |
|---|---|
| Saline matter, muriates of lime and soda) (but no potass) | 0.20 |
| Vegetable matter, mostly lignite or peaty powder, with a little water | 3.20 |
| Iron (protoxide) | 1.00 |
| Lime | 2.76 |
| Alumina | 0.20 |
| Silex | 92.00 |
| | 99.15 |
| Water and loss | 85 |
| | 100 |

The saline matter was wholly composed of muriates of lime and soda; no sulphates or potass could be detected, though these are seldom absent from inland soils. It was to be looked for, indeed, that soda would take the place of potass in a marine soil. The saline matters, trifling as their proportion appears, are always considered of importance to the crop. In appreciating this soil, we must make an allowance for the broken shells, which are always slowly decomposing and furnishing fresh calcareous matter to the soil. These have been excluded in the sifting, but it will be remarked that this and the following analysis of another specimen do not show the soil to be *so* calcareous as I had been led to suppose. The examination was indeed repeated to guard against error in this respect, and to be assured also that the proportion *by weight* of the peaty matter, which appears so large by bulk, was correct.

Another peculiarity of this soil was the state of the silex. In many of the soils of Bengal, and indeed in all soils the origin of which is *decomposed* rocks of any sort, the silex is obtained, for the most part, in the state of an impalpable white powder; or, in other words, like fine flint dust. When the soil, on the contrary, is derived from *disintegrated* rocks, the silex is in coarse grains, like coarsely broken flint. In this the silex was almost wholly of the latter description, being in bright white grains, like pounded loaf sugar. It is essential to remark this, for silex, *i. e.* flint, in coarse grains, and silex in fine dust, must act very differently in the soil, both as regards its relations to moisture, its tenacity, and its electrical properties.

Another specimen, chiefly differing in appearance by being of an uniform brown colour, yielded seven-eighths of finely divided matter, and 100 parts of this contained—

| | |
|---|---|
| Extractive and saline matter, mur of lime and mur of soda, but no potass | 0·60 |
| Vegetable matter, mostly lignite or peat in powder .. .. .. .. .. .. | 5·00 |
| Iron (protoxide) .. .. .. .. .. .. | 1·30 |
| Carbonate of lime.. .. .. .. .. | 4·00 |
| Alumina .. .. .. .. .. .. .. | 0·63 |
| Silex, coarse grains .. .. .. .. | 88·02 |
| | 99·55 |
| Water and loss .. .. .. | 45 |
| | 100 |

A specimen of Georgia Upland cotton soil, Mr. Piddington says resembles much in appearance the light, fawn-colored, sandy soils, of Lower Bengal. One half, by weight, was coarse gravitic sand, with a few minute fragments of felspar and shells, and some vegetable remains, chiefly from cotton shrubs. It was closely analogous to the Sea Island soils in showing, when heated, that it contained lignite or peaty matter. Mr. Piddington could detect no soluble saline matters in this specimen. He considers that the iron in this is probably in the state of protoxide, and in the first a deutoxide. In 100 parts were—

| | |
|---|---|
| Extractive matter, but no saline .. .. | 0·10 |
| Vegetable matter, peat or lignite.. .. | 4·60 |
| Iron, protoxide .. .. .. .. .. .. | 1·25 |
| Alumina .. .. .. .. .. .. .. | 1.00 |
| Carb, lime .. .. .. .. .. .. .. | 2·90 |
| Silex, coarse grains .. .. .. .. | 89·35 |
| | 99.25 |
| Water and loss .. .. .. | ·75 |
| | 100 |

The *mar* or *marrah*, a black soil from Bandelcund, said to be found in that district, the best soil for cotton, if not lying so low as to retain the water, was also examined by Mr. Piddington. He describes "its appearance, when dry, to be that of a dark brown, heavy, interspersed with white nodules, which are soft *kunkur*. So that the whole is easily pulverized." "It forms with water a tenacious clay, and dries into tough lumps, giving every indication of being what the black soil for cotton is described to be, viz., "a soil produced by the decomposition of trap rocks, forming a tenacious mud in the rains, and drying into a hard black clay, crossed by innumerable deep fissures and cracks in the hot winds."

*(To be continued.)*

## VOLCANOES.

(*Continued from page* 301.)

*Earthquakes.*—The constant escape of aeriform fluids from volcanic vents; the irresistible force which such elastic vapours exert when pent up and compressed—an effect with which our steam-boats and locomotive engines have made every one familiar; the immense production of such gaseous elements which must be taking place in the interior of the globe, from the igneous action which is going on unremittingly; afford a satisfactory explanation of the nature and cause of earthquakes, and of those elevatory movements by which the foundations of the deep are broken up, and raised into chains of mountains thousands of feet above the level of the sea. The volcanic vents are, in truth, the safety-valves from which the caloric from the interior of the earth escapes into the atmosphere: when these channels become choked up, the confined gases occasion earthquakes, elevations and dislocations of the crust of the earth, until the obstruction from the former craters is removed, or new vents are established.

*Volcanic Islands in the Mediterranean.*—These effects take place alike indiscriminately, either on the land or beneath the waters of the ocean. The volcanic foci of southern Italy are certainly not confined to the land, but extend beneath the bed of the Mediterranean, of which the appearance of new shoals and islands, affords conclusive evidence. Livy informs us that an event of this kind, which took place about the period of the death of Hannibal, together with other volcanic phenomena, so terrified the Roman people, as to induce them to decree a supplication to the gods, to avert the displeasure of heaven, which these prodigies were supposed to denote.

In 1831 a volcanic island arose in the Mediterranean, about thirty miles off the S. W. coast of Sicily. It was preceded by a fountain of steam and water, and at length a small island gradually appeared, having a crater on the summit, which ejected scoriæ, ashes, and volumes of vapour; the sea around was covered with floating cinders and dead fish. The scoriæ were of a greyish black colour. The crater reached an elevation of nearly 200 feet, and with a circumference of about three miles, having a circular basin full of boiling water of a dingy red colour. It continued in activity for three weeks, and then gradually diminished, so that no trace now remains of its existence, except in reefs and shoals. Mr. Lyell observes, that from the facts that have been obtained, it is certain that a hill, 800 feet high, was here formed by a submarine volcanic vent in the course of a few weeks. The occurrence of shoals of dead fish will not fail to remind one of the ichthyolites of Monte Bolca: and we cannot doubt that vast numbers were imbedded in the erupted mineral masses at the bottom of the Mediterranean; when these shall be elevated above the waters, and explored by some Agassiz of future times, the then fossil fish of the Mediterranean may afford interesting subjects for the contemplation of the geologist, and the philosopher.

*Organic Remains imbedded beneath Lava Currents.*—In the course of these inquiries, we have been familiarized with the striking contrast presented by the effects of high temperature, exerted under great pressure, to those resulting from heat and combustion in the open air. Thus we have seen that in the earliest geological eras, eruptions of basalt have burst through and overflowed sedimentary strata, and yet the most delicate animal and vegetable substances have remained; transmuted, indeed, into stone, but still retaining their original structure—as, for instance, the vegetables of the carboniferous system, and the shells and corals of the lias, oolite, and of the chalk. In the cretaceous formation of Glaris, although the strata have been converted into slate by igneous agency, the fishes still remain—the limestone of Monte Bolca, though capped with basalt, yet swarms with ichthyolites—the fiery currents of Auvergne have flowed over the lacustrine limestones, and still the remains of insects, serpents, birds, and quadrupeds, are uninjured—the tertiary forests of the Andes, which grow on beds of lava, and now lie buried beneath volcanic masses of prodigious thickness, preserve their forms unaltered—and the bones of the dodo are found imbedded in marlstone, covered by lava of recent origin.

*Ice preserved by red hot Lava.*—A circumstance of a very extraordinary nature is described by Mr. Lyell—that of the preservation for ages of a glacier, or bed of ice, from having been covered and protected by a [illegible] red-hot lava. The extraordinary heat exp[illegible] in the south of Europe, during the summer [illegible]d autumn of 1828, caused the [illegible]l supplies of ice entirely to fail. Great distress was consequently felt for want of a commodity, regarded in those countries rather as an article of necessity than of luxury. Etna was, therefore, carefully explored in the hopes of discovering some crevice, or natural grotto on the mountain, where drift snow was still preserved. Nor was the search unsuccessful; for a small mass of perennial ice, at the foot of the highest cone, was found to be part of a large, continuous glacier, covered by a lava current. The ice was quarried, and the superposition of the lava was ascertained to continue for several hundred yards; unfortunately, the ice was so extremely hard, and the excavation so expensive, that there is no probability of the operations being renewed. Mr. Lyell explains this apparently paradoxical fact, by supposing that a deep mass of drift snow was covered by a stream of volcanic sand, which is an extremely bad conductor of heat; thus the subsequent liquid lava might have flowed over the whole without affecting the ice beneath, which at such a height (ten thousand feet above the level of the sea) would endure as long as the snows of Mont Blanc, unless melted by volcanic heat from below.

*Herculaneum and Pompeii.*—But all these phenomena are far surpassed in interest by the wonderful preservation of the cities, which were overwhelmed by the first recorded eruption of Vesuvius. In the words of one of the most eloquent and philosophical writers of our times, "After nearly seventeen centuries had rolled away, the city of Pompeii was disinterred from its silent tomb, all vivid with undimmed hues; its walls fresh as if painted yesterday; not a tint faded on the rich mosaic of its floors: in its forum the half-finished columns, as left by the workman's hand; before the trees in its gardens the sacrificial tripod; in its halls the chest of treasure; in its baths the strigil; in its theatres the counter of admission; in its saloons the furniture and the lamp; in its triclinia the fragments of the last feast; in its cubicula the perfumes and the rouge of faded beauty; and every where the skeletons of those who once moved the springs of that minute, yet gorgeous machine of luxury and life."

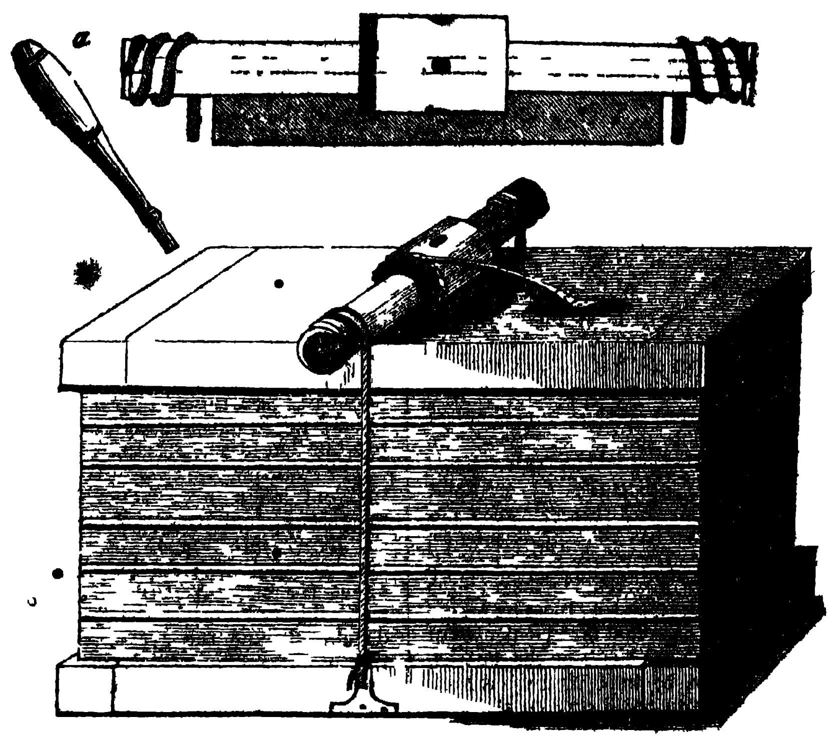
The cities of Herculaneum, Pompeii, and Stabiæ, were buried beneath an accumulation of ashes and scoriæ, to a depth of from sixty to one hundred and twenty feet. No traces have been perceived of lava currents or of melted matter; showers of sand, cinders, and scoriæ, with loose fragments of rocks, were the agents of desolation. The various utensils and works of art, as you may observe in the lamps, vases, beads, and instruments in the museums, exhibit no appearance of having suffered by the action of fire. Even the delicate texture of the papyri appears to have sustained more injury from the effects of moisture and exposure to the air than from heat. In Pompeii, the sand and stones are loose and unconsolidated; but in Herculaneum, the houses and works of art are imbedded in solid tuff, which must have originated either from a torrent of mud, or from ashes moistened by water. Hence statues are found unchanged, although surrounded by hard tuff, bearing the impressions of the minutest lines. The beams of the houses have undergone but little alteration, except that they are invested with a black crust. Linen and fishing-nets, loaves of bread with the impress of the baker's name; even fruits, as walnuts, almonds, and chestnuts, are still distinctly recognisable. The remarkable preservation, for nearly 2000 years, of whole cities, with their houses, furniture, and even the most perishable substances, beneath beds of volcanic rocks, may be compared to those geological changes, by which the forests of an earlier world, and the remains of the colossal dragon-forms which inhabited the ancient land and waters, have been perpetuated.

(*To be continued.*)

## VARIETIES.

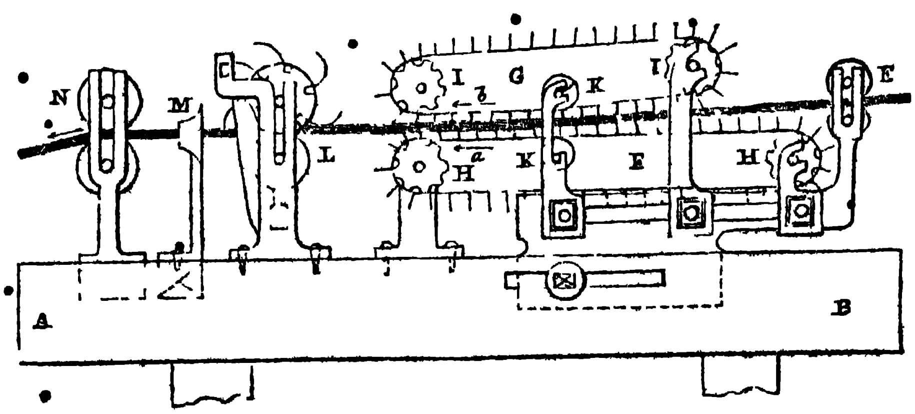
*Patent self-adjusting Ruler.*—The round common rulers necessarily soil the paper upon which the pen acts, by transferring the ink to it. To obviate this inconvenience, a Mr. Schlesinger has invented a ruler which he very properly calls self-adjusting, in which the revolving part is concealed under a brass barrel, so that the pen slides and leaves the ruler perfectly clean and free from ink. This improvement is so manifest, not only for the advantage it affords in point of cleanliness and the superior accuracy it gives in parallel ruling, but for the speed with which it is used in shading drawings. On the side opposite the brass barrel is a scale for pencil ruling, divided into inches and parts, and true as a parallel ruler.

*Photographic Bank Notes.*—It is said that an American gentleman has succeeded in making perfect imitations of bank notes by the photographic process, the plates being converted into permanent engravings. He supposes that the counterfeit £100 notes of the Bank of England recently put into circulation in Paris were fabricated by these means; and the only precaution which he can suggest as likely to be effectual, is to have the bill crossed with a variety of strong colour.




APPARATUS FOR DRYING PLANTS.

*Fig.* 1, *Worsted Spinning, page* 324.




WORSTED MANUFACTURE.

## APPARATUS FOR DRYING PLANTS.

The following is a description and use of an apparatus, of which we present a drawing, for drying plants.

Blue and white, or blue and red papers are employed; the use of colours being to distinguish where specimens are placed. Commence with a layer of six or eight sheets of blue paper, then one sheet of red or white, over which the recent specimen is placed and covered with another sheet of white, then several sheets of blue, and so on. When a sufficient quantity has been built up, one of the boards, heated on both sides before a fire, should be placed on the pile to serve as a base for another series of strata, which series is prepared before placing the heated board on the former, so that the plants above it have all the benefit of its heat; by interposing these heated boards at intervals, the plants dry much better and lie more flat. The lowest stratum under one of the boards may be made a store place for unmounted specimens, not that that plan is recommended, as all should be mounted as soon as possible, but only for the accommodation of one whose time is limited. The three usual modes of drying plants for a hortus siccus are liable to objections: first, the placing them between papers with a weight on them has this inconvenience, that where you place them there they must remain, or you stand the chance of disarranging them;—the second method, namely, compressing them by means of boards and straps, has the inconvenience of throwing all the weight on the edges of the boards, and the packages cannot be kept tight; but for a person taking a journey and botanizing on the way, this mode is the most convenient; the third method, the employment of a standing screw press, takes up much room, and having no elasticity, it will not modify the pressure to the plant, but presses unequally, and the trouble is greater in amount than in the press just described, which is unfastened and refastened in a moment, and may be moved anywhere, being nearly as portable as the boards and straps; and the cords render it almost as elastic as the weights and boards, &c. It is capable of compressing any plant that it may be necessary to place in it.—*Pharmaceutical Journal.*

---

## ELECTRO METALLURGY.

*On the Apparatus to be employed for the Reduction of Metals.*

Electro-metallurgy depending essentially on galvanic agency, is subject to the operation of the same principles, and governed by the same laws which have already been laid down in the book which treats of galvanism and galvanic batteries; the successful reduction, therefore, of the metals must depend entirely upon a thorough knowledge of galvanism, and galvanic apparatus. We should recommend our readers then, before they enter upon this department, to make themselves thoroughly conversant with the nature of the implements with which the operations are to be performed.

Independently, however, of these general galvanic properties already adverted to, there are certain particular ones appertaining either to the different metals, or to the different qualities of the same metals, which have to be considered in detail, as well as the apparatus to be employed for precipitations.

The idea of electro-metallurgy appears to have been first suggested by the use of Professor Daniell's battery, for during its action the outer copper vessel, which is the negative metal, becomes coated with an additional layer of metallic copper; hence, as this new deposit is placed in close opposition to the vessel, a cast is produced. If we call to mind the construction of the battery, we see that it consists essentially of two vessels, the inner being porous, and containing dilute sulphuric acid, while the outer contains the solution of sulphate of copper, and the negative metal.

If sulphate of zinc be present in a solution of sulphate of copper, the texture of the copper has been described by many authors to be so brittle as to be crumpled up in the hand. For this reason the nature of the porous tubes ought to be such as to preclude the possibility of the salt of zinc, which is produced by the chemical solution of the zinc, being mixed with the sulphate of copper. The effect of the salt of zinc in causing the brittleness of the copper appears, from my experiments, to be altogether overrated, and though it would be undoubtedly preferable to prevent, as far as possible, the mixing of the solutions, yet I am not prepared to state that it is of any material consequence.

The substance best adapted for the separation of the solutions in an electrotype apparatus, is animal membrane, though a coarse gold beater's skin, from the larger intestine of the ox, or a thin bladder may be used with impunity, provided they are about the same texture. The more porous this vessel is, the greater the quantity of electricity developed, and the greater, therefore, the quantity of copper deposited, as the amount of deposit is always in relation with the quantity of electricity generated. The following is the order in which different substances stand with regard to their capabilities of admitting the passage of electricity:—

Brown paper
Thin plaster of Paris
Gold-beater's skin
Bladders of various thickness
Thick plaster of Paris.

Of the various forms of apparatus which may be used for the precipitation of the metals, the most simple is Daniell's battery, having a porous earthenware tube, to contain the acid and zinc, whilst the cast is placed externally to this, and connected by a piece of wire to the zinc. Thus, for instance, take a pound pot and half fill it with a solution of sulphate of copper; in this, place the earthen vessel with the acid and zinc, and this constitutes the whole of the present form of apparatus; for when we desire to make an electrotype, it is only necessary to place the cast in the outer vessel connected with the zinc, and then action will immediately commence. Saturation of the liquid may be preserved by suspending some of the salt in a linen bag over the mould. This form is objectionable, because the salt of zinc speedily passes through to the outer vessel; but it has the advantage of allowing the mould to be placed vertically, in which position it is much less liable to have particles of dust settling upon it.

There is another form where bladder takes the place of the earthen vessel, and where the position of the cast is horizontal. Here the outer vessel, which is square, is made of wood, coated internally with cement, on one part of the edge of which a piece of brass is fixed in which are two holes, one for connection with the wire of the cast, the other for that of the zinc of the battery. In the interior of the trough a moveable shelf of mahogany is placed, on which is supported a glass containing a zinc plate and crystals of sulphate of copper to be dissolved. The glass has a piece of bladder tied over the rim, and this forms an outer vessel similar to the porous tube in the former apparatus. It in like manner contains the acid and zinc, the latter being connected by a screw to a wire, in such a way that it can be readily removed. This apparatus is preferable in many respects to that first described, because the sulphate of zinc cannot pass through the membrane readily to the copper, and facilities are offered for changing the zinc and acids, &c. In this apparatus care must be taken that the mouth of the glass be wide enough to afford a radiating point from the zinc to every part of the cast; want of attention to this would be attended with inconvenience. The only circumstance to be observed is that the zinc be equidistant at every place from the metal on which the reduction of the new metal is to be effected, so that the deposit may be every where equally thick.

The solution, in every single cell apparatus, should be acid, and the solution of the metallic salt ought to be maintained in the required degree of concentration by keeping some crystals of the salt undissolved in the solution. If these crystals are allowed to sink to the bottom of the vessel, they will not answer the intended purpose of maintaining a saturated solution; for the portions of the fluid which have been deprived of their metallic salt rise to the surface, while the saturated parts remain in contact with the crystals at the bottom, thus preventing their solution. This difficulty may, however, be readily overcome by placing the crystals to be dissolved in a little bag on a shelf at the top of the liquid, by which means the saturation of the fluid will be ensured.

Another form might be made by dividing a box into two compartments by a flat porous slab of earthenware, similar in composition to the porous tubes of a Daniell's battery. Into one compartment the solution of sulphate of copper and negative metal is to be put, and into the other dilute sulphuric acid. The advantage of this apparatus would consist in the facility gained in the manipulation, and for the arrangement of the zinc and copper, so that they may be at every place equidistant from each other—a circumstance of great importance in the manufacture of large plates, which may thus be accomplished with ease. The porous diaphragm might be exchanged for a more ready but less durable one of plaster of Paris, paper, or bladder.

Other forms may suggest themselves to the operator, for in whatever way a Daniell's battery is constructed, a similar form will equally answer for the electro-metallurgist.

(*To be continued.*)

## THE SLEEP OF PLANTS.

**This is a condition of vegetable individual life, which is not strictly analogous to sleep in animals, but presenting some of its phenomena; naturalists desiderating an appropriate word, have given it the name of *sleep*. Linnæus, with that exility of mind which distinguished him among his contemporaries, was the first to observe it. Nor do we wonder at it. Flowers were his playthings, physical objects his companions, and nature his instructor. He delighted to roam over meadows, and saunter through groves; or, reclining on the banks of some meandering stream, to picture to himself the loves of the flowers, imagine their infœtation, depict their growth, and calculate their maturity. Hence he observed that several families of plants, wearied with the labour of assimilation, or dumb with the turbulence of light, at stated periods, folded their leaves or leaflets upon themselves, and sunk into an indolent repose, or, as botanists describe it, bending the leafstalk upwards or downwards, elevated or depressed the flattened surface of their leaves. "This," he exclaimed, "is the sleep of plants." Of those which are usually quoted as possessed of this property, we may mention the oxalis, hedysarum, gyrans, the campion tribe, tragaponum luteum, convolvulus, marvel of Peru, broom, tulip, and dianthus. In tropical climates most plants appear to sleep, but that which is particularly distinguished for this property of repose, is the *mimosa sensitiva*, or sensitive plant of Jamaica. In the northern parts of that island, especially about Lucca, in May or June, it may be seen in prodigal profusion, overrunning entire acres. In this district, about noon, or when the sun sheds what Goldsmith calls "intolerable day," you will observe a vast surface covered as it were with dead plants, while the luxuriant Bahama grass, sending up its tiny blades on every side, and through every available interstice left by the collapsed mimosa's little leaves, looks the hot sun boldly in the face. This is the sleep of the "dead-and-awake"—the negro name for the plant. The duties of organization have fatigued—the exsiccative heat of the sun has exhausted it, it has laid its leaflets on the pillow of the footstalks, to sleep away the burning noon! But when the red sun shall sink behind the lofty summits of the deep green hills, and the languid sea-breeze decline upon his ocean-couch, the Spirit of the Land-Wind will arise redolent with the perfume of the pimento, the jasmine, and the night-sweeting wild pine, and touch gently with his balmy lips his slumbering bride. Then the leaflets will lift up their heads again, the footstalks extend their fairy limbs, and the orb-like flowers awake, look out, and welcome back their truant love! Such is the order of repose and slumber of the mimosa.—*Dr. Binn's Anatomy of Sleep.***

## BAIN'S ELECTRO-MAGNETIC PRINTING TELEGRAPH.

**This extraordinary piece of mechanism is now in practical operation between the Nine Elms and Wimbleton stations, on the South-Western Railway. Its purpose is, says the *Atlas*, "to instantaneously convey and *print* any message that is required to be transmitted from one place to another, no matter how remote the distance." By way of facilitating our readers' comprehension of this, beyond question one of the most beautiful existing specimens of inventive art, we shall consider it first and separately in its *mechanical* aspect. And this will be greatly assisted by comparison with a clock, to which, in many respects, it bears a close analogy. It has, then, in one frame, two distinct trains of wheel-work—to be likened to the going and striking parts of a clock—each set in motion by a weight and line of its own, and the second of which (again as in the instance of the clock) is restrained or permitted to move by a detent under the control of the first. This first train is connected with a revolving pointer travelling over a dial, on which are marked the nine simple numerals, a cipher, and a space or full stop. Connected also with this train is a *type-wheel*, on the periphery of which are the same nu-**

merals, cipher, and space that are engraved on the the dial, and the rotation of which is synchroneus with that of the pointer above mentioned; the starting points of each being so pitched that whatever be the number indicated on the dial, that number will be presented by the type-wheel to the paper destined to receive the impression. To this we have only to add, that the speed of these parts is regulated by a fly, made precisely similar to the 'governor' of a steam-engine (but which also performs a most important duty, to be presently mentioned), and our description of the office of the first train is complete. The function of the second train of wheels is to *print* the result indicated by the first; and this is most beautifully contrived. The type-wheel, before mentioned, is so centred as to allow of its being thrust bodily forward, independent of its rotatory motion. To a collar round its arbour are attached two steel rods, extending across the machine, and abutting against a strong spring, the uncontrolled action of which would be to keep the type-wheel in contact with the paper to be printed. During the inactive state of the second train, however, the type-wheel is restrained, and the spring held in tension by a projecting piece on the connecting-rod, resting on the largest part of a *snail* on the main arbour of the train. This second *train* is only put in motion on the stoppage of the first; and its action is, first, by the rotation of the snail to the extent of the sixteenth of an inch, to suddenly release the spring, and allow the type-wheel to be forcibly pressed on the paper; and, secondly, by the completed revolution of the same part, gradually to draw back the type-wheel and recompress its spring in readiness for another impression; whereupon further motion in this train ceases. It is by no means the least felicitous contrivance of the whole machine, that the 'governor' which regulates the speed of the first train operates on the detent of the second. The usual collar on the governor-shaft descending with the balls on the cessation of motion, strikes on the tail of a lever which disengages the detent of the second train, and puts in motion the printing apparatus before described. To complete this general view of the mechanism of Mr. Bain's telegraph, it is only necessary to add, that the paper to be printed is wound round a cylinder rotating and traversing spirally upwards on a perpendicular screwed shaft; and that between the types and the paper is interposed one side of an endless blackened ribbon, to which progressive motion is given by the machinery, and which not only renders the type-impression visible on the paper, but, by its firm pressure on the cylinder, imparts to the latter the rotatory motion necessary for its reception of any continuous series of characters.

"Omitting all more complex details, it will be readily seen from the foregoing description that one machine being placed at Nine Elms, and another similar one at Wimbledon, and a power whereby an operator at one station can put in motion and stop the *first train* during any part of the revolution of its pointer at the other station, any combination of figures, referring, of course, to determined sentences, can be interchanged and printed with the rapidity of thought. The power employed is galvanic electricity, and the method of its application is as simple as beautiful and efficient. In the machine before described, a magnetic needle of peculiar form is suspended within the sphere of influence of two electro-condensing coils. Any change in the electrical condition of these coils causes, in accordance with the discoveries of Oersted, a deflection of the magnetic needle, which motion, in turn, is made to disengage the fly of the first train of wheel-work. The motion of this, of course, continues until the former electric state of the coils is restored, when the needle again traverses and arrests the motion of the train, whereupon, by the contrivances already detailed, the second train is set at liberty to print that particular figure at which the pointer was brought to rest. Practically to effect these changes, both machines, with their coils and needles, are placed in a galvanic circle, extending, of course, from Nine Elms to Wimbledon. No battery, in the ordinary sense of the term, is employed, Mr. Bain having discovered that a plate of copper buried in the ground at one end of the circuit, and a plate of zinc similarly placed at the other, with a connecting wire between them, are sufficient to excite electrical action—the moisture of the earth between the two plates, though six miles asunder, being abundantly capable of completing the circuit. Of this circuit so established, the two machines are made portions by the usual mode of connexion. The method of making and breaking contact at pleasure is too familiar to need description; but it must be mentioned, as a peculiarity of this telegraph, that the current of electricity being constant, the mechanism of the apparatus is so arranged as to be detained in a state of rest while the electrical circuit is complete, and to be set at liberty by the breaking of contact."

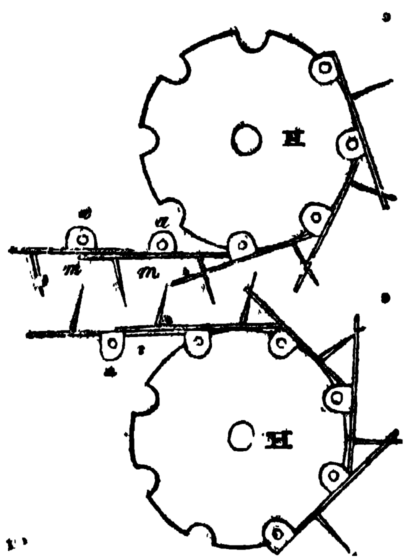
## WORSTED MANUFACTURE.

(*continued from page* 318.)

The *breaking-frame* is the next machine in the worsted manufacture, and is, in fact, a continuous form of comb or card, called by the French the *defeutreur*, from its opening out any felted fibres. Fig. 1 represents a vertical section of a breaking-comb, for the purpose of explaining the principles of its action. A B is a frame for carrying the machines, of which there are usually four alongside of one another, each from four to six inches broad. E is the front or feeding pair of rollers, three inches in diameter, the upper one bearing by a weight suspended to its axis on the under. F is the continuous lower comb, moving in the direction marked by the arrow *a*. G, the upper comb, going with the same velocity as the lower, in the direction indicated by the arrow *b*. The rows of teeth slope gently forward, and alternate with the teeth of the other comb; thus the row of the one corresponds to the middle of the two other rows. H are fluted cylinders, which cause the rotation of the endless chain of combs. I, counter cylinders, fluted in like manner. The forked bearings in which these turn are so mounted as to permit the comb-chain to be stretched. K, small tension cylinders, for giving a proper direction to each comb. L, the second pair of rollers, which takes the wool from the combs. These rollers are like the first, made of wood, and of the same diameter. The under one of this pair is kept clean by a brush. On its axis the fast and loose power pulleys are fixed, which give motion to the whole machine. The upper roller is furnished with wiper-wings; that is, its surface is covered with a series of small leaves of parchment, held by one of their edges with little clamps, or keys, in grooves cut lengthwise on their surface. The same cylinder is firmly pressed down on the lower one by a loaded steelyard.

The speed of the first pair of rollers is to that of the second as one to four, and the velocity of the comb-train is the geometrical mean between them, or two. Too great a velocity in these parts would be apt to knot and felt the wool; and it must not therefore exceed above five or six inches in a second. M is a copper funnel, or trumpet mouth, for conducting the sliver delivered by the second rollers. N, the third pair of rollers, turning with a little more velocity than the second pair, only in consequence of having a diameter a little greater.

Fig. 2.




Machine for Wool-Combing.

The comb of this continuous machine is formed of a series of small rectangular pieces of tin plate, hinged together, the half one overlapping that of the other like slates on a roof, as is shown in figure 2, in double size. These pieces are struck out by a punch, which leaves at their four corners little discs a, a, which are afterwards bent back to a right angle by a pair of plyers, and which serve to make the hinge joints, as is plainly shown in the figure. While the chain is advancing in a straight line, the teeth *m*, *m*, soldered to the lower tin plate, present the whole of their projection, minus the thickness of the upper plate, which is here cleft; but in proportion as these plates come upon the fluted cylinders H, fig. 2, which drive them, the plates cease to lie flat on each other, and become inclined by the curvature of the cylinders. The part cut through for the passage of the teeth recedes, or turns out of the way, and thereby passes by the extremities of the teeth *m*, *m*; thus getting disengaged from the fibres of the wool, and allowing them to be immediately seized by the second pair of rollers. In this way each piece of tin-plate acts both as a tooth and a disengaging bar. It is obvious that the upper and the lower combs, during their parallel progress, by means of their alternate rows of teeth passing between each other, like the fingers of our two hands, perform a double combing at a single stroke upon the cardings introduced in pairs at the feeding-rollers.

The sliver delivered by the roller N, fig. 1, proceeds next to a large bobbin or cylinder, round which it is lapped, till the whole combing is entirely wound up. It is again passed through another chain-comb like the preceding, furnished with finer and closer-set teeth; and in this process the s... is doubled, to give greater uniformity to the f...

The person who attends this machine, ... a young boy or girl, is called the feeder, ... ness is to weigh the wool, and spread it in ... quantities on a travelling apron, which feeds the first pair of rollers. The attention of the feeder is necessarily invariable while the engine is at work, as the uniformity of the thread finally produced depends, in no small degree, on his accuracy. The filam of wool, or open *drawing*, on its delivery from the last pair of rollers, is collected through a funnel mouth, and either lapped on a cylinder or received in a tin can, and broken off when the can is full. An empty can is then set in the place of the full one.

The machines for reducing, and at the same time equalizing, by doubling the *open drawings* of long wool, are constructed on the same principle as the drawing frame of a cotton-mill, only the distance between the first and last pair of rollers is much greater, on account of the greater length of the wool-staple. The drawing operation is performed by the first pair of rollers moving more slowly than the last pair, whereby the soft woolly riband is extended in length proportionably to that difference of velocity.

Hitherto, no degree of torsion has been given to the slender fillet; but a little twist must now be introduced to preserve its cohesion, in its progression towards the state of a fine thread.

*(To be continued.)*

## THE COTTON PLANT AND ITS CULTIVATION.

(*Continued from page* 319.)

"When heated in the matrass, a striking difference appears between this and the American soils in the *total absence of any trace of lignite or peaty matters!* It gives out nothing but pure water, with scarcely any smoke or smell, and with no effect whatever upon the silver foil and litmus paper enclosed in the tube. In calculation too its darkest appearance is a dull lead colour; and, as will be seen, its vegetable matter does not exceed two per cent.

The proportion of lime, however, is far above that of the American soils, being 12 per cent., while the highest of these is only 4 per cent. The silex too is in this in the state of a fine powder as before alluded to, evidently showing it to have been derived from the *decomposition*, and not from the *disintegration* of rocks. 100 parts of this soil gave—

| | | Dr. Spry from a Quobuda soil. |
|---|---|---|
| Extractive matter with a trace of carbonate of soda | 0·33 | 2·15 |
| Vegetable matter with a little water .. .. .. .. .. | 2·00 | |
| Iron *deutoxide* .. .. .. .. | 7·00 | 6·05 |
| Carbonate of lime .. .. .. | 11·90 | 8.25 |
| Alumina .. .. .. .. .. | 3·10 | 4:40 |
| Silex .. . .. .. .. .. | 74·00 | 73·15 |
| | 99·08 | 94·00 |
| Water and loss . | ·92 | 5·00 |
| | 100. | 100 |

Coimbatore, or *Oopum* cotton soil, considered one of the best for this crop in southern India, Mr. Piddington states to be like the last, black in color and tenacious in consistence, but modified in this respect by the intermixture of felspar and silex. This gravel was about one-eighth of the whole. The examination of it gave in 100 parts—

| | |
|---|---|
| Vegetable matter with a little water .. | 2·3 |
| Saline matter (muriate of lime) no potass or sulphate present .. .. .. .. | traces. |
| Carbonate of lime .. .. .. .. | 7·50 |
| Magnesia .. .. .. .. .. .. | traces. |
| Iron, protoxide .. .. .. .. .. | 4.00 |
| Alumina .. .. .. .. .. .. | 2·80 |
| Silex, .. .. .. .. .. .. .. | 82·80 |
| | 99·40 |
| Loss .. .. .. .. .. | 60 |
| | 100. |

The Tinnivelly soil found best suited for the growth of the Bourbon cotton plant, looks like a mixture of lime rubbish and yellowish brickdust, and is intermixed with nodules of kunkur. One half only passed through the scarce, and 100 parts of this contained—

| | |
|---|---|
| Extractive (Geine ?) and saline matter, (this last muriate of lime and sulphate of soda) .. .. .. .. .. .. | 0·20 |
| Vegetable matter .. .. .. .. .. | 0·15 |
| Iron peroxide (and some carbonate) .. | 2·88 |
| Carbonate of lime .. .. .. .. | 19·50 |
| Magnesia .. .. .. .. .. .. | 0·15 |
| Alumina .. .. .. .. .. .. | 2·00 |
| Silex .. .. .. .. .. .. .. | 74·00 |
| | 98·88 |
| Loss .. .. .. .. | 1·12 |
| | 100· |

One of the best cotton soils of the Mauritius, near the sea-shore, is thus described by Mr. [illegible]ington. "This also is quite different from the [illegible]s, I mean of a different *class*. Its appearance is that of a dull black soil, intermixed with a very large proportion of white fragments, small and large, some appearing to be remains of shells, but most of rock. There is also a considerable number of dark-coloured pebbles, rolled and in fragments, which seem to be portions of the soil indurated by iron, and much resemble minute nodules of kidney iron ore. There are also fragments of vegetable remains, having somewhat the appearance of brown lignite.

When agitated with cold water, it discolours it almost as much as the Sea Island cotton soil, and like it too, a part is a very fine dark brown powder, slowly settling. When heated in a matrass it gives out a faint peaty odour, but of a more earthy kind than the Sea Island, and the test paper and silver foil are not discoloured by it. Upon calcining it blackens very considerably, when sifted, about one-third is coarse gravel, of which at least three parts are calcareous fragments, the remainder the indu[illegible] nodules, &c., and fragments of lignite described [illegible]e. The saline matters, which were less abund[illegible] than would have been looked for in such a situation, were only muriates of soda and lime, without any sulphate or potass. The examination of this soil showed it to contain, in 100 parts—

| | |
|---|---|
| Saline and extractive matter, the salts muriate soda and muriate lime .. | 0·60 |
| Vegetable matter .. .. .. .. .. | 1·75 |
| Iron (protoxide) .. .. .. . | 9·15 |
| Carbonate of lime.. .. .. . | 40·85 |
| Magnesia .. .. .. .. . | trace. |
| Alumina .. .. .. .. . | 250 |
| Silex, mostly coarse grained.. . | 43·60 |
| | 98·15 |
| Water and loss .. .. | 45 |
| | 100 |

A specimen of the best Singapore cotton soil was also examined by Mr. Piddington. He describes its appearance as very remarkable; "it consisted apparently of large coarse grains of white sand, mixed with coarse charcoal dust and fragments of vegetables, and mosses of all sorts, being in fact, as to appearance, what we might suppose the Sea Island soil to be before it was reduced to a finer state. When sifted, indeed, it almost exactly resembles the Sea Island soil, except that the sand being white renders the contrast between it and the carbonaceous dust more striking. About one-third of it was coarse silicious gravel, without felspar or fragments of shells, and with a few remains of carbonised wood, roots, and moss intermixed with it. I found 100 parts of it to consist of—

| | |
|---|---|
| Vegetable matter, mostly peaty .. .. | 9·15 |
| Saline and extractive, the saline matter being only traces of sulphate and muriate of potass .. .. .. .. .. | 0·60 |
| Iron, traces, say .. .. .. .. .. | 0·25 |
| Carbonate of lime.. .. .. .. .. | 1·25 |
| Silex, almost wholly coarse grained .. | 88·20 |
| Water and loss .. | 0.55 |
| | 100· |

This soil is instructive in other points of view, for the absence of iron shows us that this is *not* essential in soils to the production of good cotton, and the very minute traces of saline matter confirm the same remark as made upon the first analysis, viz., that these, too, are not of primary importance. We find also that the carbonate of lime is in such a very small proportion, that we may consider this soil as a mixture of silex and vegetable matter, the latter being in a very soluble state.

*(To be continued.)*

## VOLCANOES.

*(Continued from page 320.)*

*On the Nature of Geological Evidence.*—The following is the admirable manner in which Professor Silliman has illustrated the principles of geological induction, by a reference to the discovery of the buried Roman cities.

"When in 1738," he observes, "the workmen, in excavating a well, struck upon the theatre of [illegible]eum, which had been buried for seventeen [illegible] beneath the lava of Vesuvius; when subse[illegible] (1750) Pompeii was disencumbered of its ashes, and thus two ancient cities were brought to light; had history been as silent respecting their existence, as it was of their destruction, would not all observers say, and have not all actually said—Here are the works of man, his temples, his houses, furniture, and personal ornaments; his very wine and food; his dungeons, with skeletons of the prisoners chained in their awful solitudes, and here and there a victim overtaken by the fiery storm? Because the soil had formed, and grass and trees had overgrown, and successive generations of men had erected their abodes over the entombed cities, and because these were covered by lava and cinders, —still does any one hesitate to admit that they were once real cities; that they stood upon what was then the surface of the country; that their streets once rang with the noise of business; their halls and theatres with the voice of pleasure; and that they were overwhelmed by the eruptions of Vesuvius, and their places blotted out from the earth and forgotten? These inferences no one can dispute—all agree in the conclusions to be drawn. When, moreover, the traveller sees the cracks in the walls of the houses of Pompeii, and observes that some of them have been thrown out of the perpendicular, and have been repaired and shored up with props, he infers that the fatal convulsion was not the first, and that these cities must have been shaken to their foundation by the effects of previous earthquakes. In like manner the geologist reasons respecting the physical changes that have taken place on the surface of our globe. The crust of the earth is full of crystals and crystallized rocks; it is replete with the entombed remains of animals and vegetables, from mosses and ferns to entire trees—from the impressions of plants to whole beds of coal. It is stored with the remains of animals, from the minutest shell-fish to the most stupendous reptiles. It is chequered with fragments, from fine sand to enormous blocks of stone. It exhibits in the materials of its solid strata every degree of attrition; from the slightest abrasion of a sharp edge or angle, to the perfect rounding which produces globular and spheroidal forms of exquisite finish. It abounds in dislocations and fractures; with injections and filling up of fissures with foreign rocky matter; with elevations and depressions of strata in every position, from the horizontal to the vertical. It is covered with the wreck and ruin of its former surfaces; and, finally, its ancient fires, although for a while dormant, have never been wholly extinguished, but still find an exit through volcanic mouths. When we reflect upon these phenomena, we cannot hesitate to infer that the present crust of the earth is the result of the conflicting energies of physical forces, governed by fixed laws; that its changes began from the dawn of the creation, and that they will not cease till its materials and its physical laws are annihilated."

*Basalt, or Trap.*—We now come to the consideration of *Whin*, *Trap*, *Basalt*, and *Clinkstone*; terms which designated the different varieties of an ancient volcanic rock. Basalt occurs sometimes in veins or dykes, which traverse rocks of all ages, filling up fissures or crevices; and at others, in layers spread over the surface of the strata, or interposed between them. Many modern lavas differ so little from basalt, that it is unnecessary to adduce proof of the volcanic nature of this rock. It often occurs in the form of regular pillars or columns clustered together; or, in scientific language, has a columnar structure, a character also observable in some recent lavas. This structure is found by some highly interesting and philosophical experiments, to have originated from the manner in which refrigeration took place. Mr. Gregory Watt melted seven hundred weight of basalt, and kept it in the furnace several days after the fire was reduced. It fused into a dark-coloured vitreous mass, with less heat than was necessary to melt pig-iron; as refrigeration proceeded, the mass changed into a stony substance, and globules appeared; these enlarged till they pressed laterally against each other, and became converted into *polygonal prisms*. The articulated structure and regular forms of basaltic columns have therefore resulted from the crystalline arrangement of the particles in cooling; and the concavities, or sockets have been formed by one set of prisms pressing upon others, and occasioning the upper spheres to sink into those beneath; thus the different layers of spheres have been articulated together, as in the basaltic columns of the Giants' Causeway.

Proofs of the correctness of this inference are afforded by the occurrence of basaltic fragments, in which a sphere is enveloped by a polyhedral figure; and from the fact, that when basalt is not divided into regular prismatic colums, it often forms laminated spheroids, which varying in size, constitute by aggregation extensive masses of rock.

*(To be continued.)*

---

## THE LAKES AND BOILING SPRINGS OF ROTORUA, NEW ZEALAND.

***From Simmond's Colonial Magazine.***

By a correspondent of the *Southern Cross*, a New Zealand paper published at Nelson,

Towards the base of Mount Edgecombe, and for two-thirds of its height, the character of the soil changes and becomes of the richest description, being made of decomposed volcanic ashes. Mount Edgecombe is in itself a beautiful object, and the numerous lovely valleys at its base afford the most splendid situations for vine-yards, that I have ever seen in this or any other country; if ever there was a country adapted for the cultivation of the vine, it is surely this—soil, situation, and climate, all combine to render it the proper habitation of the grape. From Mount Edgecombe the road leads through a desolate pumicestone valley thirty miles in length This dreary region, together with the savage natives who inhabit it tends not a little to impress upon the lonely traveller that he has actually entered the valley of the shadow of death itself. The sight of a magnificent forest, ten or twelve miles in length, with its evergreen and stately pines, will, however, enable him to go through this dreary valley, together with the prospect of being able to bathe his wearied limbs in the luxurious baths of Rotorua, to whose picturesque shores and health-giving waters this forest leads. Rotorua is, as you are aware, a lake about ten miles long, and eight miles broad; its superfluous waters find their way to Makuta by the river Rotoiti. I wish I could give you anything like an adequate idea of the beauty and loveliness of the scenery in this part of the country; it abounds in all that you have seen or fancied of the wild and magnificent, combined with the still simpler and tamer, but no less beautiful landscape.

The character of the country is very peculiar, and, I think, decidedly Eastern. But to you, as a medical man, the mineral waters, and hot springs and baths, which surround the great pah of Ohinemutu, will be a subject of greater interest; though, were their health-giving and healing powers sufficiently known, I cannot for a moment doubt the deep injury to the medical profession. Nature has here supplied the simple and appropriate cure for all "the ills that flesh is heir to;" and, not only are the means of cure supplied, but this happy region forbids the approach or the appearance of disease.

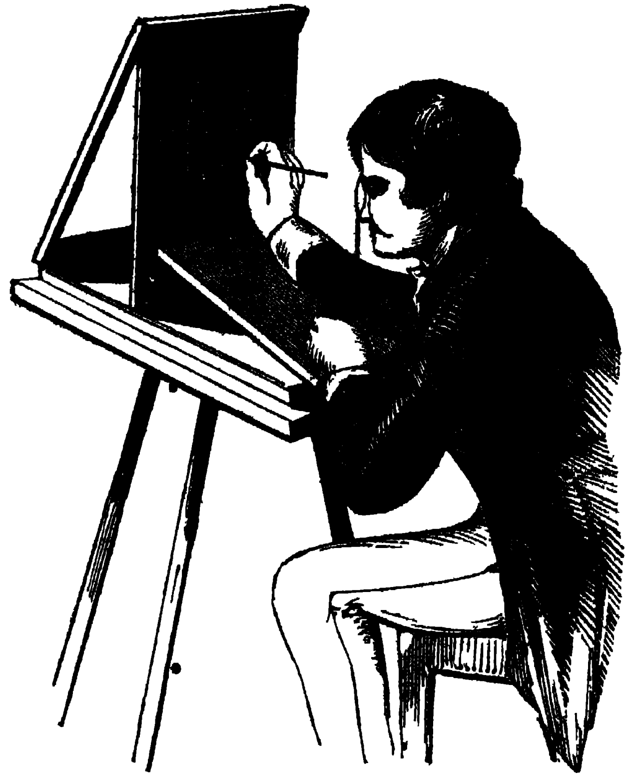
The natives are not only healthy, but they are also the strongest, the best made, and the cleanest in all New Zealand; and such are the virtues of these waters, that, like the pool of Siloam, the halt, the maimed, the lame, the blind, and the leper, are conveyed to them from the most remote parts of New Zealand. Scrofula, and certain other prevailing cutaneous diseases, are perfectly unknown among the inhabitants of Rotorua. They luxuriate from morning till night in their baths, which are made by nature, of any suitable temperature. But though the natives thus indulge in the bath with impunity, a stranger could not remain in it for a longer period than ten minutes. I had often suffered from rheumatism before I came to Rotorua, but the tepid bath soon removed all the symptoms, and restored me to my usual state of health. Some of these springs are strongly impregnated with sulphur, others saline, tasting much of Epsom and Glauber salts; others again are decidedly alkaline, so much so, that a cloth soiled with any unctuous substance, becomes soapy when washed in the water. I had no means of testing either their strength or their qualities, but I found that they affected silver differently. In some of the springs it was coloured black, in some yellow, and in others blue. The natives cook all their provisions in the hot springs; potatoes take about fifteen minutes; to a stranger they have at first a peculiar taste, but to this he gradually becomes reconciled and even insensible. I have remarked that the teeth of all the natives are black, but not permanently so, as I have discovered by some of them who accompanied me to Port Nicholson, whose teeth became as white as those of any other person before their return. So fond are they of the bath, that every family has one for its own peculiar use. These baths are in general neatly lined with stone. In consequence of this subterranean action of fire, air, and water, the temperature of Rotorua is considerably high: so much so is this the case, that the natives even in the winter time use no fires, but in cold weather betake themselves to an open space in the centre of the *pah*, whose heat is sufficiently high to render them comfortable during the coldest weather. In this place they squat with their blankets over their heads.

The hot springs are not confined to one or two places, but are so numerous that it is dangerous for a stranger to walk about without a guide; at least if he does he runs a great risk of scorching the soles of his feet. In attempting to wade through one of the rivers, I had my foot very severely scorched from a hot spring in the bottom of the river, which is itself not only cold, but of considerable size. The water rises in some of the springs to the height of fifteen and twenty feet in regular jets, others emit steam like a high-pressure engine. The natives say that the waters rise higher during westerly winds, and fall with the easterly; but this I had not the means of ascertaining the truth of, nor can I understand why it should be the case. The country in the neighbourhood of Rotorua is exceedingly picturesque. Besides Rotorua itself, there are several other beautiful lakes, such as Rotoiti, Kokatina, and Rotoihu. This would be a splendid place for old retired East Indians; it affords such lovely sites for houses, gardens, and vineyards, &c. &c., and what with rocks, woods, lakes, rivers, waterfalls, hot, cold, tepid, and vapour baths, together with the artificial luxuries of billiards, news-rooms, &c., the bilious-livered old gentlemen might enjoy themselves here much more than they can ever expect to do either in South Australia or at the Cape. The temperature is equable in this place throughout the year, though, unlike South Australia, it certainly never rises to 98° in the shade and 120° in the sun; and I am convinced the stagnant and nitrous waters of the Torrens, however strongly recommended by the disinterested Company, will never impart the health and vigour which the Rotorua waters bestow. Many an old dyspeptic lady in England, and gouty rheumatic gentleman, would bless their stars if they had an opportunity of drowning their blue devils in these springs. I am certain that, in a medical point of view, there is not a spa, or mineral water in England or Europe, whose virtues are half as efficacious as those of the Rotorua springs, affording as they do such a variety—chalybeate, sulphureous, saline, and alkaline, and each of these of every shade of temperature, from the cold to the steam or vapour bath.

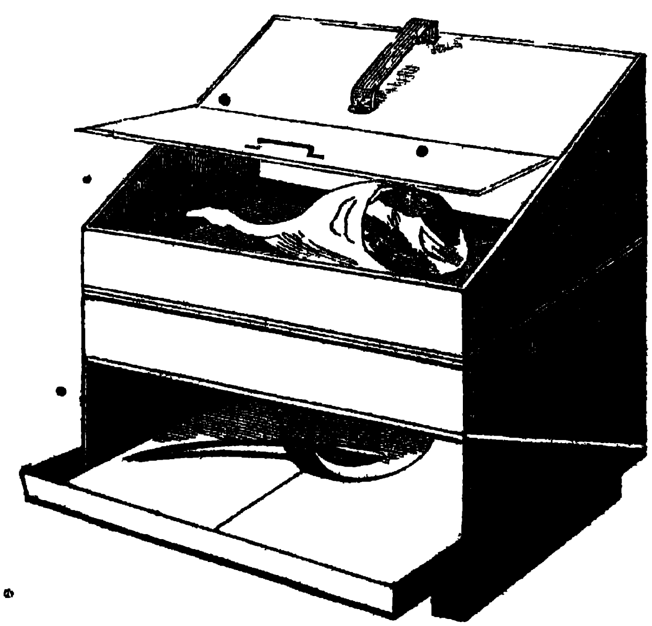
Leaving reluctantly the Rotorua country and its delightful baths, I travelled by Toupo over a fine and level country, thickly covered with grass, well watered, and admirably adapted both for sheep and cattle; indeed, more so than any other place that I have seen either in this country or in New Holland. This beautiful plain extends in one direction for fifty or sixty miles; in another, I could not discover its termination. The natives say the land is similar all the way to Ahuriri, in Hawks' Bay; and I should say from the appearance of the country they are correct. The country is perfectly level from Rotorua to within twenty miles of Cook's Straits, and were the woods cleared for twenty miles from Port Nicholson, say to Rangatiki, which is between Manawatu and Wanganui, there would not be the slightest difficulty in riding from Port Nicholson to Tauranga, or the Valley of the Thames; so that your project, or rather prediction some years ago, of the possibility of making a road from the Thames to Port Nicholson, is not only perfectly correct, but very easily practicable. Such a line of road would confer not only much benefit on each of the settlements, but would also be the means of bringing the natives of the interior into frequent and friendly intercourse with the European population.

## VARIETIES.

*Spontaneous combustion of Guano.*—Considerable alarm was excited on Saturday week, in the neighbourhood of the West India Docks, by the outbreak of a fire in the forecastle of the barque *Hand*, 150 tons burden, laden with a cargo of guano. When first discovered it was raging with fearful violence, and before the arrival of assistance, the destruction of the ship, and ignition of other craft appeared inevitable. Fortunately the fire was prevented from communicating with the rigging, but a quantity of cordage in the hold having ignited, and the guano being on fire, the stench was almost stifling, and the duty of the fireman was thereby rendered one of no ordinary difficulty. By three o'clock the mastery of the flames was complete, but the forecastle was burned out, and all the contents completely destroyed. It is fortunate that at the time of the outbreak no one was sleeping in the forecastle, as, from the peculiarly suffocating nature of the cargo during the process of combustion, the disaster might have been attended with loss of



LORIMIER'S PATENT TRANSPARENT PLANES



REFLECTING OVENS.—*Page* 333.

## LORIMIER'S PATENT TRANSPARENT PLANES.

An ingeniously contrived invention has just been brought before the public for facilitating the sketching of landscapes, &c., it consists of a medium sufficiently transparent to give a clear and distinct view of all objects beyond it, and which is at the same time adapted for the use of the pencil. By means of this instrument any person with but moderate skill will be enabled to trace correct representations of landscapes, &c. To architects, designers, schools, and teachers of drawing, and indeed all to whom correct outline, true perspective, and the reducing of drawings to any given scale, are objects of importance; this invention will be found especially useful.

## TO CLEAN PRINTS.

The following useful remarks are extracted from the Athenæum.

Under the head of "care of prints," it may be expected that something should be said of cleaning them. Prints which have existed for years, and perhaps centuries; transmitted from hand to hand, passing through auctions, exposed in shop windows, turned over again and again in dealers' folios, necessarily acquire an accumulation of the dirt of ages; and yet may not have had the ill luck to be actually stained or soiled, otherwise than by this gradual effect of exhibition and use. In such cases, the chief part of the soiling, thus acquired, may be removed by pure water merely. To effect this, the print is laid, face downwards, in a vessel large enough to admit of the whole paper lying flat; water, boiling hot, is then poured over it, sufficient to cover it to the depth of an inch, or more. The print is allowed to soak in the water more or less time, according to circumstances. By degrees, the dirtiness disengages itself from the surface into the water; the print is then taken out, and passed through fresh, clear water, and held or hung up, for the superfluous moisture to run from it; and, when this has sufficiently taken place, it is laid between sheets of white French blotting-paper, and covered by a thick millboard, weights being laid on it, so as to have the effect of a moderate press, and it is thus left till dry. Where there is much soiling to be removed, and of old standing, it may be allowable to use, gently and carefully, a soft hair brush, while the print is saturated with the water, to assist in the disengagement of the impurities.

## THE COTTON PLANT AND ITS CULTIVATION.

(*Continued from page* 326.)

The guarded conclusions which are drawn by Mr. Piddington from these researches, are—1st. That the abundance and fineness of good cotton depends on the quantity of carbon in the soil, and the solubility of that carbon. 2nd. That the next best soil is one containing carbonate of lime. 3rd. That the soil should not be too tenacious. "I have had repeated experience of this," he adds, "in Bengal; and on the Bombay side of India I observed, sometime ago, that a Parsee gentleman, Furdonjee Cowasjee, had partly failed, or experienced much loss, in some experiments in cotton, in consequence of the clayey nature of the soil, which retained too much moisture. In the West Indies, the years of drought are far the most favourable to the cotton crops, and the Singapore soils are instances of cotton growing in what might be called pure sand with vegetable matter; but we must probably make allowances in these instances for the vicinity of the sea." 4th. That it is preferable for the sand to be in coarse particles.

These conclusions, in all of which I cordially agree, sustained as they are by inquiries which I have made, and by a host of concordant testimonies that have been published, concur in establishing one fact beyond controversy, viz., that superior cotton requires a light porous soil for its production; and resting on a subsoil, permitting the easy escape of superfluous moisture.

Thus, writing from Tinivelly, Mr. Hughes states "that the red and brown loams, or indeed any silicious or calcareous soil, fertile in a moderate degree, is the most suitable and fruitful. That no very rich, heavy, retentive, stiff soils, should ever be selected, for though the plants are luxurious, yet they have as much and more tendency to produce redundance of wood and leaf than of fruit buds, besides harbouring insects." What is commonly known in many parts of India, under the denomination of ***black cotton soil***, Mr. H. states is to be entirely avoided.

From Persia we have similar information; for there, we learn, that cotton is chiefly cultivated on a silicious soil, containing shells, and consequently well supplied with calcareous matter. Again, Captain Robertson reported to the Bombay government that the Bourbon cotton succeeded very well in the eastern parts of Broach, in the light sandy soils, as recommended by the cultivators of the Isle of Bourbon.

The Agri-Horticultural Society of Bangalore reports that the light brown soil of moderate depth and rather sandy (so prevalent in Mysore) seems to be the soil that suits the Upland Georgia and New Orleans; but the Sea Island thrives in moist ground that is well drained. Captain Basil Hall says that for cultivating the New Orleans cotton, a soil rich, light, and dry is to preferred; but that it is generally thought *new* land does not produce a cotton so fine in *quality* as it does after bearing one or two crops of grain.

Mr. Ewart, speaking of his experience in the cultivation at Guzerat of Bourbon cotton, or a variety nearly akin to it, says, "it requires a dry sandy soil, and no irrigation; water or manure sends it all to leaves and branches."

The failure of the experiments made at the Akra farm by the Agri-Horticultural Society is also a forcible illustration of the unfitness of an over fertile tenacious soil for the production of cotton. The Committee of the Society, reporting upon the failure, observes, "that it establishes the fact that the cotton of America will not flourish on a rich and moist soil, whilst its natural basis is for the most part composed of three-fourths of sand, and one-fourth of clay." This was evidenced "by the rapidity and luxuriance of vegetation, in the production of abundance of wood, leaf, and flower, but little produce."

These results of experience and observation point out that soils constituted almost entirely of the least retentive of all constituents silex, carbonate of lime (chalk), and oxide of iron, are best suited to the growth of cotton. In other words that the soil cannot be too light, whether it is upland or lowland, maritime, or inland. This rule applies, I think, to all except the indigenous varieties of the *G. herbaceum*, which are most productive on soils much more fertile and tenacious than are suited to the superior kinds from Bourbon, Georgia, and elsewhere. This opinion is confirmed by the statements of Mr. Heath, who says, "that in the Madras territories two species or varieties of cotton plant are cultivated, and these require very different soils; one is annual *(oopum punthee, G. herbaceum?)*, and the other perennial (*madam punthee*), The first succeeds only in the 'black cotton soil,' formed apparently from the decomposition of trap rocks; but the second only in a very light soil, formed from the disintegration of granitic rocks, especially when mixed with *kunkur* or calcareous tufa."

Mr. Heath made his experiments on the Bourbon cotton in the latter kind of soil, which is more abundant than any other in the districts on the Coromandel coast, south of Madras; and he entertains no doubt that the Bourbon cotton plant might be successfully cultivated wherever this kind of soil occurs. In introducing this cultivation, he had to encounter the usual difficulties consequent on the introduction of any novelty in agriculture, but these gave way to perseverance. At the end of four years, Mr. H. had the satisfaction of seeing the experiment completely successful, as in the seasons 1823-4, he procured from the district of Coimbatore, five hundred bales of clean Bourbon cotton, of three hundred pounds each, and the natives were at that time well satisfied that the cultivation of this was more profitable to them than that of the common cotton of this country.

That light soils should be best suited for the production of cotton superior both in quantity and quality, is precisely what our knowledge of vegetable physiology would have suggested. There is an axiom in that science to which I know no exception; that whatever tends to promote the production of super-luxuriant foliage, and an enlargement of roots, proportionately diminishes the amount and perfection of the parts of fructification. A familiar example is afforded in England by the potato. Its varieties producing early tubers, are characterised by having little foliage, and no blossom; but if the tubers are removed as fast as they are formed, the foliage becomes more abundant, and they blossom as freely as the later varieties.

A soil abounding in moisture promotes the development of leaves and roots, not only by the superfluity of water, but by presenting to the roots the food of the plant rapidly and more abundantly than is done in a drier soil, To explain this, it need only be remarked that the roots of a plant are only capable of imbibing its nourishment afforded by the soil when it is in a state of solution. The roots of a plant in a light dry soil, are wide-spreading and minutely fibrous; in a wet, tenacious soil they become more massive and fleshy, as do those of a hyacinth, grown in water, which suggests that the food of the cotton plant obtained from the soil, should be presented to it very gradually, and never in superabundance.

This leads to another important consideration:—

*Manures.*—The facts just stated indicate that rapidly decomposing animal or vegetable remains, if applied in considerable quantities, or even in small quantities, if not well mixed and dispersed through the soil, must be injurious to the crop. On the other hand, if the soil is poor or exhausted, a small quantity of such fertilising matters may be applied advantageously. In such soils the American cultivators sprinkle a little well-decayed stable compost along the trench where the seed is to be sown.

The best of all fertilisers for cotton will be doubtless found to be peat, saw-dust, or other woody matters that decay slowly. The natives consider that wood ashes are excellent for the purpose, and the opinion is evidently founded on truth, for the carbonaceons matter remaining in them after combustion, is in a state to become slowly available to the plants.

Of animal matters, the only one that could be applied with a prospect of success, is *bones*, crushed to fine powder, and sown broad-cast in very small quantities.

Mr. Piddington recommends *lignite* (fossil wood) peat, farmyard manure, wood ashes, decayed leaves, mud from old ditches, oil cake, the cotton seed of the preceding crop, pressed or fermented to prevent germination, and charcoal of all kinds, "excepting perhaps the ashes of secondry and other woods near the sea, which may contain too much muriate or carbonate of soda." Why this exception is made I cannot understand, because of all the saline manures, the two just named have been found in Europe the most beneficial, if judiciously employed.

(*To be continued.*)

## THE MODE USED FOR MOVING HOUSES.

The following interesting and curious process, of moving a house from one place to another, we take from Capt. Basil Hall's 'North America':—

"I was so fortunate as to see during my stay at New York, the curious process of moving a house bodily along the ground. The merit of this curious adaptation of well known mechanical operations, belongs to Mr. Simeon Brown who has very kindly explained the whole process to me, and by his permission I shall endeavour to give an account of it.

"Every one has heard of moving wooden houses; but the transportation of a brick dwelling is an exploit of a different nature. I shall describe simply what I saw, and then tell how the details were managed. In a street which required to be widened there stood two houses much in the way, the front being twelve feet too far forward. These houses, therefore, must either have been taken down, or shifted back. Mr. Brown undertook to execute the less destructive process. They were both of brick, and built together, one being forty feet deep and twenty-five feet front; the other thirty-two feet deep, and twenty-two feet front. They were of the same height, that is to say, twenty-two feet from the ground to the eves, above which stood the roof and two large stacks of brick chimnies; the whole forming a solid block of building, having two rows of six windows each, along a front of forty-seven feet by twenty-two. This was actually moved, in a compact body, without injury, twelve feet back from the street. I watched the pro. ress of the preparations on the 25th of May with great interest, but unfortunately, just as the men were proceeding to the actual business of moving the screws. I was obliged to run off to keep an appointment with the Mayor and Corporation; and when I came back, three or four hours afterwards the workmen had gone away after moving the buildings thirty inches; which fact I ascertained by measurements of my own. On the next day with equal perversity of fate, I was again called off to join a party going to New Jersey; and on my return two days afterwards I had the mortification to find the work completed. The houses were now exactly nine feet and a half from the position in which I had left them a few days before.

"It would be tedious, perhaps, were I to give a very minute description of the whole process; but it is so simple, that it may, with a little attention, be understood in a general way even by persons not much accustomed to such subjects, and may possibly be useful to those who are familiar with them.

"The first object is to place a set of strong timbers under the house, parallel to, and level with the street, at the distance of three feet apart, extending from end to end of the buildings, and projecting outwards several feet beyond the gable end walls. The extremities of these timbers are next made to rest upon blocks of wood, placed on the ground quite clear of the walls on the outside. Then by means of wedges driven between the timbers and the blocks, they are made to sustain a great part of the weight of the ends of the house. When this is done, the foundation of the end walls may be removed without danger, as they now rest exclusively on the timbers, the ends of which, as I have described, lie on solid blocks.

"I shall describe presently how the above operation of inserting the timbers is performed; but if for the present we suppose it done, and the house resting on a sort of frame-work, it it easy to conceive that a set of slides, or what are called in dock-yards, ways, on which ships are launched, may be planced transversely under these timbers, that is, at right angles to them, so as to occupy the very place where the foundations of the end walls once stood. It is neccessary to interpose between these ways or fixed slides, and the aforesaid timbers, a set of cradles, similar in their purpose to the apparatus of the same name on which ships rest when launched, to which final process of ship-building this whole operation bears a close analogy. These cradles are long smooth beams lying along the top of the ways, and in the same line with them; their under surfaces in contact with the ways, and the upper made to bear against the cross timbers which support the house. The object, at this stage of the business, is to bring the whole weight of the house upon these cradles, and consequently, upon the ways which support them. If this be done, it follows that the ends of the timbers, formerly described as resting on the blocks, will no longer be supported at the same places. This change of the point of support is effected by driving in wedges between the timbers and the cradles; and it will readily be seen, that these wedges have the twofold effect of forcing the cradles down upon the ways, and at the same time of raising up the timbers which support the house, and consequently in a very small degree the house itself. The ends of the timbers now rest no longer on the blocks, which are removed, and the the house, supported upon the cradles and the ways, is ready for being moved, as soon as the front and back walls have been taken away.

"Suppose all this done, there is nothing required but to apply screws, placed horizontally in the street, and butting against the cradles. On these being made to act simultaneously, the cradles, and consequently the frame which they support, together with the house on its back move along.

"Such is a general account of the process. I shall now mention how the various difficulties, most of which I dare say will have suggested themselves in the foregoing account, are overcome in practice.

"The horizontal supporting timbers, already described as being placed parallel to the street, and nearly at the same level with it, are introduced one by one in this way. A hole is blocked out in each of the end walls, just above the ground, and large enough to admit a squared beam, say 15 inches each way, of which the ends project beyond the gable walls about a couple of feet. A firm block of wood is then placed under each of these ends, and wedges being driven underneath, the beam is raised up, and made to bear against the upper parts of the holes. Thus the inserted timber completely supplies the office of the disloged portions of the masonry. Another pair of holes is then made, and a second timber introduced, and so on till they are all inserted and firmly wedged up. The distance at which these are placed, must depend upon the weight of the wall. In the case I witnessed the houses were of brick, and the timbers stood at the distance, I should think, of three feet apart. All this being done, the intermediate masonry, forming the foundation, may be gradually removed, and a clear space will be left under the supported walls for the reception of the ways.

"There are two more precautions to be attended to; these ways must all be coated with tallow, in a layer of at least half an inch thick, so that the wood of the cradles may never come in contact with them. Some device must also be adopted to prevent the whole affair, house and all, from sliding laterally off. This, Mr. Brown prevents by cutting along the top of one of the ways, a deep groove, into which is fitted a correspondent feather, as it is called, of the superincumbent cradle. This being made to work easy, and well greased, the direct motion is not retarded.

"I have said nothing all this time of the front and back walls; but it will easily be understood how these may be made to rest, like those at the ends, on timbers inserted under the house at right angles, to the first set. The whole of the supporting frame-work is tied so firmly together by bolts, that there is not the slightest bending or twisting of any part of the building.

"When at last the house has reached its destination, a new foundation is built, and the whole process being inverted, the timbers are withdrawn one by one; and such is the security of these operations, that no furniture is removed from the houses so transported. The inhabitants, I am told, move out and in as if nothing were going on. This, however, I did not see.

"Mr. Brown was once employed to remove a house from the top to the bottom of a sloping ground; and, as no additional impulse from screws was here required, he resolved to ease the building down, as sailors call it, by means of tackle. Unfortunately, aabout the middle of the operation, the strop of one of the blocks broke, and the operator, who was standing on the lower side of the building, was horrified by the apparition of the house under weigh, and smoking, by its friction, right down upon him. With that vigorous presence of mind, which is compounded of thorough knowledge, and a strong sense of the necessity of immediate action, and without which, courage is often useless, he dashed a crow-bar, which he happened to have in his hand at the time, into a hole accidentally left in one of the ways, and leaping on one side watched the result. The momentum of the enormous moving body was so great, that it fairly drove the iron bar, like a cutting instrument, for a considerable distance through the fibres of the timber. The main point, however, was gained by the house being arrested in its progress down the hill; and the able engineer, like an officer who has shown himself fertile in resource, reaped more credit from the successful application of a remedy to an evil not anticipated, than if all had gone smoothly from the commencement."

## WORSTED MANUFACTURE.

(*continued from page* 325.)

The following description of a roving apparatus for long wool will communicate a tolerably distinct idea of the process.

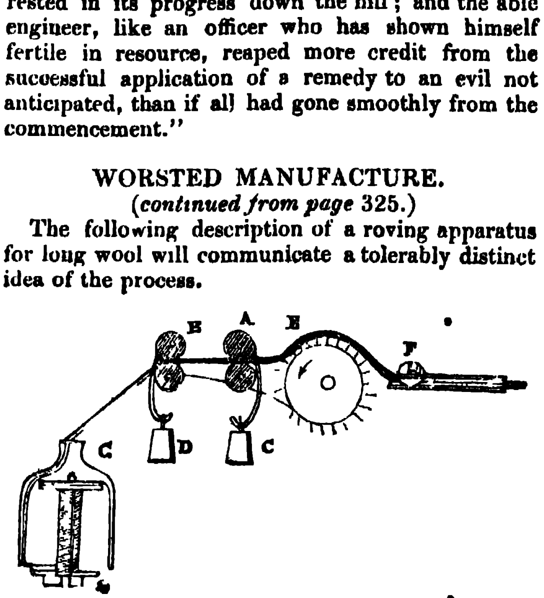



Fig. 1. Worsted Roving.

A and B represent the sections of two pairs of rollers, the lower ones being made of iron, and fluted; the upper being of wood, covered with leather. Pressure is exercised by the upper on the under one by means of the weights C D, suspended by curved rods from the ends of the axes of the upper rollers. The roller B moves faster than the roller A, in the proportion of $2\frac{1}{2}$ or 3 to 1, according to the nature of the wool. The roller A rests on a moveable bearer, which permits it to be placed nearer to, or farther from, the roller B. E is a cylinder mounted with pins, which revolves very slowly on its axis, and delivers to the roller A, moving with a treble surface velocity, the open drawings of wool supplied by the feeding roller F. G is a spindle, having one leg of its forked flyer tubular, through which the roving passes in its way to the bobbin. The spindle turns very slowly, so as to give no more twist to the filaments than may be necessary to secure the formation of an uniform soft cord during their extension. The up and down motion of the bobbin is given by an eccentric acting on the copping rail, in a way which will be fully explained in treating of the cotton manufacture.

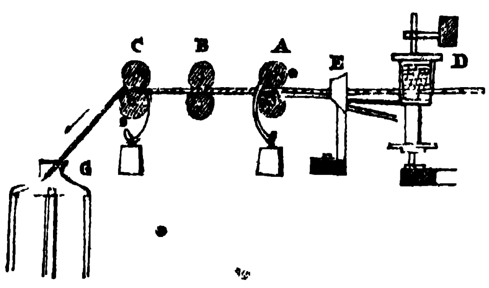



Fig. 2. Worsted Spinning.

Fig. 2. is intended to explain the general manner of spinning long wool into a finer thread. Here are three pairs of drawing rollers, A, B, C; the first two of which are supported on moveable bearings, or brass bushes, which allow of their being separated more or less, from one another, and also from the roller C, to suit the staple of the wool. The ratio of the speed of the first and last pair of rollers is as one to four. The roller B serves merely to bear up the fine roving; its velocity is therefore a mean between that of the other two. The bobbins filled with rovings made on the previously described machine, are arranged at D, behind the back-drawing roller A, in a creel-frame, so that three rovings together may pass through the funnel or eyelet E, placed opposite the middle of this roller. The roving is never reduced to its ultimate fineness by passing through two or three such machines, but it passes successively through five or six of them, receiving not only extension, but an equalizing combination every time. At last, the fine yarn is formed by a spinning frame or throstle, which may contain 254 spindles on each side, furnished with a four-fold set of drawing rollers.

In this final spinning there is no doubling operation; but single bobbins are set on skewers in the reel in correspondence with the single spindles on the copping-rail. The number of doublings in the process of drawing and roving long wool may amount in certain cases to several thousands.

The spindles revolve very quickly in the spinning frame, in order to give the requisite degree of twist to the worsted. The hardest twisted worsted is called *tammy* warp; and when its fineness is such as to contain twenty-four hanks to the pound weight, the twist is about ten or twelve turns in very inch length. The least twist is given to the hosiery worsted yarn, which runs from eighteen to twenty-four hanks to the pound weight. The twist is only from five to six turns per inch. The degree of twist is regulated by the size of the wharves or whorls upon the spindles, and the speed of the front rollers, as will be fully explained in treating of cotton, in the spinning of which, on the fine mule, extraordinary nicety of adjustment is required.

A hank of worsted yarn contains five hundred and sixty yards; and it is divided into seven leys of eighty yards each. Some count hanks of eight hundred and forty yards, like those of cotton yarn.

The roving frames have much fewer spindles than the fine spinning frame; some of them are two spindle, some of them four spindle, others six spindle frames, &c., which all repeat, however, the similar process of doubling threads and passing under drawing rollers, so as to give successive draughts to the spongy cords, and to maintain their perfect equality of texture. Girls, from sixteen to twenty and upwards, are generally employed at drawing, roving, and spinning-frames. At the former two they earn from 6s. to 7s. each weekly; at the last from 9s. to 10s.

## REFLECTING OVENS.

THE introduction of the reflecting oven, and the universal approbation with which it was received by the public, fully attests its superiority in point of economy and portability over the usual method of roasting and baking; the one before us contains an improvement, the want of which was long felt; it consists in a part of the top opening, so as to get at the contents without the inconvenience of withdrawing it from the fire. The lower part contains a dipping pan from whence meat may be basted with the same facility as from the usual roasting screen, over which the reflecting oven maintains a superiority on account of the many useful culinary purposes to which it may be applied.

## VOLCANOES.

(*Continued from page* 327.)

*Staffa—Fingal's Cave*—Many of the Hebrides (or Western Isles of Scotland) are almost wholly composed of trap rocks. The island of Staffa is the most celebrated, from a chasm or recess in the rock, which has been produced by the degradation and removal of the basaltic columns by the waves. This natural cavern is of singular beauty, and is well known by the English name of Fingal's Cave, but it is called by the islanders Naimh-bim, or cave of music, from the murmuring echoes occasioned by the surges, which, in rough weather dash with violence into the chasm.

Staffa is a complete mass of basalt, covered by a thin layer of soil; it is about two miles in circumference, and is surrounded on every side by steep cliffs, about seventy feet high, formed of clusters of angular columns, possessing from three to six or seven sides. Fingal's Cave, first made known to the public by Sir Joseph Banks, in 1772, is on the south east corner of the island, and presents a magnificent chasm 42 feet wide and 227 in length. The roof, which is 100 feet high at the entrance, gradually diminishes to 50, and is composed of the projecting extremities of basaltic columns; the sides of perpendicular pillars: and the base, of a causeway of the same materials. The vaulted arch presents a singularly rich and varied effect; in some places, it is composed of the ends of portions of basaltic pillars, resembling a marble pavement; in others, of the rough surface of the naked rock; while in many, stalactites mingle with the pillars in the recesses, and add, by the contrast of their colours, to the pictorial effect, which is still further heightened by the ever varying reflected light thrown from the surface of the water, which fills the bottom of the cave. The depth of the water is nine feet, and a boat can therefore reach the extremity of the cave in tolerably calm weather; but when the boisterous gales of that northern clime drive into the cavern, the agitated waves dashing and breaking among the rocky sides, and their roar echoed with increased power from the roof, present to the eye and ear such a scene of grandeur as bids defiance to any description. The short columns composing the natural causeway before mentioned, continue within the cave on each side, and form a broken and irregular path, which allows a skilful and fearless climber to reach the extremity on the eastern side on foot: but it is a task of danger at all times and impossible at high tide, or in rough weather. It would be useless to attempt a description of the picturesque effect of a scene which the pencil itself is inadequate to portray. But even if this cave were destitute of that order and symmetry, that richness arising from multiplicity of parts, combined with greatness of dimension, and simplicity of style, which it possesses; still the prolonged length, the twilight gloom half concealing the varying effects of reflected light, the echo of the measured surge as it rises and falls, the transparent green of the water, and the profound solitude of the whole scene, could not fail strongly to impress a mind gifted with any sense of beauty in art or nature.

The basalt, of which the columns are composed, is of a dark greenish-black hue, highly coloured by iron; a thin layer of silicious cement is seen between the joints, or articulations, which is called mortar by the islanders, and strengthens their persuasion that this wonderful cave is the work of art.

*The Giants' Causeway.*—In the sister kingdom, a magnificent range of basaltic pillars appears on the northern coast of Antrim. It consists of an irregular group of hundreds of thousands of pentagonal, jointed, basaltic columns, varying from one to five feet in thickness, and from twenty to two hundred feet in height. Their prevailing colour is a dark greenish-gray. In the cliffs, a chasm, formed by the inroads of the waves, presents a natural cavern, about sixty feet high, and of great picturesque effect; the entrance is nearly thirty feet in width, and the walls are formed of dark balsalt. But the great interest of this spot, in a geological point of view, is the altered structure observable in the sedimentary rocks wherever they have been traversed by the basalt.

*Rocks altered by contact with Basalt.*—The chalk north of Ireland constitutes a line of cliffs traversed by basalt, which sometimes forms vertical dykes, and at others extensive beds, having a columnar structure. The chalk is about 270 feet thick, and rests on a green sandstone, called *mullattoe*, the equivalent of the *glauconite*, or firestone. It contains flint nodules, ammonites, belemnites, echinites, terebratulæ, and the usual fossils of the cretaceous formation. In the isle of Rathlin, nearly vertical dykes of basalt are seen intersecting the chalk, which at the line of contact, and to an extent of several feet from the wall of the dyke, is completely changed. Those portions of the chalk which have been exposed to the extreme influence of the lava, are now a dark-brown crystalline rock, the crystals running in flakes, like those of coarse primitive limestone; the next state is saccharine—then fine-grained and arenaceous; a compact variety, with a porcellaneous aspect, and of a bluish-grey colour, succeeds; this gradually becomes of a yellowish-white, and passes insensibly into unaltered chalk. The flints in the indurated chalk are of a yellowish, or deep-red colour; the chalk is highly phosphorescent. The fossils are much indurated, but retain their usual structure.

To the south of Fair Head, in the county of Antrim, syenite traverses mica, schist, and chalk; and fragments of the latter are found broken up, and impacted in the erupted mass; the included portions being changed into marble. The geological relations of that part of Ireland are as follow: 1 mica slate; 2, coal shale, and new red sandstone; 3, chalk.

At Straithaird, in the Isle of Sky, vertical dykes and veins of trap intersect the horizontal strata of sandstone, porphyry, and other ancient lavas, also occur in the same island, sometimes protuding through, and at others spread over, clay slate, red sandstone, and shelly limestone.

In some of the slate districts, where the trap has burst through and overflowed the strata, fragments of slate are found imbedded in the basalt, appearing to have been detached from the rock at the intrusion of the lava, and become enveloped while the latter was in a state of fusion.

*Granite Veins—Rocks altered by Granite.*—From this subject, we pass to the consideration of the changes produced by granite and other ancient mineral masses that have been erupted in a melted state. The transition from granite to modern porphyritic trachytes, passes through infinite gradations, but all the modifications appear referrible to the degree of incandescence of the materials, the circumstances under which they were erupted, and their slow or rapid refrigeration. An instructive example of the passage of granite into basalt, described by Mr. Hibbert, will illustrate these remarks. In one of the Shetland Isles, a bed of basalt, extending for many miles, is seen in contact with granite. At a little distance from the junction of the rocks, the basalt contains minute particles of quartz, and these become larger and more distinct as they approach the granite; hornblende, felspar, and greenstone (the latter is a homogeneous admixture of hornblende and felspar) next appear; still nearer, the rock consists of felspar, quartz, and hornblende: and at the line of junction, felspar and quartz form a mass, which requires but the presence of mica to be identical with the granite in which it is insensibly lost.

Veins are fissures or chasms, originating either in mechanical disturbance, or from contraction in mineral masses during their consolidation; and the mechanical veins are found filled by subsequent infiltrations or depositions. It is obvious that these veins must be of later origin than the rock which they traverse. Thus the veins of granite are more modern than the mass through which they are disseminated. It therefore follows that when rocks of granite are intersected by veins, or dykes of the same substance, the latter are of later origin than the former, and have been injected into rents and openings of pre-existing granite rocks; a proof that the formation of granite has taken place at more than one epoch. By numerous observations of phenomena of a like nature, it is now clearly established that melted granite has been ejected during the Cumbrian, Silurian, carboniferous, oolitic, chalk, and even tertiary epochs. When granite appears to have been erupted among the secondary strata, the latter, as we have already remarked, are invariably altered near the line of junction; but when consolidated masses of granite have been protruded, no such change is observable. Into the slate rocks of the Cumbrian chain, syenite, porphyry, and greenstone, have been injected in a melted state, and now fill up the fissures produced during the general movements of those strata; but the central nucleus of primary rock exhibits no such appearance. In Cornwall, and other places, the granitic rocks were evidently in a state of fusion, for the slates are penetrated by veins of granite; and in some instances are changed into fine-grained mica, or hornblende slate. An extraordinary fact is noticed by M. Elie de Beaumont. In the environs of Champoleon, where granite comes in contact with the Jura limestone, whatever may be the position of the surfaces in contact, the limestone and the granite both become metalliferous near the line of junction, and contain small veins of galena, blende, iron and copper pyrites, &c.; and at the same time the secondary rocks are harder and more crystalline, while the granite has undergone a contrary change.

*(To be continued.)*

## IMPROVED ALLOY OF METALS.

A Patent has lately been granted to James Fenton, of Manchester, for an invention of an improved combination or alloy, or improved combinations or alloys, of metals, applicable to various purposes for which brass and copper are usually employed, in the construction of machinery.

This invention is intended to be used in the construction of machinery in general, in those places and situations where brass and copper are usually employed; and it is stated, that it may be beneficially used as a substitute for the ordinary metals, in consequence of its not being liable to heat or subject to other destructive results caused by friction and ordinary wear and tear; also, by greatly decreasing the consumption of oil or grease, and being of increased durability, and much lighter weight in the same bulk of metal. All these advantages will be sufficiently evident to the practical engineer and mechanic. as well as the great variety of purposes for which this improved combination or alloy of metals may be employed in the construction of machinery, such as steps, bearings, pedestals, journals, bushes, axle-boxes, connecting-rod ends, cocks, taps, pump-barrels, pump-rams, plungers for buckets, &c., and also as a substitute for the more elementary parts of machinery, (formerly made of brass or copper,) such as rollers for calico and other printers, bowls, &c.

The manner of carrying this invention into practical effect, is to be according to the following formula;—Firstly, take 32 parts of copper, 15 parts of block tin, and 1 part of sheet brass, and mix or combine these in the following manner:---The copper being fused or melted in a crucible, or other suitable vessel or furnace, the sheet brass is added thereto, and afterwards the block tin is thrown in; the alloy is then poured off in ingots, and a metal is produced, which the patentee terms "hardening metal." Under this head he claims the novel and peculiar use of these metals to form "hardening metal;" but the quantities may be varied, to give the alloy any required degree of hardness, or various other metals may be added, in small quantities, to effect the same purpose; he likewise claims the use of these, in connexion with copper and block tin: the above constitutes the first part of the process employed by the patentee in the manufacture of his *ultimate* alloy or alloys.

Secondly, take 2 parts of the hardening metal, previously described, 19 parts of zinc or spelter (or so many parts of calamine as shall be equal to the quantity of zinc or spelter), and 3 parts of block tin, and mix or combine these in the following manner:—First, fuse or melt the zinc, spelter, or calamine in a crucible, or other suitable vessel or furnace, which must be sufficiently large to contain along with the zinc or spelter, the hardening metal previously described, and the block tin last specified. The hardening metal should be fused or melted in a separate crucible or other suitable vessel or furnace, and then mixed or combined with the zinc, spelter, or calamine: the alloy must be well stirred with a suitable implement, in order to render the combination of these metals or semi-metals as complete as possible. The block tin is then added, to give the ultimate alloy or alloys the requisite degree of ductility or toughness. The whole must be again well stirred with a suitable instrument, in order to render the combination of this, the ultimate alloy or alloys, as complete as possible. It may then be cast, or employed in the usual manner, in the various forms required for the construction of machinery.

While the zinc or spelter is being melted, the surface of it should be well covered with a coating of powdered charcoal, in order to prevent the volatilization of the semi-metal.

Under this head the patentee claims as follows:---"The use of these metals and semi-metals, above described, to form my ultimate alloy or alloys; but the proportions may be varied, to suit particular cases, and a variety of other metals may be added in small quantities, the use of which I also claim, though not absolutely requisite to form my ultimate alloy or alloys. I further claim the use of the semi-metal zinc, spelter, or calamine, as the basis of my ultimate alloy; and although I have found the manner of combination above described the most effective in preparing the alloy or alloys which I substitute for brass or copper, in the construction of machinery, I claim the use of the said alloy or alloys although combined in any other manner or proportions whatever; such combination or alloy being made, either in the exact proportions herein set forth, or in any other, within such limits as are substantially the same, and will produce a like result, as a substitute for brass and copper, to be used in the construction of machinery,

## ON THE MANUFACTURE OF CASKS.

At a recent meeting of the Society of Arts, the Secretary read a paper, by Mr. R. Davison, 'On the manufacture of Casks,' more particularly those used by brewers; with remarks on the methods adopted for cleansing and purifying such Casks. In some establishments in London, there are no fewer than from 70 to 80,000 casks used; and in the United Kingdom, for public brewing alone, about 2,600,000 casks,; the subject, therefore, of keeping, such vessels in fit and proper condition becomes one of importance. The new process invented by Messrs. Davidson and Symington includes—1st, a new method of making casks; 2ndly, a new method of cleansing casks by machinery; and 3rdly, a new method of purifying casks. 1st, for making casks:—New wood containing the vegetable juices is to be used so that the staves may easily be bent to the required curvature without cracking or otherwise injuring them. After being thus bent and *set up* with temporary hoops to the required form, they are to be subjected to a rapid current of heated air, until the wood has given off all its natural sap and other aqueous matters; thus the staves will become denser and harder, all the fibres being brought closer together. The heads are prepared in a similar manner, and the casks are then finished off. The cleansing process is performed by machinery, which consists of two frames made of iron, one revolving inside the other; the inner may be termed a cradle, in which the cask is secured by means of a chain lever and catch; motion being given to the outer frame either by hand or engine power, causes the inner one to revolve in a contrary direction, which is accomplished by an eccentric next the axis of the outer frame, and to which is connected a set of jointed rods communicating with a ratchet which is fixed in the axis of the inner frame. The action is thus: for every turn the outer frame makes in the direction of its length, the inner one, which contains the cask, moves at right angles with the other frame, a distance equal to one tooth of the ratchet, or one-twentieth of the circumference of the cask; in this way, by the time the outer frame with the cask has made twenty revolutions, *end over end*, the inner frame has moved the cask round only *once* sideways, Thus by means of a chain of peculiar construction attached to a plug suited to the bung-hole, which is in the first instance inserted in the cask, together with two or three gallons of hot water, every inch of surface of the cask becomes acted upon and freed from all adhering matter in a very short time. The new mode of purifying casks is, first, to cleanse the inside thoroughly from all extraneous matter, afterwards to subject them te slow or moist steam for about twenty minutes, or not exceeding half an hour, and immediately afterwards, whilst the cask is yet warm, to remove it to the hot-air nozzle; this very quickly drives out, not only the vapour inside the cask, but in the course of ten minutes exhausts even the pores of the wood of every watery particle, which may be known by applying a mirror or other polished surface to the *tap-hole*,—and this without in the least deteriorating or shrinking the cask. The temperature of the air found most beneficial for this purpose is from 350 to 400 degrees Fahrenheit, and the speed should not be less than 100 feet per second. *Mouldy* casks thus cleansed and purified are found not to exceed (including engine-power and every other expense) *a penny three-farthings* each, whereas casks that are unheaded, scrubbed, and again reheaded (leaving out any expence of purifying) seldom cost less than 6d, but more generally from 8d. to 10d.

## VARIETIES.

*Discovery of Aborigines.*—A gentleman just come in from Arima (Trinidad) has informed us that an interesting discovery has been made, in taking the census in that part of the island, of two encampments of the aboriginal Indians of the island, belonging to a race perfectly distinct from any with whom we have hitherto been acquainted, and whose existence had remained unknown. We are, we must confess, not a little surprised that such a circumstance should have so long escaped the knowledge of the rest of the inhabitants of this colony, and that these people could have kept themselves so perfectly secluded. It is a very interesting fact, and we shall feel glad to be furnished by the parties who have made the discovery, with particulars.—*Standard.*

*How to cut and grind Glass*—The art of cutting glass is much more modern than that of painting and staining it. At present the richness and brilliancy of our vessels of glass, which contribute so much to the ornament of our tables and saloons are owing, in a great degree, to the elaborate and elegant manner in which they are cut. The cutting is effected by wheels driven by considerable power, the glass being held to the wheels. The first curting is with wheels of stone, then with iron wheels covered with sharp sand or emery; it is then polished in the same manner by putty, or oxide of tin. To prevent too much heat being excited by the friction, a small stream of water is kept constantly running on the glass. In large manufactories the wheels are urged by a steam-engine. Glass may be ground by hand on any coarse-grained sandstone, or with sand, or with emery and water. Panes, of flat pieces of glass may be divided, when a glazier's diamond is not at hand, by making a notch with a file and carrying a piece of hot charcoal in the line in which it is wished the fracture should proceed. The charcoal must be kept alive with the breath. A red hot iron will also do. The art of casting in glass has lately arrived at such perfection that many articles, such as small plates, salt-cellars, &c., now almost rival, at first sight, those that are cut; and glass casting has one advantage over glass cutting, that certain ornaments can be cast that could not be cut with the wheel; but no casting has ever yet equalled the sharpness and beauty of cut glass; and indeed, cannot bear close comparison with it.

## IVORY ENGRAVING, OR DURERTYPE.

*From the Athenæum.*

Great as are the improvements which have been made in the art of engraving, there is no reason to believe we have yet arrived at perfection in any of its various departments. For a considerable period no method besides that of wood-engraving was known as suitable for printing along with type. Stereotyping, though it affords a metallic duplicate of the engraved wood block, and is so far useful for multiplying such works, yet is of no avail in the production of original designs, and it was not until we were made acquainted with Gypsography and Glyphography, that we were put in possession of methods at all likely to compete with, if not supersede, wood engraving.

It is not my object to extend my remarks to those other methods of engraving applying to copper, steel, stone, &c., which even those most superficially acquainted with typography must be aware cannot be printed off along with letterpress. An early partiality for typographical works made me long desirous of re-discovering the supposed peculiar art by which Albert Durer produced those remarkable effects, particularly in cross-hatchings, which have perplexed all who have studied his prints, and have been the fruitful source of much speculation whether they are from true wood engravings, or absolute copperplates with all the lines in relief, the result of biting-in with nitric acid; thus etching the lights, instead of as usual etching the shadows, or lines to be printed. It may not be known to the general reader, that the shading produced by cross-hatching has ever been one of the principle difficulties in the art of wood engraving, not from its impossibility, but its extreme tediousness; and is, therefore, in all old prints particularly, very sparingly introduced, and much oftener entirely omitted. The frequent interlacing, or cross-hatchings, as well as the spirited freedom of his lines, form a remarkable feature in Albert Durer's engravings. It was in 1837 that I designed a means of surmounting the main difficulty of the cross-hatching, which I could produce with the greatest freedom either as an original effect, or to copy, as I then did, one of Albert Durer's prints. At that time the electrotype process was not known, or I should have employed it for one part of my invention, instead of stereotyping, which I found it requisite to abandon, as involving too much difficulty, labour, and expense. My method of engraving calls in aid either stereotyping or electrotyping. Its peculiarity is the facility it affords for *copying*, without any great skill on the part of the copyist. Indeed, in this respect it probably offers a dangerous temptation to the committal of forgery. Though myself a mere amateur, I have copied a print of Albert Durer's with all the exactitude that a steady hand could pass a tracer over lines already prepared. How much superior, however, must be the labour of one skilled in engraving. My method is as follows:

1. I take a plate of clear, thin, flatted glass, round the edge of which is to be pasted a ribbon of card, one quarter of an inch broad, flat to the glass, and close to its outer edge, forming a white margin or frame all round; a few drops of spirits turpentine are to be rubbed over the glass, but on the card side only; next melt a little pure white bee's-wax, and holding the glass, if small, over a lamp, or a larger one over a chaffing dish, pour upon it the wax, allowing all the superfluous portion to run over the card margin, the object being not to have it anywhere thicker than the card. The turpentine causes it to be very adhesive.

2. The glass thus prepared may be laid, with the varnished side uppermost, on any print, which will appear distinctly through the wax varnish, and in this state is ready for copying with the graver.

3. The needles or gravers I propose using may be of ivory (and hence, or from Durer's name, may be chosen a distinctive title for this invention); the softness and thinness of the coating, as also the smoothness of the glossy surface, favouring their employment. For open-lined engravings like Albert Durer's, maps, plans, and the like, ivory needles would answer every purpose, and without scratching the glass. To copy a fine copper-plate might require a steel point. The varnish is merely cut through, as in etching copper-plate.

4. A cast of the glass plate so prepared is what is next most wanted; and it was here my original difficulty occurred. By the electrotype process a copper printing block may be at once obtained, backed with soft metal and raised on wood.

Such is my method, with which a variety of circumstances have occurred to frustrate my bringing forward, but chiefly the want of sufficient leisure to prepare suitable specimens. That in the hands of able artists its capabilities are very surprising, I feel satisfied, and its affording an extremely easy means of copying, to those who are entire amateurs at engraving, or drawing, is self-evident; arising from its not requiring the *reversing* of objects. Thus the ancient method of obsolutely writing with a stiletto on a wax tablet, may now be advantageously revived, and when electrotyped may even be printed with letter-press. Prints on paper, silk, cotton, &c.; pencil drawings, writing, embroidery, leaves of plants, medals, &c., may all be exactly traced by placing them under the glass plate, saving all the tediousness of first drawing and then etching. Some time back I intimated to private friends, what I still think might be carried out, that my method of engraving offers a light and suitable employment for females, who might be advantageously occupied in copying for the electrotypist.

Before concluding, I wish to observe that my invention may, on a hasty glance, appear similar to, or even seen to be borrowed from the Gypsographic and Glyphographic processes. But such is not the case. The only similarity is that of cutting down through a soft substance to a hard one; and the publication of those methods has certainly, so far, deprived me of the credit I might earlier have obtained for that useful part of the invention, of which no advantage had at that period been taken. But as regards employing a *transparent medium*, I believe my method distinctly stands alone. I can only say, in reference to my own knowledge of it, it is perfectly original in every respect; and I shall be sincerely pleased should these few hints be found serviceable in at all advancing an art I much admire.

Henry Dircks.

## POLISHING METALS.

The polishing of metals differs according to their kind and the kind of manufacture; nevertheless, there are some general principles to be attended to as being common to all, of which it may be useful to have a clear idea. All polishing is begun in the first instance by rubbing down the surface by some hard substance that will produce a number of scratches in all directions, the level of which is nearly the same, and which obliterates the marks of the file, scraper, or turning-tool that has been first employed. For this purpose coarse emery is used, or pumice and water, or sand and water, applied upon a piece of soft wood, or of felt, skin, or some similar material. When these first coarse marks have been thus removed, they next proceed to remove the marks left by the pumice stone by finely powdered pumice stone ground up with olive oil, or by finer emery and oil. In some cases certain polishing stones are employed, as a kind of hard slate used with water. To proceed with the polishing, still finer powders are used, as Tripoli, and rotten stone, which is still infinite, and is found only in Derbyshire. Putty of etr and crocus martis are also used for high degrees of polish. But the fact is, in respect to polishing, that the whole process consists merely in removing coarse scratches by substituting those which are finer and finer, until they are no longer visible to the naked eye: and even long after that, if the surface be examined by a microscope, it will be seen that what appeared without any scratches is covered all over with an infinity of them, but so minute that they require a high magnifier to be discovered. The operator, therefore, who understands this principle, will know how to vary his polishing substances according to the nature of the article he wishes to polish. It is quite evident that his polishing material must be able to scratch in a coarser or finer manner the substance he is desirous of polishing; for wearing down is only effected by producing minute cuttings or scratches. It is evident also that great care must be taken to have the last polishing material uniformly fine, for a single grain or two of any coarse substance mixed with it will produce some visible scratches instead of a perfectly polished surface.—*Ency. of Domestic Economy.*

## VOLCANOES.

(*Continued from page* 335.)

*Metamorphosed Rocks.*—Enough has been advanced to convey a general idea of the character and relation of the primary crystalline rocks, and of the agency which has reduced them to their present state: but the question naturally arises—What was their orignal nature? Intense heat has effected the present arrangement of their molecules, but upon what materials was that influence exerted? The transmutation, by heat, of chalk into crystalline marble—of loose sand into compact sand-stone —of argillaceous slate into porcelain jasper—of coal into anthracite—of anthracite into shale and slate—of slate into micaceous schist—of micaceous schist into gneiss and granite—of the latter into trap—and so forth—together with the characters presented by the mineral products of existing volcanoes, prepare the mind to receive without surprise the theory of an eminent geologist and chemist, M. Fournet, *that all primary rocks are simply sedimentary deposits metamorphosed by igneous action.* We will only add that this opinion is but a modification of that long since expressed by our illustrious countryman, Hutton, that granite rocks are consolidated and altered sediments which have accumulated at the bottom of the ocean.

*Metalliferous Veins.* In our description of the fissures observable in consolidated strata, we mentioned that the great depositories of the metals are found in certain cavities termed metalliferous veins; which are separations in the continuity of rocks, of a determined width, but extending indefinitely in length and depth, and more or less filled with metallic and mineral substances of a different nature from the masses they traverse. These natural stores of hidden treasures are not confined to any epoch of formation, nor to any tracts of country, although most frequent in beds that form mountain elevations, and in the oldest rocks; veins of iron, copper, arsenic, silver, and gold, occur in tertiary strata. Many veins are fissures of mechanical origin, into which metalliferous matter has been sublimed from the effects of high temperature; but others have resulted from an electro-chemical "separation, or segregation, of certain mineral and metallic particles from the mass of enveloping rock, while it was in a soft or fluid state, and their determination to particular centres." The nature of these veins receives illustration from the nests of spar and mineral matter in masses of trap rocks from Scotland, in which, as you perceive, there was no possibility of the introduction of any foreign substance from without. From the observations of M. Fournet, in the mines of Auvergne, it seems probable that sulphurets of iron, copper, lead, zinc, barytes, and other minerals, have been introduced at different periods, by electro-chemical action, accompanied by new fractures and dislocations of the rocks, and the widening of previous fissures.

There appear to be certain associations of metallic substances in the veins; as for instance, iron and copper, lead and zinc, tin and copper; and those ores which are combined with a similar base, as sulphurets, carbonates, phosphates, arseniates, &c. are commonly found together. The following is a brief notice of the geological distribution of a few of the chief metals.

"*Lead.* The ores of this metal are very numerous; and the sulphuret, or galena, occurs in primary and secondary rocks.

"*Tin*—exists in veins traversing granite and schist; those of Cornwall have been celebrated from the earliest historical period.

"*Copper*—is found in primary and secondary rocks, and is often *native*, that is, in a pure metallic state; and crystallized,

"*Gold*—exists in granite and quartz rocks. The gold found in the mud and sands of rivers (as those grains from Ovoca in Ireland, collected by the late Earl of Chichester,) is derived from disintegrated rocks.

"*Silver.*—This metal is found in transition and primary rocks; sometimes native and in ores associated with arsenic, cobalt, &c."

The almost universal presence of the ores of iron, and the infinite variety of its combinations, are well known. The formation of what is termed bog-iron ore, found in marshes and peat-bogs, is supposed to have been derived from the decomposition of rocks over which water has flowed; but the observations of Ehrenberg, seem to indicate a different origin.

*Copper Ore of New Brunswick.*—An illustration of a metallic deposit by the effects chemical action, without the agency of heat, is afforded by a singular formation of copper ore, which occurs in New Brunswick. In a bed of lignite, which is covered by a few feet of alluvial soil, and rests on a conglomerate, the precise nature of which is not stated, occurs a nearly horizontal layer of green carbonate of copper, about eight inches in thickness. The ore is disseminated through the lignite in the same manner as the metallic ores are usually blended with their accompanying vein-stones. This bed bears a close analogy to the modern cupreous deposits of Anglesea, or of some parts of Hungary and Spain, where, at the present time, water charged with copper in solution, is by the introduction of iron made to precipitate the former metal. From the stratum of lignite occurring with the copper, and the mode in which the latter is interspersed throughout the mass, it would appear that the water in which the vegetable matter floated was, at the same time, saturated with a solution of copper, and that both the organic and mineral substances subsided to the bottom together, and formed the singular compound deposit under consideration, over which, probably at a subsequent period, the alluvial covering was drifted.

*Sapphire, Ruby, Emerald.*—Connected with the changes to which the metamorphic rocks have been subjected is the formation of some of those minerals, which, from their beauty, splendour, and use as ornaments, are termed precious-stones. The sapphire and oriental ruby, which are prized next to the diamond, and almost equal that gem in hardness, are found in trap rocks; and the common corundum, which is a species of the same mineral, and the emerald, occur in granite. The two former principally consist of aluminus earth; and the supposition that they have been formed by intense igneous action, is not only probable, but is rendered almost certain, by the late experiments of M. Gaudin, who has succeeded in producing fictitious rubies, which, in every respect, resemble the natural gems. These were formed by submitting aluminum, with a small quantity of calcined chromate of potash, to the influence of a powerful oxy-hydrogen blowpipe, by which the materials were melted into a crystalline mass, that presented, when cooled, all the characteristics of the ruby.

Instances occur in which garnets and other crystals are found in shale, when altered by contact with a dyke of igneous rock, though altogether wanting in every other part of the bed; a proof that they have been produced by the effects of heat on those parts of the sedimentary deposits which were most exposed to the influence of the erupted mass.

*(To be continued.)*

## DIGNITY OF SCIENCE.

The spaces in which the systems composing the universe move, is illimitable. Were we to attempt to assign its limits, what could we imagine to be beyond? The number of worlds is infinitely great; it is inexpressible, indeed, by numbers. A ray of light traverses 180,000 miles in a second of time. A year comprises millions of seconds, yet there are fixed stars so immeasurably distant that their light would require billions of years to reach our eyes. We are acquainted with animals possessing teeth and organs of motion and digestion, which are wholly invisible to the naked eye, Other animals exist, which, if measureable, would be found many thousands of times smaller, which, nevertheless, possess the same apparatus. These creatures, in the same manner as the larger animals, take nourishment, and are propagated by means of ova which must, consequently, be again, many hundreds of times smaller than their own bodies. It is only because our organs of vision are imperfect that we do not perceive creatures a million times smaller than these.

What variety, and what infinite gradations do the constituents of our globe present to us in their properties and their conditions! There are bodies which are twenty times heavier than an equal volume of water, there are others which are ten thousand times lighter, the ultimate particles of which cannot be seen by the most powerful microscopes. Finally, we have in light---that wonderful messenger which brings us daily intelligence of the continued existence of numberless worlds,---the expression of an immaterial essence which no longer obeys the laws of gravitation, and yet manifests itself to our senses by innumerable effects. Even the light of the sun---with the arrival of which, upon the earth, inanimate nature receives life and motion---we cleave asunder into rays which, without any power of illumination, produce the most important alterations and decompositions in organic nature. We separate from light certain rays, which exhibit among themselves a diversity as great as exists amongst colours. But nowhere do we observe either a beginning or an end. The human mind perceives in nature no limit either above or below itself, and in this infinity,---scarcely conceivable since it is in both directions unfathomable by human power,---not one drop of water falls to the ground, not one particle of dust changes its place, without compulsion. Nowhere beyond the sphere of his own being does man perceive a conscious will; he sees everything around him bound in the chains of invariable, immutable fixed laws. Within himself alone he recognises a *something* which may govern these effects, a *will* which has the power to rule over all natural laws, a *spirit* which, in its manifestations, is independent of these natural powers, and which, when it is in its conceivable perfection, is subject only to its own laws.

The mere empirical knowledge of nature forces upon us, irrestibly, the conviction that this *something* within us is not the limit beyond which there exists nothing similar or more perfect. The inferior gradations only of this *something* are accessible to our powers of perception. And this conviction, like every other truth in inductive natural investigation, affirms the existence of a higher, indeed of an infinitely exalted Being, to contemplate and to comprehend whom our senses are too feeble, and of whom, in his greatness and sublimity, we can only form some conception by the highest cultivation of every faculty of our minds.

The knowledge of nature furnishes us with the most effectual means of advancing our intellectual powers to this degree of perfection.

The history of philosophy informs us that the wisest men, the most profound thinkers of antiquity, and, indeed, of all ages, considered the insight into the essence of natural phenomena, the acquaintance with natural laws, as an indispensable means for cultivating the mind. The study of external nature---physics---constituted a part of philosophy. Science renders the powers of nature the servants of man, whilst empiricism subjects man to their service. The empiric, placing himself on a level with an inferior or unconscious being, employs but a small portion of his power for the advantantage of society. He permits effects to govern his will, whilst, by a true insight into their hidden connections, he might govern them.

The pertinence of these remarks will appear to you when I attempt to explain one of the most remarkable laws which lies at the foundation of modern Chemistry.

If, to the comparative anatomist, a small fragment of bone, a tooth, serves as a volume from which he can relate to us the history of a being belonging to a past world, describe its size and shape, point out to us the medium in which it breathed and lived, and demonstrate to us of what its nourishment consisted, whether animal or vegetable, and its organs of motion---all this might be supposed to be the mere creation of a lawless imagination, if this small fragment of bone, this tooth, owed its form and constitution to mere chance. But the anatomist may safely assert all this as a reality, because every particle owes its form to definite laws, and because, when the form of a part is once known, it indicates the mode of construction of the whole.

It may not appear less wonderful to many that the chemist should be able, when he knows the proportion in which any single substance unites with another substance, to conclude and assign the exact proportion in which the former will unite with all other bodies whatever.

The discovery of these laws, to which all the processes comprising number and measure are subordinate, in organic as well as in inorganic nature, and which regulate and govern all chemical actions, is acknowledged to be the most important acquisition of the present century, and the most productive in its results.—*Liebig.*

## GILDING.

Some knowledge of the nature of this kind of ornamental work, and the processes employed in producing it, is necessary, with a view to preserve it in a proper manner, and to prevent its being damaged by wrong treatment. Gilding, in general, may be described as the art of covering certain substances with gold, either in very thin leaves, in powder, or in amalgam by quicksilver, according to the material to which it is applied, and to the object in view. Wood, leather, paper, and similar substances, are gilt by fastening on leaves of gold by means of some cement: but metals are gilt chiefly by a chemical process, called amalgamation; or, as has lately been discovered, by the action of galvanism. Gilding on wood is the most general, but used for various mouldings and ornaments in apartments, and on articles of furniture, as chairs, picture frames, &c. Gold has not only the advantage of a rich colour and splendid lustre, but also that of unalterability in the air, retaining its metallic appearance and beauty in all weathers, and for an indefinite length of time, which is owing to its property of not rusting or oxidating by the ordinary causes. Its great value and ductility led the ancients, as well as the moderns, to extend it into very thin leaves, for the purpose of applying it to the surfaces of other bodies, so as to imitate the solid metal; and it is astonishing to what a degree of thinness gold is extended by the gold-beater. The gold for this purpose must be very pure, and it is hammered out, or beat, after it has been rolled out as thin as paper, by being put between the leaves of a book of parchment and extremely thin skins, called gold-beaters' skin; the book is then laid upon a block of marble, and beat with a heavy hammer. When the leaves of gold are extended to the full size of the book, they are divided, and each portion is placed between the leaves of another book which is hammered as before. This process is continued till the requisite thinness is acquired. The thinness of gold leaf is quite surprising; it has been calculated that it does not exceed the $\frac{1}{218332}$ part of an inch. The sort of gilding on wood, called oil gold, cannot be burnished, and is always of the natural colour of unwrought gold. It has the advantage that it may be washed and cleaned with water, which burnished gold never can. It is often used for picture frames, parts of furniture, and mouldings of apartments; as it stands the weather, it is also employed for out-door work. To gild in oil, the wood after being properly smoothed, is covered with a coat of what is termed gold size made of drying linseed oil, mixed with yellow ochre. When this has become so dry as to adhere to the fingers without soiling them, or is tacky, as the gilder expresses it, the gold leaf is laid on with great care and dexterity, and pressed down with some cotton wool. Any places that have been missed are covered with small pieces of gold leaf, and when the whole is quite dry, the ragged bits are rubbed off with the cotton. This is by far the easiest mode of gilding; any other metallic leaves may be applied in a similar manner. Pale leaf gold has a greenish yellow colour, and is an alloy of gold with silver. Dutch gold, which is brought from Holland, is in fact only copper leaf colloured yellow by the fumes of zinc. It is much cheaper than true gold leaf, and is very useful where large quantities of gilding are wanted in places where it can be defended from the weather, by being covered with varnish; but it changes colour if exposed to moisture. It is only a cheap substitute for true gilding, useful where durability is not required, and is that which is used so profusely at present in our paper hangings. Silver leaf is prepared in the same manner as that of gold, but it is liable to tarnish, except it be well secured by varnish.

If covered with a transparent yellow varnish, it has much the appearance of gold. Japanners' gilding is where ornaments are drawn in gold upon japanned work, and is often seen in folding screens and cabinets, &c. The ornaments are formed by a camels' hair pencil, with japanners' gold size, made by boiling linseed oil with gum animi, and a little vermillion. When the size is nearly dry, gold powder or gold leaf is applied. It is to be understood, that in all cases where gold has been fixed on by means of linseed oil, it will bear being washed without coming off. Burnished, or water gilding is much more difficult; and as it cannot bear being wetted, is only fit for work to be always kept within doors. For this method of gilding, the wood is first covered with four or five coats of whiting and size; and that the gilding should be perfect, it is necessary that there should be a sufficient body of whiting. When these are dry, they are laid over with a coat of gold size made of Armenian bole, a little wax, and some parchment size. When the size is dry, a portion of the surface is wetted plentifully with clear water and a soft brush, and a leaf of gold is dexterously applied, so as almost to float on the water, when it instantly settles down and adheres to the size. Great care must be taken not to suffer any of the water to come over the gold, or a stain will be produced. When the whole is covered with gold leaf, the effect is what the gilders call *matt*, or the natural colour of gold not burnished. Such parts as are required to be burnished are rubbed over with a burnishing tool of agate. Ornaments executed partly matt, and partly burnished, have a very rich effect, which is seen in most picture frames.

We have stated that burnished gilding cannot be cleaned with water though oil gold may; but the matt portion of water gilding is so like oil gold as not to be distinguished by an inexperienced eye: and it may be very desirable to know, in that case, by which of the two processes it has been executed, with a veiw to cleaning it when soiled by flies or otherwise. This may be ascertained by observing in some crack or crevice wether the gold is laid on a coat of whiting; and if there be no other method, a small scratch with a knife may be made in some unimportant part to ascertain the fact. On account of the impossibility of washing water gilding without injury, it is necessary to take great care to protect it from flies, or other causes of soiling it, particularly in the summer season, by covering it over with some fabric of threads woven like a very fine net, as it is observed that flies instinctively avoid any thing in the shape of a net. Frames which have been executed in water gilding are sometimes required to be regilt: this cannot be done without taking off the whole of the whiting, and commencing the process again which is expensive. When this is done, the frames may be either re-gilt in the water or in the oil manner; and as the last is much the cheapest, it is sometimes preferred. We have observed that oil gilding cannot be burnished.

## THE COTTON PLANT AND ITS CULTIVATION.

*(Continued from page 331.)*

So far indeed from agreeing with Mr. Piddington in deprecating the use of common salt (muriate of soda or chloride of sodium) as a manure for the cotton plant. I believe it will be found to be one of the most useful that can be employed in its cultivation, and I would most earnestly urge upon every cultivator to give it a fair and careful trial.

I have seen common salt employed too generally and successfully in England, to come to any hasty conclusion that there is a single crop in India which is incapable of being benefitted by its applications. Let it be rembered that this manure destroys predatory vermin, abstracts moisture from the atmosphere, thus tending to keep the soil regularly moist: promotes the decay of stubborn vegetable remains in the soil, being antiseptic only when present in large quantities, and that it acts as a gentle stimulant to the plant, promoting its health.

I am not driven to advocate the employment of common salt as a manure for the cotton crop upon conclusions drawn from these general principles alone, for we have direct and satisfactory testimony upon the subject.

Mr Bolinbroke says that in Demerara the British settlers found that the cotton plantations succeeded better on the sea-coast than on the banks of the river, a superiority which he attributed to its containing more common salt. This opinion that salt promotes the growth of the cotton plant is also expressed in the third report of the African Institution, it being stated positively that the saline air of the sea-shore, though generally destructive to the coffee plant, is favourable to the cotton.

Mr. Bernard Metcalf, remarking upon the cottons of India, observes, "that the Georgia, Sea-island, Surinam, and Demerara cotton plants are all grown on the border of the sea, and the prime qualities only so far inland as the influence of the sea-air and tide waters extend."

This fondness of the cotton plant for maratime places has been observed also in other parts of the world, for Mr. Bruce, who resided many years in Persia, states, that the cotton was always fine in proportion as it was grown nearer to the sea.

It might be objected that the benefit the cotton-plant derives from the vicinity of the sea arises possibly from some other cause than the saline matter thence obtained, but such surmise is rebutted by the results of direct experiments.

A report published in 1827, by the Hon. Mr. Seabrooke, corresponding Secretary of the Agricultural Society of St. John's, South Carolina, seems to put beyond dispute the importance, not to say the absolute necessity, of using common salt as a manure, if a superior stapled cotton is desired. His researches were especially directed to ascertain the cause of the fineness of the Sea-island cotton, and the conclusion to which these researches led him was, that *salt mud*, the almost sole manure used by the best planters, was a principle cause of the superiority. "This manure," observes Mr. Seabrooke, "is known to impart a healthful action to the cotton-plant, inducing it rapidly to mature its produce, and giving it a staple at once strong and silky." One of his relatives, by steadfastly adhering to the application of soft mud, literally converted a barren waste to a soil as fruitful as any of which Edisto Island can boast.

Captain B. Bailey, a member of the before-named Agricultural Society, demonstrated that one bushel of salt, added to sixty bushels of compost, and spread upon the soil of a cotton plantation, improves most decidedly the quantum and quality of the crop.

This testimony, sustaining the legitimate conclusions deducible from scientific considerations, must justify my urging the importance of attending to the merits, and testing carefully the effects of one of the cheapest of manures—cheap, from the small quantity required to a biggah; for I believe that half a maund will be found sufficient, and the most beneficial time of applying it (by hand broad-cast) just before sowing the seed.

Let its value be tested fairly; part of the plantation being salted, and part left untreated. Let the produce of an equal number of shrubs on each be brought separately to the scale and to the merchant, and let these decide the question. Let no one be deceived by that suggestion of idleness, "I can see no difference;" for I would impress upon all the result of my own experience, and that of a hundred others, that *common salt promotes the development of the parts of fructification, and rarely or never increases the luxuriance of the plant.* These are precisely the contingencies desirable to be obtained for the cotton shrub, and I would conclude this head of my subject by suggesting as probable, that the use of salt as a manure will enable the Sea-island cotton to be cultivated in inland districts.

It is said that gypsum (sulphate of lime) may be used with success as a manure to cotton-lands, not near the sea. Lands so situated usually contain a minute proportion of this earthy salt. It perhaps, therefore, acts beneficially by entering into the constitution of the plant, as it does into that of clover and of lucerne; crops, which have been ascertained in England never to succeed well on soils in which this salt could not be detected.

*Preparation of Soil before Sowing.*—No ground should be cropped with two successive growths of cotton, as the produce of the second is always inferior to the first, both in quantity and quality. This rule applies whether the plants remain in production only one or more seasons. Following and cropping alternately is recommended by some planters; but this is certainly an unnessarily losing system, for if an intermediate crop of any kind is grown, especially if manure is given, and a strictly clean husbandry followed, the succeeding crop of cotton has never be known to be injured; but, on the contrary, rather improved.

In the south-western parts of Mysore they cultivate cotton in succession to millet. As soon as the millet is harvested, about the autumnal equinox, they immediately plough the field, and endeavour to cleanse it more effectually by hoeing it twice with the *cuntay* or bullock hoe. Manure is then put upon the field, which, after the first rain, is again ploughed.

In Bundelcund, land which has borne a winter crop is usually selected for cotton the following year, and the seed appears to be sown upon it without even the previous preparation of ploughing.

In other parts of India, although this previous preparation is not quite so neglected, yet, in no district, is it sufficiently attended to. The cotton-plant roots deep, and never succeeds in any soil not permitting the ready extension of its radicle fibres. This circumstance decides the importance of having it brought to a deep and fine tilth before the seed is sown. A Bombay Government Report of 1811 states, that in Georgia and Carolina, incessant labour is bestowed in ploughing, harrowing, trenching, and hoeing the cotton-fields.

This is confirmed by Captain Basil Hall from actual observation in Georgia—"The preparation of cotton-land," to use his own words, "requires most particular attention; it must be repeatedly ploughed, and frequently harrowed, say twice or thrice, until it is *fully* pulverised."

The Committee, reporting on the experiments made at Akra farm, are very particular in enforcing this preliminary cultivation. The success, they say, of a good crop, will depend upon the land being dug to a sufficient depth; if less than eighteen inches, the tap-root, which is exceedingly delicate, and extending nearly that length, becomes obstructed, and the growth of the plant is checked.

*Choice of Seed*.—The employment of seed, possessing its full vegetative power, is a consideration of primary importance, whatever may be the crop under cultivation; but where the seeds are of an oleaginous nature, as is the case with those of cotton, even extra caution is required, on account of the facility with which their germinating power is injured and destroyed.

Upon this point there are many particulars requiring attention. The seed ought to be selected from the most perfect early stalks, produced on the best soil. Mr. Seabrooke adds, "that frequent change of soil and situation is indispensable to sustain the quality of the cotton produced by any particular kind of seed; and employing mixed and bad seed is the origin of the indifferent quality of the produce of many countries. That which is intended for sowing should be known to be new, and ought to be well cleaned previously to sowing. At Surat, this is effected by rubbing it over a kind of sieve, called a *cott*, the bottom of which is made of close and tightly-strung coir. The refuse cotton, and a great many of the light seeds, are left upon the coir, and the good seed falls through. But it is best, in order to secure the employment of none but perfect heavy seeds, to put the whole into water just previously to sowing, and reject those which float upon the suface."

The quantity of seed employed per biggah varies considerably.—In Surat, 3 seers are sown upon a biggah; in Poorneah, 10 seers on a biggah, equal to 3,600 square yards; in the Dooab, 5 seers on a biggah, containing 2,800 square yards. Pierce Butler, Esq., a successful cultivator in the Georgian Island, St. Simon's, says "that a bushel of seed is required for an acre."

No particular quantity need, however, be assigned, because, if the best mode of sowing is adopted, drills will be made at eight feet apart throughout the field, and the seed inserted in them at three inches distance.

*Time for Sowing*.—The Committee, who reported upon the causes of the failure of the Akra farm, included amongst them "positive ignorance of the proper season for sowing;" and, as a more fatal mistake cannot occur than that of performing this operation at a wrong period of the year, it may be well to accord those months which have been selected by the most skilful cultivators.

Mr. Hughes, already mentioned as a grower of Bourbon cotton, at Tinivelly, says, "that there, if the seed can be got into the ground in September, the young plant may be able to resist the continued wet of a heavy monsoon; but little is gained by sowing in October, November, and December, unless the land is very high, dry, and free from weeds. The clear interval of these months, especially early in October, answer well for transplanting, and the first week of January very well, in general, both for sowing and transplanting."

Mr. Gilder, who has also cultivated the Bourbon cotton successfully at Guzerat, sowed at the end of July, after the heavy rains had ceased.

In America, Captain Hall says, "the sowing is performed from the beginning of April to the 10th of May.

In Central India, Baboo Radhakant Deb relates that the sowing is performed "during the month *Assar* (from mid-June to mid-July), or when the sun enters the sign of Gemini."

In the Dooab and Bundelcund, Mr. Vincent says, "the seed is committed to the ground immediately after the first heavy showers at the end of June, or beginning of July.

In Burmah the seed is sown in the beginning of the rains in April or May.

In the vicinity of Dacca the sowing is performed in October and November.

In the district of Poorneah the seed-time is March and April.

The object to be kept in view is to have the blossoming and harvest-time during the dry season, because heavy rains at such periods of the plant's growth are fatal, both to the quantity and quality of the production.

*Sowing*.—The best mode of arranging the land for the growth of the cotton-plant is by dividing it into flat beds at least four feet wide for the smaller kinds, separated from each other by alleys about eighteen inches broad. The seed being sown in a single row down the centre of each bed affords a space of five and a half feet between each two rows.

For the larger kinds, as the *C. acuminatum*, the Bourbon, &c., the bed should be seven feet wide. Mr. Hughes, so often before mentioned, says that the rows ought to be eight feet apart, and the plants thinned in the rows to the same distance. The facility for ploughing and hoeing is so great, besides the great advantage of a free circulation of air, that Mr. H. particularly insists on this method, especially as he knows that too close planting is a common mistake.

In Mysore the rows are made two feet apart, and even in some districts of America the intervals are only three or four feet apart; but if there be any increase of quantity obtained by this crowded culture, it is certainly at the expense of quality; and loss is insured by the unnecessary exhaustion of the soil by superfluous plants, and the operations of hoeing, &c., are extremely retarded.

The best mode of sowing is by opening a drill down the centre of each bed by means of a hoe, which ensures that the seed shall be buried at a regular, and not too great a depth. The depth should not be more than one inch or one inch and a half.

The seed may be strewed by hand along the drills, about three inches apart, and the earth immediately drawn over it by the hoe. In Mysore, they use a thorny bush for the purpose.

In some parts of America, they open a row of holes with the hoe about a foot apart, sprinkling a handful of seed in each; and in Burmah they adopt the still more slovenly mode of sowing broadcast.

*Preparation of the Seed.*—I have already noticed that, in Burmah, the seed is washed before it is sown; but as I am not aware that the cotton plant is liable to the attack of any parasitical plant, I do not see that this operation can be of any benefit beyond removing the seeds which are light and imperfect.

In central India they wet the seed, and then roll it in powdered cow-dung, waiting until the seed is nearly dry before they commit it to the ground.

About Dacca they merely wet the seed for a few minutes before it is sown; but in Bengal they frequently do not sow it until, by keeping it moist, it begins to germinate.

Dr. Anderson tried all these modes, as well as the mixing of various composts with the seed, but could not perceive that there was any difference in the size or strength of the young plants.

*Mixing Crops.*—Mr. Gilder, who made some successful experiments in cultivating Bourbon cotton in Guzerat, during the year 1816, grew with it *bejarce*, sown in drills as usual, at the same time. Indian corn is similarly mixed with the cotton crop in the Isle of Bourbon, being held to shelter the tender plants from the sun. Mr. Gilder found the bejarce to answer the same purpose; and he says it ought to pay the expense of rent and cultivation the first season, during which the cotton plant yields nothing.

In Burmah they sow brinjalls and other culinary vegetables with the cotton; and in Bundelcund, either urbur, tillil, or motee, are similarly mixed with it. Indeed, it may be considered as the general practice, but this universality is no justification; and, after some years experience in cultivating plants, I have never yet found two crops which could be grown together without one interfering with the operations that might be usefully performed to the other, or being in some other way prejudicial. In India, neither land nor labor are so dear as to render it desirable in an economical point of view. The plea of sheltering the cotton plants will be found invalid, for the shelter has a more than equivalent drawback by rendering the plants weak and spindled.

*After-culture.*—The after-culture consists chiefly in hoeing and stirring the soil, not only for the purpose of extirpating the weeds, but to pulverise the surface, so as to facilitate the penetration of the air, and the absorption from it of moisture by the soil. This is particularly beneficial in the dryest periods of the year, when, as is not generally known, the atmosphere is saturated with moisture.

The seedlings make their appearance in three or four days after the seed has been sown, and in two or three more develop two leaves. The thinning and weeding may then at once be commenced, this being at first carefully done by hand, for the young plants are very tender and easily injured. Mr. Butler, who has been more than once mentioned as a distinguished cultivator in the Island of St. Simon's, Georgia, recommends that the hoeing should be repeated at least once every twelve days until the plants flower, or even until they pod, if the ground is foul.

At such hoeing the thinning must be also attended to, which must be done moderately until the third hoeing; the plants will then be out of danger from the worms, and large enough to bear the drought.

In Mysore Dr. Buchanan found that the native cultivators performed the hoeing even still more frequently, drawing the *cuntay* or bullock-hoe between the rows once in every eight days, until the cotton was ripe.

The thinning should keep pace with the growth of the plants, and when they have attained the height of three feet apart, or whatever less distance may be determined, but the greater the interval the better.

Suckers thrown up about the root must be removed as formed.

Pruning is adviseable, if done with judgment.

Mr. Butler says that the Sea Island cotton requires not only the suckers to be removed, but, if the plants are vigorous, to have their tops pinched off once or twice.

Mr. N. Savi goes so far as to say that all who understand the cultivation of the Seychelles and Bourbon cotton, agree that to make them produce a fine quality of down, they should not be allowed to grow higher than three feet, which may be effected by cutting off the tender tops of the stems as soon as first blossoms appear. This causes them to spread wide in the their horizontal growth.

Mr. Higgins, in describing the cultivation of Upland Georgia cotton at Allahabad, says that "topping may or may not be resorted to; it may strengthen the plant, but I think it makes them later in bearing."

Mr. Hughes, who has, as before mentioned, cultivated the Bourbon cotton so successfully at Tinivelly, prunes this shrub twice in the year, the first and principal as soon as the heavy rains have passed away, that is from the 15th to the 31st of December, when the shrub is cut down, generally to two feet high and two feet wide, only the firm wood being left with the strong white and brown bark. In the fine days of January the plantation is ploughed thoroughly three or four times. In less than two months the whole is again in the finest foliage and full blossom, and continues in full bearing all the months of March, April, and May. A good many pods still remain in June, early in which month a second pruning is practised of the long, straggling, twisted, soft shoots, with diminutive pods. Good produce is yielded from July to September, unless the plants receive damage in these months of rain.

In Persia, after the crop is gathered, and the leaves fed off by sheep, the poor women are allowed to break the shrubs down close for firewood. The stumps shoot out again as luxuriantly as ever, when the season returns.

*Transplanting.*—If any vacancies occur in the rows whilst the plants are young, these may be successfully filled up by removing to these places some of the plants from situations where they may be growing too thickly; it is not a practice to be commended, as it renders the plants at least a fortnight later in coming into production.

*Watering.*—Although the cotton plant requires a light silicious soil, and is destroyed by water remaining stagnant around it, yet excessive dryness of soil is to be avoided. It may even be flooded with advantage, provided the water is allowed to flow off quickly again.

To preserve the soil in a due state of moisture, considerable attention is requisite during every period of the plant's growth. The object is to keep it soft and damp, so as to allow the free extension of the roots, but at the same time to avoid having the texture saturated with wet; and, much more, never to have so great an excess as to suffer the water to stand in pools upon the surface. The same precaution is requisite at the time of sowing; for water in excess at that time either induces the total decay of the seed, or causes its germination to be weak and unhealthy. When the shrubs are well grown and strong, which they are by the end of October, they seldom require more moisture than they acquire from the heavy dews which then accompany the cold weather. This, however, is not the case if the weather be dry. Particular attention to this point is requisite during the blossoming time.

The flower-buds appear in November, and in the course of five days the blossom is fully open. The flower falls off after being expanded about four days, leaving the pod apparent. Bright weather and heavy dews are to be desired during the blossoming: rain at that time destroys the crop. The pod requires about four weeks for ripening, this period being curtailed or extended in proportion to the heaviness of the dews and brightness of the sunshine at the season. A deficiency of either, delays the ripening. If the dews are particularly light, a gentle watering may with advantage be occasionally given. In Peru and Egypt the irrigation of this crop is most carefully attended to, and the results are proportionately beneficial.

(*To be continued.*)

## VARIETIES.

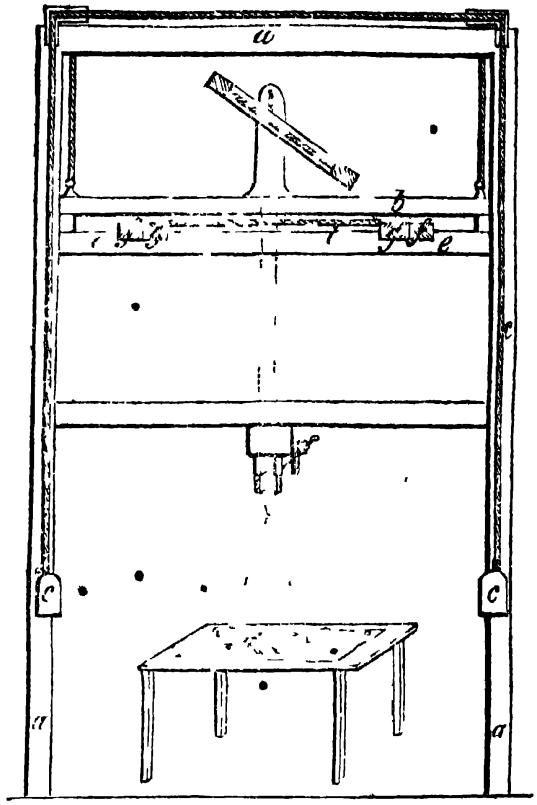
*Baths heated by Gas.*—Dr. Fyfe suggests, that where a bath is required in a bed-room, it may easily be heated by gas, by attaching a flexible pipe to a tube in the room, so that it will supply from 30 to 40 feet of gas per hour; six rose-jet burners, 16 holes each, will be sufficient. In his trials, Dr. Fyfe used a bath, in which were put 24 gallons of water at 50°; beneath the bath and a little from it, there was passed a tube of about two inches diameter, with six rose-jet burners attached to it. The gas was kindled, and in three quarters of an hour, the water was brought to 100°; gas consumed, 17 feet; cost, nearly twopence.

*American Clocks.*—A correspondent of the *Hartford Journal*, from Bristol, writes: "The amount of capital employed in this branch alone is some three or four hundred thousand dollars, and the business gives employment to nearly four hundred mechanics. The manufacture of clocks has greatly increased within the last five years although for fifteen years prior probably one million were made and profitably disposed of. We have every facility for manufacturing, and the vast improvements recently effected in machinery have done wonders for the business. The divison of labour is well understood, and carried out to a nicety, otherwise it would be impossible to manufacture and afford brass mahogany cased clocks for the low price of three, four, or five dollars each, which is now done. More than ten thousand have been sent to England alone within the last eighteen months."

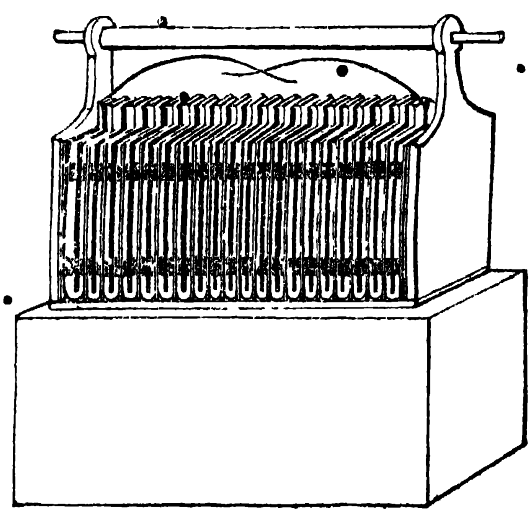
*Sheep Boiling.*—Mr. King's establishment at Maitland, Sydney, is now in full operation, about 14 tons of tallow from a herd of bullocks having been obtained. There are three large boilers, each of which will contain 10 bullocks, or about 100 sheep, so that a very large quantity of tallow will be made every week. If there is a full supply of cattle and sheep, about 25 tons of tallow will be produced every week. Being in a large town like Maitland, there is a market for the hind-quarters of the bullocks, which contain the least fat, but have the best joints of meat, and are therefore preferred by the retail butchers. Mr. King is making preparations for adding a steam-apparatus to his establishment, when he will be able, should it be required, to melt double the quantity of cattle he can at present. A good bullock will at the present prices produce nearly twice as much when melted into tallow, as if brought to Sydney and sold to the butchers. We think the melting question is now about to have a fair trial, and we have no doubt that £100,000 worth of tallow will be exported from this colony, between April, 1844, and March, 1845; and unless sheep should rise to a high price, which is by no means probable, we have no doubt that henceforth we should have an annual export of tallow to quite that amount.

*Action of weak acids on Electro-plated Vessels*—Mr. Warrington asserts that copper vessels, such as saucepans, extract-pans, &c silvered by the electrotype process, are acted upon by weak acids, as lemon juice or vinegar, if allowed to remain in them for a short time. This, he says, must arise from the deposited silver being so porous as to allow the acids to permeate its substance, and the action is most likely assisted by the formation of a galvanic current.

*Cure for the sting of a Wasp.*—When stung by wasp, suck the wounded part, if practicable, and then rub some drops of hartshorn into it, and the inflammation will be abated, if not prevented, or rub the part with the washerwoman's blue bag, so as to rub a little into the wound before the swelling closes it up. This applied in time gives instant relief, we have heard chalk will do, and it is possible that it is the chalk used in the stone-blue that effects the cure, but we have the best proof of the efficacy of the blue bag which is generally already wet, for being stung twice within the hour, an old cottager applied the bag, rubbing it itself for half a minute, the recent sting was cured so completely, that we did not feel the hurt, the other had swelled as large as half an egg, and the bag had but little if it had any effect.




CAMERA OBSCURA COPYING MACHINE.



VOLTAIC BATTERY.

## CAMERA OBSCURA COPYING MACHINE.

Mr. W. E. Newton, of Chancery lane, civil engineer, has lately obtained a patent for improvements in machinery or apparatus for facilitating and copying of designs, drawings, and etchings of all kinds, either of the original size, or upon an enlarged or reduced scale.

This invention is said to consist in a new application of the camera obscura, in the construction of which it will be necessary that the frame containing the design to be copied should have a backward and forward, and also a vertical and horizontal movement: and, lastly, that part of the apparatus containing the lens should be capable of being raised or lowered; the annexed engraving, which is an elevation of one side of the machine, will suffice to give our readers a clear idea of the invention. *a a* shows the frame work of the machine, which is about 9 feet high, this frame supports a horizontal frame *b*, which is suspended by cords and weights *c c*. in such manner as to be capable of being raised and lowered at pleasure; at *d* there are two standards, supporting a plate of glass *d'* placed at an angle, *e e* is also another rectangular frame supporting a frame *f f*, which has a movement in the direction from *e* to *e*, this frame is made with a feather or projection on the inside, which slides within a groove formed in another frame marked *g g*, which frame moves in an opposite direction to the frame *f f*, or at right angles to it; this frame *g g*, also carries a plate of glass *i*, upon which the design to be copied is placed: the object of these moveable frames is to bring the various parts of the subject or design immediately below the rays of light which pass through the plate of glass in the manner shown by dotten lines, and also through a double convex lens fixed within a sliding tube supported by the cross frame *h h*, which frame can also be raised and lowered by weights attached to ropes passing over pullies, or by other mechanical means; the tube containing the lens is also capable of being adjusted by means of a rack and pinion, for the purpose of regulating the distance with greater nicety.

It will, therefore, be seen that the design to be copied must be on varnished or transparent paper, which on being placed upon the plate of glass *i*, the image or a portion of the image will be thrown upon the table k k, upon which there is a sheet of paper which receives the image of the design to be copied, the part surrounding the table being kept perfectly dark, so as to exclude all light but that which passes through the lens.

This machine may also be employed for copying designs drawn upon ordinary paper by making the frames which receive the designs capable of moving in such a manner that the design can be placed in a vertical position opposite a prism, and thereby made to pass through a lens, by which means the design can be altered to any size at pleasure. The specification also describes another machine constructed upon the same principles, the arrangement of some of th parts being somewhat altered, so as to admit the light at the side, the foregoing machine admits the light at the top.

## VOLTAIC BATTERY.

BY VAN MELSEN.

The engraving represents an useful arrangement of copper and zinc plates for a voltaic battery, the contrivance of J. A. Van Melsen, of Maestricht. The copper soldered to the zinc in each pair envelopes the zinc of the following pair, so as to be exposed to the two surfaces of this plate, but without being in contact with it, It differs from Wollaston's pile, in having the metallic plates much nearer to each other; they are only about $\frac{1}{13}$ inch apart, and are maintained thus by small pieces of cork interposed between the plates of zinc and those of copper, whilst the plates of copper of the consecutive elements are separated by squares of glass of the same size as the plates. All the pairs are placed in a kind of wooden frame carefully varnished, in which they are easily retained without its being necessary to attach them by screws to a bar of wood, as is the case in the Wollaston combination. This arrangement presents the additional advantage of greatly facilitating the taking to pieces of the elements. The pairs united in the frame are at once immersed into the acidulated liquid contained in the trough: the plates of zinc are carefully amalgamated. Van Melsen describes a battery on this plan, which he constructed for the Maestricht University, consisting of 52 pairs, of which the plates of zinc are $6\frac{1}{2}$ inches wide, and $7\frac{7}{8}$ inches high. By its means a platinum wire $\frac{1}{50}$ of of an inch thick, and $17\frac{3}{4}$ inches long, was reduced to incandescence with an extraordinary brilliancy, and fell into seven pieces, at the extremities of which the melted metal arranged itself into globules. A silver wire $\frac{1}{50}$ of an inch thick, and $15\frac{3}{4}$ inches long, became intensely red, and fell into fragments. An iron wire $\frac{1}{50}$ of an inch thick, and $15\frac{3}{4}$ inches long, was speedily brought to the most vivid state of ignition, and was reduced into four pieces, in which, in many places, the melted iron was gathered into large globules. At the period of this latter experiment the battery had already been a long time in action, and was much weakened. When the battery was first excited, in order to produce a spark, the two slips of copper which serve as conductors were brought into contact. The parts in contact became immediately soldered together, so that it was necessary to employ a certain effort to separate them.

## SCAGLIOLA, OR THE ART OF IMITATING MARBLE.

The art of manufacturing scagliola, or imitation marble, was well known to the ancients; although chiefly confined to the pure white or *marmoratum opus*, and *albarum opus*, mentioned by Pliny, and of which the statues, busts, basso-relievos, and other ornaments of architecture were composed. The cements of the Egyptians employed in coating the walls of the tombs, and forming the ground-work of their paintings, also partake of the character of marble. In modern times the art of imitating marbles has been carried to a far higher state of perfection, particularly in Italy, and some parts of France and Germany; and the imitations of many of the precious marbles, such as sienna, brocatello, jasper, porphyry, verde antique, &c., exhibit an astonishing degree of beauty of perfection and finish. In England this art is comparatively unknown, having almost sunk into disuse in consequence of the perishable nature of the material, its insecurity when employed as pillars having to bear a heavy super-incumbent weight, its liability to damage, ready absorption of damp, and its expense, which, although trifling when compared to marble, is still much higher than is warranted by the nature of the material.

It is evident that this truly beautiful art is open to great improvement, and experience tells us there is something wanting beyond that of mere skilful imitation and beauty of finish, for after all it is simply lath and plaster with an exterior coating, rather harder, it is true, than the rest, but still incapable of resisting the influence of moisture or the slightest external violence. By the present imperfect process the plaster of scagliola work is produced by applying a pap of finely-ground calcined gypsum, mixed with a weak solution of Flanders glue upon any figure formed of laths nailed together, or occasionally upon brickwork, and bestudding its surface while soft with splinters of spar, marble, granite, bits of concrete, coloured gypsum, or veins of clay in a semi-fluid state. The substances employed to colour the spots and patches are the several ochres, boles, *terra di sienna*, chrome yellow, &c. The surface of the column is turned smooth with a lathe, polished with stones of different fineness, and finished with some plaster pap to give it lustre. Pilasters and other flat surfaces are smoothed by a carpenter's plane with the chisel finely serrated, and afterwards polished with plaster by friction.

By the above process the scagliola manufacturer, with a vast deal of labour employed in the final polishing, is enabled to turn out pillars and pilasters of great magnitude and beauty of polish; but the glue which is the cause of the gloss, is also a cause of its subsequent dulness and decay when it becomes exposed to moisture and damp air. Again, by employing plaster of Paris alone, the manufacturer is subject to great loss by waste of material, in consequence of its setting too rapidly, or of the coagulating property of the burnt alabaster being very much impaired or lost by the powder being kept too long, especially if in the open air, before it is made use of, for when it has once been suffered to grow hard, it is no longer serviceable, nor can it be made so, by any known process of burning.

The first and most important step towards improving the art, so as to ensure durability, is by employing more substantial materials in the body or ground-work than are at present used. The second consideration is to substitute a cement of mixed qualities instead of pure plaster of Paris or burnt alabaster, so as to ensure the requisite strength and density of the material, and to enable the artist to finish off the polishing without the use of glue or any other substance which has the property to absorb, and thereby cause the rapid decay of the work; greater hardness is also essentially requite to avoid moisture, the chipping, indentations, and scratches to which it is now so very liable.

For pillars of magnitude, pedestals and pilasters, a core of rough brickwork might be used to great advantage instead of the present lath and plaster, the bricks being cemented together, and roughly covered in by one of the cheap durable cements commonly in use, or by a mixture of lime, oxide of iron, and manganese, similar to Parker's cement, which has the effect of setting rapidly even under water. Mortar made with about five parts of flint powder, one of shell-lime and the necessary quantity of lime-water and molasses, well triturated together, will make an exceedingly fine and durable base on which to dispose the colours, and if properly used and followed up with an outer coating composed of fine shell-lime, flint powder, milk, and eggs, will assume the hardness and capability of polish of marble. The room in which these works are carried on should be kept at a warm temperature, and great care should be taken under all processes of scagliola work to exclude the atmospheric air as much as possible, also that the stucco should be free from saline impurities, contain some coherant body, and be capable of acquiring hardness gradually until it becomes of stone-like quality.

The art of making plasters of mixed qualities, to be employed in modelling statues, busts, and other works of architecture, instead of using pure plaster of Paris, is unknown to us. The Romans paid great attention to these matters, and the ancient plastering preserved to this time, where it has not met with violent blows or injuries from accidents, is still as firm and solid, as free from cracks or crevices, and as smooth and polished on the surface as if made of marble; the bottoms and sides of their aqueducts were made of plaster, which has endured many ages without decay. Again, the roofs of houses and the floors of rooms at Venice are covered with a sort of plaster, made at later date, and yet strong enough to endure the sun and weather for several ages without spoiling or cracking, and without much injury from the feet. But the greatest attention perhaps is paid to this subject by the natives of the East Indies, who, for their finer cements, which are capable of receiving a most exquisite polish, use ghee (butter in its oily state), oils, jaggery, and other, to us, expensive ingredients. At Madras fifteen bushels of pit sand well sifted are added to fifteen bushels of stone lime; this is slaked in the common manner, and so laid two or three days together. Twenty pounds of coarse sugar or molasses is dissolved in water, and the mortar is sprinkled with the liquor, which is then beat up together and well incorporated, and afterwards let to lie in a heap. A peck of *gram* (similar in nature to our coarse grey pea) is then boiled to a jelly, and the liquor strained and preserved. A peck of *mirabolans* is also boiled, and the liquor set aside; the three waters are then added together. The mortar beaten up, and, when too dry, sprinkled with this liquor, proves remarkably good for laying bricks or stone, keeping some of the liquor always at hand for the workman to wet his bricks with. For very strong work, tow is incorporated with the mortar. Of this the natives makes many architectural ornaments, such as columns, arched work and imagery, besides using it for common building purposes. For finer works, to every half bushel the white of five or six eggs and four ounces of *ghee*, or ordinary salted butter, and a pint of butter-milk beaten all well together; mix a little of the mortar with this, till the ghee, butter-milk, and white of eggs be soaked up; then soften the rest well with plain fresh water, and so mix altogether, and let it be ground, a trowel-full at a time, on a stone with a stone roller. When you use it, in case it be too dry, moisten it with some water, or the before-mentioned liquors. This is for the second coat of plastering.

When the first coat of plastering is laid on, let it be well rubbed with a hardening trowel, or with a smooth brick, and strewed with a gritty sand, moistened, as occasion may require, with water, or the before mentioned liquor, and then well-hardened again; when half dry, take the last mentioned composition for the fine plastering; and, when it is almost dry, lay on the whitening varnish; but, if the work should be quite dry, then the chuman liquor must be washed over with a brush.

The best sort of whitening varnish is made thus: —take one gallon of toddy (the juice of a tree), a pint of butter-milk, and as much fine shell-lime as shall be proper to colour it; add to it some of the chuman liquor, wash the the plastering gently over with this, and when it is quite dried in, do the same again. A plaster thus made is more durable than some soft stone, and stands the weather better in India than any of the bricks they make there. Butter-milk is always added to the outer coating. There are several varieties of cements of durable quality, and capable of receiving a fine polish.

The above are the Indian methods, and they have been thus particularly described, because the cement so made is vastly preferable in every respect to the plaster of Paris used in the process of scagliola work, and also for making large capitals to imitate marble, which, however beautifully executed, soon lose their polish, and are liable to be injured past the power of repair. It may be thought that the materials are much too expensive, but the small quantities of each actually required for scagliola or plastering of walls and floors will raise it but little above the common price of cements.

The boles and earths laid on for the imitative part of the work ought to be mixed with the like material, so that it may incorporate as one with the interior coats, the pillars being carefully fashioned on the lathe, as is at present practised, or polished dry, or with the use of the liquor. Clay ought to be used as sparingly as possible, the requisite plastic quality being given to the mass by the mixture, The common scagliola of the day, as exhibited in some of the leading shops of the metropolis, deceives nobody; it is what it purports to be, a vile imitation of Nature; but nevertheless there are some fine specimens to be found in Buckingham Palace, the Pantheon in Oxford-street, in Everington's, and other buildings of the metropolis. No attempt is, however, made in the present day to extend and improve the art of imitating the precious marbles, or to ensure durability, consequently it falls into disesteem, and is rarely used.

The Palace of Munich is built of artificial marble, the material being boiled, and the colouring added when the boiling mixture has acquired consistence. This practical application of the art might be employed to great advantage with us, chimney-pieces and vast variety of ornaments being by this means formed at so cheap a rate, and of so fine a fabric, as to supersede marble. It is hoped that this beautiful branch of architectural art will speedily be revived, and that no opulent house-holder will be without some specimen of it adorning his mansion, as pillars, pedestals, slabs, vases, baths, or other ornament. A little determination and enterprise on the part of the scagliola manufacturers, and the importation of a few first-rate Italian artists, would soon bring it into favourable notice.—*Builder*.

## THE COTTON PLANT AND ITS CULTIVATION.

(*Continued from page* 344.)

*Gathering.*—The season for gathering differs in India with the place of growth.

Mr. Gilder, at Fuzerat, picked his Bourbon cotton from the end of November to the close of January. A second, but more scanty crop, occurring in May.

In Central India, Baboo Radhakant Deb says, the pods are ripe in the month Choytc, when the sun enters Pisces (mid-March to mid-April), and that the gathering continues until the close of May.

About Decca the crop is gathered in April, May, and June; and where the situation is beyond the reach of inundation, a second crop, but inferior in quantity and quality, is obtained.

In Bundelcund, on the poorer soils, the crop begins to be collected about the middle of September, but from those of the richer and more northerly situated soils, not until November and December.

When the pods are ripe, which they are in less than two months after blossoming, three of their sides burst, and the cotton protrudes through the fissures. In five or six days after the pods have burst, the cotton is usually gathered, though it is often allowed to remain longer. At Surat they wait for ten days, and continue the gathering once after every similar lapse of time until the close of April, by which time the cotton is all gathered.

There is no doubt that the being allowed to remain so long without being gathered after the pods have burst, is not injurious to the quality of cotton, but it is at the same time quite as certain that it is in no way beneficial. Granting this, however, to be immaterial, the plan of allowing it to remain seems objectionable, upon the plain reason that every day renders the skin of the pod and the leaves of the calyx more brittle, and consequently increases the liability to injure the quality of the crop by their fragments getting intermixed.

I have a strong opinion that it would be found in every way advantageous to gather each pod immediately that it shows symptoms of bursting, as enabling the cotton to be separated from it without so much liability to contamination from its fragments. However this may be, experience teaches us that the gathering should be effected very early in the morning whilst the dew is upon the plant, the calyx is at that time pliant, yielding to the hand without breaking, and consequently keeping the cotton free from leaf.

In gathering, care must be taken to grasp at once all the locks of cotton in the pod, so that they may come away together. If any dry leaves fall upon the cotton before the gatherer has secured it in the bag hanging by his side, they must be carefully removed. This bag must be covered to prevent the admission of pieces of the dry leaves, always to be found about the branches, and which are disturbed by a very slight agitation. It is this admixture of leaf which is so much objected to by the spinner, and proportionately lowers the value of the cotton. After gathering, it should immediately be thoroughly dried, whether it is to be stored or at once dressed and packed. A woman in America will generally gather twice as much per day as a man.

The pods which burst the earliest, usually those on the tops of the shrubs, produce the finest cotton; the quality as well as quantity diminishing as the plants decrease in vigour. This is so apparent, that the cotton of the first two gatherings is usually worth three or four rupees per candy more than that of the later gatherings.

*Produce.*—In favourable seasons a biggah in *Guzerat* will produce 25 maunds of cotton, mixed with the seeds. Where these have been separated by the wheel or cheriah, the cotton will be found to weigh about nine maunds, and the seed 15 maunds. In the eastern and southern parts of India, two or three maunds of clean cotton is the estimated average of a biggah.

Twenty-seven biggahs in *Broach* produce 444 maunds of clean Bourbon cotton, fully equal to that of the island after which it is named.

In *Poorneah* five maunds of uncleaned cotton are usually grown per biggah.

Dr. Buchanan says, that in *Mysore* the produce varies between 110 and 270 lbs. per acre.

Captain Hall states, that in *America* from 400 to 500 lbs. of cleaned cotton is produced from a similar space of ground.

In Central India Baboo Badhakant Ded states that a biggah yields about one maund and three quarters of cleaned cotton.

The comparative proportion in weight between the cotton and the seed usually varies from one to four and one to three. It is of course, a great object in the growth of cotton to obtain an increase in the proportion of wool produced above that of the seed. At Shahabad this was effected in the instance of Egyptian cotton. Mr. Seyburne says its produce there was not only superior in staple, but was half-cotton and half-seed, whilst the country plants yielded only one part cotton and three parts seed.

We thus conclude our rather lengthened account of the cultivation and produce of this most interesting vegetable production, one in a trading point of view, forming a most important branch of our national resources and comfort, and to the manufacture of which, we intend to devote a portion of our future pages, illustrating them with diagrams of the machinery employed.

## FIRE PROOF HOUSES.

The attempts which have been made to render houses fire-proof are so intimately connected with the construction of dwellings, that it will be proper to give a few brief details on the subject. There are many difficulties attending these attempts; for so long as wood forms the chief inner frame-work of a house, there will always be considerable liability to destruction by fire. Most of the proposed plans have had relation to the coating of the wood with some substance which should render it less inflammable, while others have been directed rather to the rejection of combustible substances from the list of those used in house-building.

So long back as 1775, Mr. Hartley made several trials in order to test the efficacy of a method invented by him for that purpose. Thin iron plates were nailed to the top of the joists; the edges of the sides and ends being lapped over, folded close, and hammered together. Partitions, stairs, and floors were proposed to be defended in the same manner. The plates were so thin as not to prevent the floor from being nailed on the joists in the same manner as if the iron were not used: and the plates were kept from rust by being painted or varnished with oil and turpentine. Mr. Hartley had a patent for this invention; and Parliament voted a sum of money towards defraying the expense of his numerous experiments. It does not, however, appear that the plan was permanently adopted.

About the same period, Lord Mahon, afterwards Earl Stanhope, a nobleman possessing a highly inventive tact in mechanical matters, brought forward another method having the same object in view. This method was of a three-fold character, comprising *under-flooring*, *extra-lathing*, and *inter-securing*.

The method of under-flooring is either single or double. In single under-flooring a common strong lath of oak or fir, about one-fourth of an inch thick, should be nailed against each side of every joist, and of every main timber supporting the floor which is to be secured. Other similar laths are then to be nailed along the whole length of the joists, with their ends abutting against each other. The top of each of these laths or fillets ought to be at an inch and a half below the top of the joists or timbers against which they are nailed; and they will thus form a sort of small ledge on each side of all the joists. These fillets are to be well bedded in a rough plaster when they are nailed on, so that there may be no interval between them and the joists; and the same plaster ought to be spread with a trowel upon the tops of all the fillets, and along the sides of that part of the joists which is between the top of the fillets and the upper edge of the joints. In order to fill up the intervals between the joists that support the floor, short pieces of common laths, whose length is equal to the width of these intervals, should be laid in the contrary direction to the joists, and close together in a row, so as to touch one another; their ends must rest upon the fillets, and they ought to be well bedded in the rough plaster, but are not to be fastened with nails. They must then be covered with one thick coat of the rough plaster, which is to be spread over them to the level of the tops of the joists; and, in a day or two this plaster should be trowelled over, close to the sides of the joists, without covering the tops of the joists with it.

In the method of double-flooring, the fillets and short pieces of laths are applied in the same manner as here noticed; but the coat of the rough plaster ought to be little more than half as thick as that in the former method. Whilst the rough plaster is being laid on, some more of the short pieces of laths must be laid in the intervals between the joists upon the first coat, and be dipped deep in it. They should be laid as close as possible to each other and in the same direction with the first layer of short laths. Over this second layer of short laths there must be spread another coat of rough plaster, which should be trowelled level with the tops of the joists, without rising above them. The rough plaster may be made of coarse lime and hair; or instead of hair, hay chopped to about three inches in length may be substituted with advantage. One measure of common rough sand, two measures of slacked lime, and three measures of chopped hay, will form in general a very good proportion, when sufficiently beaten up together in the manner of common mortar. The hay should be put in after the two other ingredients are well mixed up together with water. This plaster should be made stiff; and when the flooring boards are required to be laid down very soon, a fourth or fifth part of quicklime in powder, formed by dropping a small quantity of water on the limestone shortly before it is used, and well mixed with this rough plaster, will cause it to dry quickly. If any cracks appear in the rough plaster work near the joists, when it is thoroughly dry, they ought to be closed by washing them over with a brush wet with mortar wash; this wash may be prepared by putting two measures of quicklime and one of common sand into a vessel, and stirring the mixture with water till the water becomes of the consistence of a thin jelly.

Before the flooring boards are laid, a small quantity of very dry common sand should be strewed over the plaster work, and struck smooth with a hollow rule moved in the direction of the joists, so that it may lie rounding between each pair of joists. The plaster work and sand should be perfectly dry before the boards are laid, for fear of the dry rot. The method of under-flooring may be applied to a wooden staircase, but no sand is to be laid upon the rough plaster work. The method of extra-lathing may be applied to ceiling joists, to sloping roofs, and to wooden partitions. The third method, which is that of inter-securing, is very similar to that of under-flooring; but no sand is afterwards to be laid on. Inter-securing is applicable to the same parts of a building as the method of extra-lathing.

Such is a general outline of the modes proposed by Lord Mahon for rendering houses fire-proof; in which it will be seen that the safeguard consists in the use of a non-combustible material with, and among, and between the pieces of wood forming the frame-work of a house.

The more recent attempts to gain the same object by means somewhat similar have been very numerous; some of which we may here notice as examples of the whole.

An American patent was granted in 1837 to a Mr. Louis Pambœuf, for the invention of a fire-proof paint. The mode of preparing it is thus described. A quantity of the best quicklime is selected, and slacked with water in a covered vessel; when the slacking is complete, water, or skimmed milk, or a mixture of both, is added to the lime, and mixed up with it to the consistence of cream. When milk is not used, a solution of rice paste is employed, obtained by boiling eight pounds of rice to every hundred gallons of paint. When the creamy liquor is prepared, alum, potash, and common salt are added, in the proportion of twenty pounds of alum, fifteen pounds of potash, and a bushel of salt, to every hundred gallons of the paint. If the paint is to be white, six pounds of prepared plaster of Paris and the same quantity of fine white clay are added to the above proportions of the other ingredients. All these ingredients being mingled, the mixture is strained through a fine sieve, and then ground in a colour-mill.

When roofs are to be covered, or when crumbling brick walls are to be coated, fine white sand is mixed with the paint, in the proportion of one pound to ten gallons of paint; this addition being made with a view to giving the ingredients a binding or petrifying quality. In applying this paint, except in very warm weather, it is prepared in a hot state, and in very cold weather precautions are necessary to prevent it from freezing. Three coats of this paint are deemed in most cases sufficient.

In another variety of this paint, oil is the chief liquid ingredient. To prepare it forty gallons of boiled linseed oil are mixed with slacked lime to the consistence of a paint; and to this are added two pounds of alum, one pound of potash, and eight pounds of common salt; or good wood-ashes may be substituted for the potash. This paint is used in the same manner as other paint; and any colour may be obtained by adding the usual pigments to the composition.

The preparation of a kind of paint containing alkalies seems to have been a favourite measure among inventors of "fire-proof" composition; for many of the modern projects have had this for its basis. But in most cases there have not been means for determining the degree of efficacy possessed by these compositions.

Perhaps the mode in which we may more consistently look for the practical attainment of the object in view is by the adoption of some improved mode of building, in which either wood is not employed at all, or, where sparingly used, measures are taken to shield it from the action of fire. One such method is Leconte's, described as follows.

This plan consists in the employment of iron frames to receive concrete matter for forming the walls. The basement story of the building is constructed according to the ordinary methods up to one foot or more above the ground. On the basement so constructed is to be erected the patent wall, formed of frames entirely of cast-iron, in one or more pieces, or a combination of cast-iron and wrought-iron plates. These frames are to be set one on the other until the required height is attained, the necessary stability being obtained by means of steady pins at the corner of one frame fitting into holes made in the corners of the frame which is opposed to it. Suitably shaped frames are employed for the internal partition walls, and for door-ways, window-frames, &c. The flues of the chimneys are formed of iron or other metal pipes, placed in the thickness of the walls. When the required elevation is obtained, a concrete of any suitable material is poured into the framing, and fills up the vacant space, giving firmness and solidity to the structure; the concrete being made of gravel and lime. To give steadiness, lead is to be introduced between the joinings of the iron-work. The doors and window-frames are to be fastened to the walls by any of the usual known methods. The main beams and cross beams of floors and roofs may be of cast-iron, or formed of iron and wood; or they may be formed of one or more pieces of plate-iron, bent up into an oval form, and straightened by an iron or wooden bar passing through them lengthwise, the upper edges of the metal being turned over to increase the strength. In the interval between the beams there are to be iron rods running in various directions, and supporting a metallic wire-work, which forms the foundation for the ceiling. Similar wirework is to be employed in lieu of lathes for all plaster surfaces. All the iron work is to be painted over with some suitable composition to prevent oxidation.

A plan for the same purpose has been proposed by Mr. Varden as follows:—"It appears probable that common fir or oak joists with their lower edges chamfered, and coated over with a mixture of alum, black lead, clay, and lime, or some similar composition, would (if closely floored above with earthenware tiles, bedded all round into the plastering, the joists being made air-tight) resist the action of flames, at least for a considerable time. Fire could not descend through such a flooring so as to communicate with the rooms below, till the tiles used in it had become red-hot; neither could it ascend until the tiled floor above gave way from the burning joists; which if coated, as proposed, would not take fire from below till the tiling over them acquired a sufficient heat to cause the distillation of the turpentine from the wood. In general, there is not furniture enough of a combustible nature in any room to do this. The battening against the outer walls might be of larch, as that wood burns less freely than most others; but if the walls were brick, or lined with brick, battening of any kind will be unnecessary. If this plan should be thought likely to answer the end proposed, houses built in the common manner might be altered at a moderate expense, by taking up the boarded floors, and substituting earthenware tiles."

Another plan, proposed by Mr. Frost, consists in forming the floors of rooms of hollow earthenware tubes embedded in cement, combined so as to form a sort of flag-stone, covering the whole floor. These hollow tubes are squares in section, about an inch and a half on the side externally, with a tubular space of an inch and quarter on the side internally; they are formed of brick earth, prepared in a superior manner, and pressed through moulds by machinery; and their length is about two feet. In forming a floor of these tubes, the centering, after being prepared and fixed in the usual manner, is first covered with a coating of cement of a quality sufficiently fine to form the ceiling of the apartment to be floored over; and if it is desired that there should be mouldings or ornaments in this ceiling or its cornices, moulds for them can be placed in the centering, so as to form a part of it. One or two coats of cement having then been laid over the centering, a stratum of the square tubes laid side by side, and breaking joint, is next embedded in fine cement, and the interstices between them also filled in with that material. One thin coating of cement is then laid over the whole stratum; and in a week, when this is dry, another stratum of tubes is laid over the first in a contrary direction, bedded and filled in with cement as before, and finished by a coating of the same material.

Mr. Loudon gives descriptions of two methods, the one for building houses in general fire-proof, and the other for imparting that property to houses already built. He considers the two main points for the consideration to be, to have staircases of iron or stone, or both combined, and to avoid having any hollow partitions or floors. A house having a stone or iron staircase, and having all the partitions either of four-inch brickwork, or of brick nogging, in whatever way it might be set on fire, could hardly be burned down, if ordinary exertions were made to extinguish the flames. One apartment might be set on fire, but before the flames could spread to the one under or over it, or to a staircase adjoining it, the fire might be extinguished. In a house so constructed there would be no piece of timber that was not in close contact with mortar, at least on one side; and all the strong pieces of timber, such as joists, rafters, quartering in partitions, &c., would be closely imbedded in mortar on two sides. Where the partition could not be made entirely of brick, the interstices might be filled up with a mortar prepared of clay with a small proportion of lime. The same material might be filled in between the joists, and where it is desired to render the roof fire-proof, the rafters might be made of iron, or the space between wooden rafters might be filled in with thin mortar. This mode of proceeding would lengthen the time required for the drying of a newly-built house, and would also add somewhat to the expense; but it is conceived that the increased safety would more than counterbalance these inconveniences.

In respect to the means of giving a fireproof quality to a house already built, Mr. Loudon remarks: "All the interstices between the floors, in the partitions, and in the roof, where there was a ceiling formed to the rafters, might perhaps be filled in with earthy matter in a state of powder. This powder might be clay or loam mixed with a small proportion of Roman cement; it might be injected into the vacuities, through small orifices, by some description of forcing-pump or bellows, which, while it forced in the powder, would permit the escape of the air; and, while this operation was going forward steam might be injected in the same time so as to mix with the mortar and be condensed by it; by which means the whole mass would be solidified with a minimum of moisture. In short, in rendering houses fire-proof, the next important object to using fire-proof materials, is that of having all the walls and partitions, and even the steps of wooden staircases, filled in with such materials as will render them in effect solid. On examining into the causes of the rapidity of the spread of the flames in London houses when on fire, it would almost invariably be found, that whatever may have occasioned the fire to break out, the rapidity of its progress has been in proportion to the greater or less extent of the lath and plaster partition, the hollow wooden floors, and the wooden staircases. Were the occupier of houses sufficiently aware of the danger from lath and plaster partitions, especially when inclosing staircases, they would never occupy such houses, or, if they did, they would not give such rents for them as they would for houses with brick-nogging partitions. It appears to us to be the duty either of the general or local government or police to see that no houses are built without stone or iron staircases; and that no partitions and floors are made hollow; or, if they are, that the materials should be iron and tiles, or slates, or stones, or cement, or other earthy composition."—*The Useful Arts Employed in the Construction of Dwelling Houses.*

## FIRE DAMP—VENTILATION OF MINES.

At the first meeting in the present year of the Royal Institution, Professor Faraday laid before the members some observations on coal mines, and the accidents to which the miners are liable, with especial reference to what is called the *goaf* of the mine.

In consequence of the disastrous explosion in the coal mine at Haswell, where 95 men and boys were killed, he had been deputed by Government to proceed there, in conjunction with Mr. Lyell, and to make a report upon it. That report was before the public, and it was with the view of explaining some points in it that he came before them on that occasion. He did not profess to understand coal mines so well as those who had devoted all their time to the subject, but he did profess to understand Nature in some degree, and it was from this circumstance probably that Government had selected him for the inquiry. He would premise that the inquest shewed that no blame attached to any person in the late disaster; all precaution, so far as their knowledge went, had been taken, but certain observations had occurred to Mr. Lyell and himself which, if attended to, might, he thought, have the effect of lessening danger in future. He then described, by means of a black cloth stretched against the wall of the theatre, the appearance of a seam of coal, and the mode of working the mine. He shewed that having sunk a shaft down to the seam (in the present case 900 feet deep), a straight passage 5 yards wide was worked out of it, 25 yards forward; the roof being secured by props. A passage right and left of the same width, was then cut to the same extent, and then again returned right and left, so that ultimately the mine presented a series of masses of coal, 25 yards square, called pillars, each surrounded by a passage or way. They then began to work out one of these masses (the thickness of the seam in question was 4 feet 6 inches), and as they removed the coal, they secured the roof by means of props. When the whole of one pillar had been taken out, as they could not afford to leave the timber supports, they were withdrawn, and the superincumbent earth descended. This was called a *goaf*, and ultimately presented a heap of ruins of enormous extent. The *goaf* they examined covered thirteen acres (an area once and a half as large as Lincoln's-inn-Fields).

Leaving this part of the subject, the professor then described the nature of fire-damp, and shewed its properties by experiments with coal-gas, which, in most respects, resembled it. The gas which exudes in the mines becomes explosive when mixed with atmospheric air in quantities of not less than 5 of air to 1 of gas, or more than 14 of air to one of gas; with less air or more air there is no danger. The professor was of opinion that the coal-dust scattered about was licked up by the rush of air produced, in which case the combustion (as he shewed by experiments) was very different. Fire-damp is exceedingly light, and necessarily ascends to the highest parts. This he exemplified by various experiments, as upon this property was based the proposition he wished to enforce—namely, that the goaf is a receptacle for fire-damp, and by a variety of circumstances may be made to discharge part of its contents into the mine—for example, by change in the density of the atmosphere.

The ventilation of mines was effected by two shafts, in one of which was a furnace; through the rarefaction produced, currents were established which drew off the gas. To shew the size of the furnace at the mine where the accident occurred, he mentioned that a ton of coals was always in combustion. The professor then shewed by experiments how rapidly smoke was carried off in this manner. He filled a glass vessel (which represented the goaf-cavity) with inflammable air, smoke, &c., and then exhausted it in a few seconds, by means of a pipe communicating with the flue of one of the small furnaces in the theatre. He used tubes of thin sheet-iron and of air-proof cloth for experiments on large and rapid currents, proposing (to avoid the effect of excess) to suspend them, or place them on props in the open space of any passage most convenient for the purpose; and said that such tube, or even others made by nailing four boards together, would be sufficient for the purpose. He showed that the terminal ends of these need not be reversed every time the upper end of the goaf changed its form, and concluded by confuting objections that had arisen in his own mind, or might be urged against the details of the arrangement he recommended, and stated his belief, that it was in reality as practicable as it was theoretically unimpeachable.

## MUTUAL RELATION OF THE SCIENCES.

It is so congenial to the human mind to inquire into the causes of the natural phenomena existing around us, and presented to us in the daily changes taking place in all visible objects, that those sciences which give satisfactory explanations and correct answers to our inquiries, exercise more influence on the advancement of mental cultivation than any other. Thus the relations of light to the earth, the succession of day and night, the variations of the seasons, and the differences in the temperature of different climates, gave birth to *astronomy*. As the mind advances in knowledge, as it becomes enlightened by the influx of truths, no mattter from what source, its capabilities are increased, its powers strengthened and elevated, and its progress in all other directions proportionately facilitated. When we obtain a correct knowledge of the link which connects certain associated phenomena, when we have made an acquisition of a new truth relative to causation, it becomes equivalent to a new and additional sense, enabling us to perceive innumerable phenomena which had previously escaped our notice, and which still remain mysterious or altogether invisible to others.

In the progressive growth of astronomy the other physical sciences were developed, and when these had been, to a certain degree, successfully cultivated, they gave birth to the science of chemistry. And now we may anticipate that organic chemistry will perfect our knowledge of the laws of life—the science of physiology.

But it must not be forgotten that our predecessors determined the duration of the year, explained the changes of the seasons, and calculated eclipses of the moon, without any acquaintance with the laws of gravitation; that people have built mills and constructed pumps without knowing anything of atmospheric pressure; that glass and porcelain were manufactured, stuffs dyed, and metals separated from their ores by mere empirical processes of art, and without the guidance of correct scientific principles. Even geometry had its foundation laid in experiments and observations; most of its theorems had been seen in practical examples, before the science was established by abstract reasoning. Thus, that the square of the hypothenuse of a right-angled triangle is equal to the sum of the squares of the other two sides, was an experimental discovery, or why did the discoverer sacrifice a hecatomb when he made out its *proof*?

How different now is the aspect of the discoveries of the naturalist, since the spiritual impetus of a true philosophy urges him to investigate phenomena in order to understand their *causes* and *laws*, whether in natural philosophy, chemistry, or in other sciences. From one sublime genius—from Newton—more light has preceeded than the labour of a thousand years preceding had been able to produce. The true theory of the movements of the heavenly bodies, the law which regulates the fall of bodies, *i. e.* gravitation, has become the parent of innumerable other discoveries. Navigation, and, in consequence, commerce and industry, immediately felt its influence, and every individual of our species has derived, and will continue to derive, as long as mankind exists, incalculable benefits therefrom, both intellectual and material.

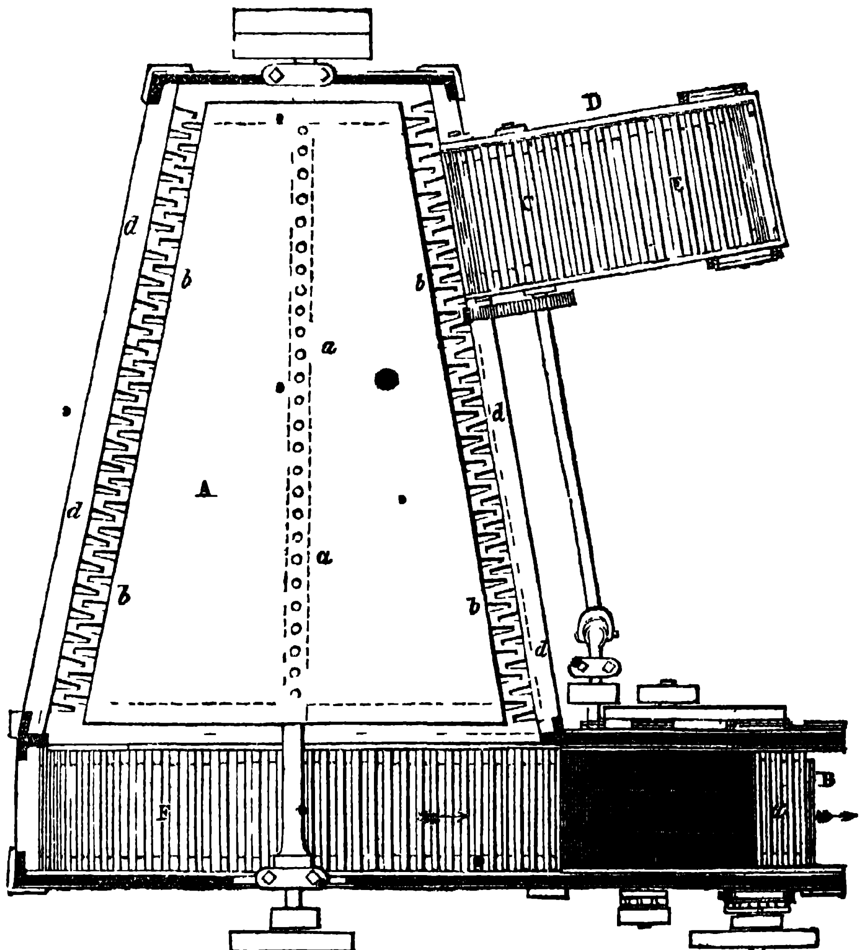
(*To be continued.*)

## VARIETIES.

*Coffee.*—Chicory is detected by shaking the suspected article with cold water, in a glass vessel; if the coffee be pure it will swim and give little or no colour to the liquid, but if chicory be present it sinks to the bottom, and communicates a pretty deep red tint to the water. Roasted corn may be detected by adding tincture of iodine to a cold decoction of the suspected coffee, which will produce a blue colour in the liquid.

*Purifying Dwellings.*—Take six drachms of powdered nitre, six drachms of oil of vitriol, mix them in a teacup, by adding to the nitre one drachm of vitriol at a time; the cup to be placed during the preparation on a hot hearth or plate of heated iron, and the mixture stirred with a tobacco-pipe or glass rod; the cup to be placed in different parts of the contaminated chamber.

Fig I




NATURE AND OPERATIONS OF A WOOLLEN FACTORY

## NATURE AND OPERATIONS OF A WOOLLEN FACTORY.

Having in former numbers given a description of the Worsted Manufacture, we proceed to lay before our readers an interesting account of the Nature and Operations of a Woollen Factory, wherein will be shewn the process of the Short Wool, or Cloth Manufacture.

In the structure and mechanical properties of its filaments, short or carding-wool resembles cotton very closely, and is therefore, throughout the spinning department at least, the object of similar machinery and manipulation. The great contractility and elasticity of the animal fibres, however, give to the cloth made of them a susceptibility for peculiar treatment by what is called the fulling, felting, and teasling operations.

The *wool-mill* or *willy* (called *willow*, in the cotton manufacture, probably a corruption of winnow) is the first machine to which clothing-wool is subjected. It opens up and cleans from sandy and other loose impurities the matted fleeces supplied by the wool-stapler. The most improved willy is the conical one, as now constructed by Mr. Lilly of Manchester, for opening out the staple of cotton as it comes from the bags. A correct delineation of all the essential parts of this very effective automatic apparatus is hereafter described. In the former willows used in cotton-mills, the cotton was introduced to the revolving spiked apparatus and removed by hand, not without risk of injury to the operator. Here, however, no such danger exists, for the wool, whether of the sheep or the cotton-plant, is continuously fed in at the one end by means of a travelling exterior apron, and given out by a similar mechanism at the other end. This facility of spontaneous circulation and discharge is derived from the conical form of the revolving drum.

The wool entering near the summit of the cone is at first subjected to the minimum rotatory impulsion of the machine, and is thenceforth continually solicited onwards, in the direction of the base, in obedience to the increasing centrifugal force. This cone is studded with rows of iron pins, and it revolves within a concentric case, studded with similar pins arranged alternately, so as to permit the former to pass through their intervals, When the wool has arrived by a spiral circulation near the base of the cone, it is deposited upon an endless apron, by whose motion it is turned out upon the floor of the apartment in a disentangled state. Fig 1 exhibits a top view of this willow, with part of the casing and frame removed to show the interior structure. The cone A consists of a strong iron-shaft *a*, surmounted with three cast-iron rings, one at each end and one in the middle for supporting the sheet-iron mantle which forms the surface of the cone. Along this surface four equidistant iron bars are fixed parallel to the axis, each of which receives a row of strong iron pins *b*, fixed perpendicularly by nuts and screws; corresponding with the intervals of these pins, are fixed also by nuts and screws a row of pins *d*, *d* on each side of the casing-frame. The top of the cone is covered in by a concentric envelop of thin sheet-iron, and its bottom is formed of a grid-iron-plate also concentric. In the top casing near the narrow end there is an oblong opening C having a frame D attached to it, which carries an endless apron E. On this table or travelling apron the wool is spread by hand. The table consists of parallel slips of sheet-iron three-quarters of an inch broad, with interstices between them of half an inch, rivetted at their ends upon two endless leather straps. These travel upon pulleys fixed on two shafts parallel to the iron slips, the one of the shafts being moved by wheel-work and the other being adjustable by set screws which act on the bearings of the shaft so as to tighten the strap.

At the wider end of the machine there is a chamber F into which the wool is tossed out of the cone, after performing its spiral revolutions, and is then received on an endless apron like the former, as shown in the figure. About an inch above the surface of this apron, a cylindrical wire-cage revolves on an axis parallel to the apron. It is enclosed in a casing of sheet-iron, which communicates at its side with the chamber F. Over this casing, within the frame-work of the machine, is a fan placed, enclosed in a similar case, which sucks out the dust through the wire or squirrel cage in the chamber F below it, and blows it out through a large pipe connected with an orifice not visible in this view. The wire-cage and the fan are placed in communication by a flat tin-plate cover or lid, which embraces the openings at one end of the axis of these two cylinders. The opposite ends of the fan and case are left open to draw the dust out of the room and to ventilate it. The wire-cage not only prevents the fibres of cotton or wool from being wafted away with the lighter dust, but it lays them down in a fleece by its rotation on the travelling apron. Two other figures are requisite for exhibiting the working geer of the machine, but these are reserved for the more minute details illustrative of the cotton manufacture.

The machine is here represented on the greatest scale, and is drawn correctly three-fourths of an inch to a foot. There is one of them in action, which is capable of cleaning 3000 pounds weight of cotton-wool in twelve hours. The wool slowly fed in by the apron E is disentangled by the revolving spikes of the cone, aided by the centrifugal movement; and discharges at once its heavier impurities, such as twigs, dirt, and stones, through the perforated bottom, and the lighter ones through the cylindrical cage under the draught of the fan, into a large pipe, and thence into a separate dust-room of the factory. The cleansed fibres thereafter come forth on the apron at *w* in the direction of the arrow. The best speed of the revolving cone is about 500 turns per minute.

Sheep's wool for coarse goods is passed several times through the willow, first to break the mats of the raw wool and to render it light; then a second time after it is dyed; a third time to mix the different sorts together, and a fourth time with the view of incorporating the oil thoroughly with the woollen fibres.

Blowing and lapping machines of curious structure are universally employed for cleaning and opening cotton after it has passed through the willow, before submitting it to the cards. But these refined mechanisms do not seem to have been introduced into the general run of the woollen manufacture, though they will probably be adopted to a certain extent when their nature and merits become better known; a result which may in some measure be promoted by the delineations and descriptions of them prepared for the second portion of the present treatise.

*Scribbling* is merely a rude species of carding the oiled wool, and is the next process in the woollen manufacture. The scribbling machine delivers its wool in the form of a broad thin fleece or lap, and therefore corresponds exactly to the breaker-cards in a cotton-mill. This lap is then presented to the cards properly called, which work it again, and deliver it in a narrow band or sliver. A view and description of one of these machines will therefore serve to explain the structure and operation of both. Carding opens up and separates the woolly filaments, renders the fleece lighter, more equable, and homogeneous; it occasionally breaks the fibres in disentangling their connexions, multiplies their fibrils, and by giving them a bristling and downy texture, renders them more disposed to agglomerate in the fulling process.

By carding, wool expands greatly in its dimensions; the short broken filaments get crossed in every possible direction and are ready to lay hold of one another; constituting the most favourable conditions for being fulled. As the fibres of wool are more tortuous, elastic, and stiffer than those of cotton, they require in their carding apparatus not merely a main cylinder with card teeth, but a series of smaller ones riding upon and embracing it, for alternately taking off and returning the wool, so as to open it sufficiently without breaking it to pieces, and to lay the fibres at every imaginable angle to each other. Yarn made of wool thus carded becomes susceptible of entering into a coherent combination, and forms at once a more ductile and more substantial thread, than yarn from wool which has been carded by hand.

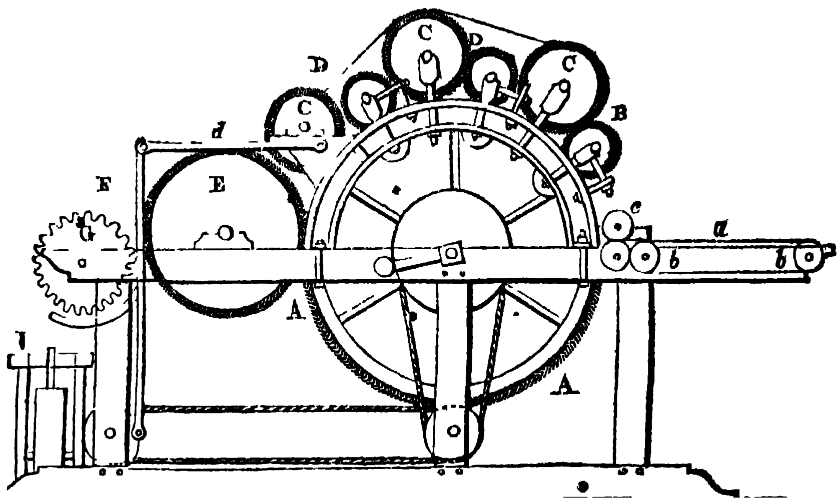



Fig. 2. WOOL-CARDING ENGINE.

The wool-carding engine represented in Fig. 2, consists of several smaller cylinders covered with card cloth grouped round a larger cylinder A similarly covered, which is about thirty-two inches long. The wool is first laid down and spread evenly by hand upon an endless apron *a*, stretched between two rollers *b*, *b*, which by their rotation gradually move forward the cloth and introduce the flocks of wool upon it between the pair of feed-rollers *c*, *c*, by which it is seized and distributed upon the first cylinder-card B, and from it transferred to the card-drum A. The drum is surmounted by three other pairs of cylinders of smaller diameters, which take successive shares in the carding operation. Each pair of cylinders consists of a *worker* C, and a *cleaner* D, somewhat less in size than its fellow, and turning in the reverse direction of the drum. The teeth of the first *worker* strip the wool from the surface of the drum, and then give it up to the *cleaner*, which, revolving with much greater rapidity, returns it to the drum-card. Hereupon the second working cylinder takes possession of the wool thus deposited, and turns it over to its attendant cleaner, whence it is again given up to the drum, and thus in continual succession. It is therefore by this repeated transfer from one cylinder-card or urchin to another, and by a continual drawing out between the teeth of the different orders of cards, that the filaments become separated and expanded. Pulled about, turned, and re-turned in every way, they get mixed and confounded together at one moment, to be disentangled at another, in order to form a light and homogeneous fleece. The teeth of the several cylinders do not come into actual contact, but they work so closely that they strip each other, time-about, of every adhering filament in regular succession.

When the fibres have been thus thoroughly teazed out by three and sometimes four pairs of urchin cylinders, they are finally taken off the main drum by the stripping-cylinder E, called the *doffer*, which is of a smaller size and turns more slowly. The wool is taken off the doffer by a steel comb F, or doffing-knife, moved rapidly up and down by a crank, so as to give a shaving stroke to the surface of the card-teeth a continuous fleecy web of extreme tenuity. In the scribbling process this fleece is wound upon the surface of a revolving roller in the form of a lap.

In this lap, however, the fibres of the wool are seldom sufficiently disentangled. Several little knots and convoluted flocks may be perceived which this primary carding has not been able to undo. A second operation is therefore performed on the same wool by the same machine, and if necessary even a third.

*(To be continued.)*

## VOLCANOES.

(*Continued from page* 339.)

*Review of the Silurian and Slate System.*—Let us now review the leading phenomena which have been brought under our notice in our former pages. The Silurian system presented all the usual characters of sedimentary deposits, with which our previous investigations have rendered us familiar. Its marine origin is evinced by the organic remains; and the strata have evidently been formed and consolidated by mechanical, chemical, and vital agency, acting through a long period of time, in like manner as in the production of the newer secondary formations. The fossils consists of a few algæ, equiseta, lycopodiaceæ, and ferns; about ninety species of polyparia, of which the lamellar and cellular corals form by far the largest proportions; thirty-five species of crinoidea; about two hundred and sixty species of bivalve shells, and eighty of cephalopoda; sixty-five species of trilobites, or other crustacea; and the remains of a few species of fishes. Mr. Murchison, from his extensive collection of fossils, has selected several which he considers characteristic of the four groups into which he has subdivided the system; and these fossils, with but few exceptions, are assumed to be specifically distinct from those of the carboniferous group.

In the Cumbrian, or slate system, we have a vast argilaceous formation, with numerous conglomerates; and from the structure of the entire series, it would appear that after the deposition of the strata by water, the whole had been exposed to the long-continued influence of heat, by which the original sedimentary character was either greatly modified, or entirely obliterated; about twenty or thirty species of shells and corals, consisting of cyathophyllia, spiriferæ, productæ, &c. are the only organic remains. In accordance with the slaty structure, is the prevalence of melted rocks throughout the Cumbrian epoch; for not only do granite, porphyry, serpentine, and trap, occur in veins and dykes, but also intercalated with the strata, as if the melted matter had been poured over argillaceous sediments at the bottom of the sea, and had become covered by succeeding deposits.

We have thus, in these two systems, evidence of marine depositions going on through an immense period of time, during which the sea abounded in polyparia, mollusca, and crustacea; for although organic remains prevail only in the uppermost or newest group, yet as we have decided proof that the lowermost division has been subjected to intense heat, and that even the lines of stratification are in a great measure melted away, it is clearly reasonable to conclude, that the absence of fossils is attributable to the obliteration of the remains of the animals which lived and died in the waters that deposited the slate. We must not, however, fail to remark, that the relics of organized beings which remain are of a peculiar type, and altogether different from the corals and shells of the newer secondary formations.

*Review of the Metamorphic Rocks,*—The traces of stratification, a structure which, we have seen, is characteristic of aqueous formations, are evident in the upper group of the crystaliine metamorphic rocks; and there is also an obscure resemblance to the alternate depositions of secondary beds, in the succession of different mineral masses, as gneiss, mica schist, quartz rock, &c. But the lowermost term of the series, the granite, even these apparent relations to the stratified formations, are wanting; and in the amorphous masses, veins, and dykes, we have the effect of long continued and intense igneous action, produced under circumstances which have given to the resulting rocks a very peculiar character. There is one striking deduction which M. Fournet has drawn from the mineralogical character of these rocks, namely, that those masses which, according to our chemical knowledge, would require the most intense and long continued incandescence for their formation,—those in which quartz largely predominates,—are precisely those which from their geological position must have been longest exposed to such an agency—hence, in granite, the foundation rock, quartz, which is the most infusible and refractory material, largely prevails. The possibility of an earth being converted by intense heat into the hardest and purest crystal, was shown in the formation of fictitious rubies, To the granite succeed rocks in the exact order of their containing less quartz, and being therefore more easily fusible—granite with a large proportion of felspar, porphyry, serpentine, mica, schist, and clay slate. If we take these phenomena into consideration, together with the facts previously stated, of the transmutation of one substance into another by heat, it appears to me, that in the present state of our knowledge, we are warranted in concluding that granite and its associated rocks, are nothing more than sedimentary deposits altered by igneous agency.

*Organic Remains in the Metamorphic Rocks.*—From the intense heat to which the metamorphic rocks have been exposed, we cannot expect to find any elementary organic structures, except those which are formed of materials capable of resisting the effects of such an influence. The observations and experiments of Mr. Reade have shown that vegetables possess a structure which is composed of silex, and is indestructible in a common fire. In animals, we seek in vain for an elementary tissue, capable of resisting the powerful influence of heat, except in those minute beings, the infusoria. In certain families of these living atoms, the soft body of the animal is protected by two cases or shields, like the cypris, and these cases are, in various species, composed of lime, iron, or flint. In others, the skeleton or solid support is in the form of rings, or moniliform (head-like) threads. The silicious skeletons and shields of the infusoria, are therefore the only animal structures that can escape destruction, in substances subjected to the influence of a high temperature; and it is clear, that if the skeletons or durable parts of any other animals were exposed to such an agency, all traces of their organization would be obliterated. It would therefore be a hopeless task to seek for any trace of animals, in rocks where even the lines of stratification are melted away, except of those which, like the infusoria, possessed silicious skeletons. When speaking of the fossils of the chalk, it was stated that the coatings of many of the flints contained myriads of the silicious skeletons of animalcules and that some rocks were almost wholly composed of such remains.

Ehrenberg, to whom we are largely indebted for opening this new field of inquiry, has discovered the remains of this class of animals in numerous deposits. Thus the ferruginous or ochreous film or scum seen on the water of marshes, or of stagnant pools, or collected at the bottom of ditches, sometimes forming a red or yellowish mass many inches thick, without any consistence, which divides upon the bare touch into minute atoms, and when dried resembles oxide of iron, is found to be wholly composed of the shields of infusoria (*gaillonello ferruginea*). The formation of bog iron-ore is supposed to be in a great measure dependent on these animals. A ferruginous mass from a peat bog, "which appears to have owed its origin to the action of volcanic heat at the bottom of the sea," entirely consisted of shields of infusoria (*naviculæ*), The semi-opal, and the tripoli of the tertiary deposits, are wholly composed of the fossil remains of this class of animals. In the secondary formations, we have seen that they are equally abundant. Ehrenberg also distinctly states, that while in the instances above mentioned, there cannot be the least doubt of the nature of the organic remains; in the semi-opal of the serpentine formation of Champigny, and in the precious opal of the porphyry, he has detected bodies so exactly similar, that although at present he hesitates postively to affirm that they are organic, he can scarcely entertain any doubt upon the subject.

*Relative Age of Mountains.*—We have seen that the intrusions of melted rocks have not only altered the chemical nature of the strata, through which they were erupted, but have also changed their position and relations, and produced corresponding modifications in the physical geography of the dry land, transforming plains into mountain peaks, and occasioning the subsidence of elevated regions to the bottom of the deep. As these revolutions took place at various epochs, separated from each other by considerable, or brief periods of repose, it is manifest that the existing mountain chains are of very different ages. By a careful examination of the phenomena which bear upon this question, the relative antiquity of many of the principal ranges has been determined; or, in other terms, it has been ascertained during what geological epochs the Alps, Pyrenees, Andes, &c. were elevated above the waters. Our observations on this subject must, however, be restricted to an explanation of the mode of induction employed, and a brief notice of some of the results which have been obtained. The positions and relation of the secondary strata afford the principal data by which this problem may be solved; for, as secondary and tertiary formations have been deposited in directions either nearly or entirely horizontal, it is obvious, that when they are found highly inclined, and in contact with mountain masses of primary or volcanic rocks, the latter must have been protruded *since* the sedentary were deposited, and of course during the secondary or tertiary epochs, as the case may be. On the contrary, if we find other strata in contact with the same masses, but only touching them with their edges, or encircling their base, it is obvious that the mountains must have been elevated before the formation of the surrounding deposits. It is by cautious indiction of this kind, that a distinguished savant, M. Elie de Beaumont, has shown—1. That the mountains of Frzegebirge, in Saxony, and of the Cote d'Or in Burgundy, are newer than the Jura limestone, but older than the green sand and chalk. 2. That the Pyrenees and Appennines are of about the same age with the chalk formation. 3. That the western part of the Alps is newer than the older tertiary formations, and was raised up after the last of the newer pliocene strata were deposited. It is obvious that the protrusion of such immense masses as the Alps or Pyrenees from the bottom of the sea, must have dislodged a vast body of water, and created a series of waves high and powerful enough to cause transitory but destructive inundations over such portions of the adjacent dry land, as were only a few hundred feet above the level of the sea. In this way M. Beaumont thinks some of those revolutions may have been produced, which seem to have extinguished animal life at different periods, and prepared the way for new forms of living beings.

(*To be continued.*)

---

## MUTUAL RELATION OF THE SCIENCES.

(*Continued from page* 352.)

Without an acquaintance with the history of physics it is impossible to form any correct opinion of the effect which the study of nature has exercised upon the cultivation of the mind. In our schools mere children are now taught truths, the attainment of which has cost immense labour and indescribable efforts. They smile when we tell them that an Italian philosopher wrote an elaborate treatise to prove that the snow found upon Mount Etna consists of the same substance as the snow upon the Alps of Switzerland, and that he related proof upon proof that both these snows, when melted, yielded water possessed of the same properties. And yet this conclusion was really not so very palpable, since the temperature of the two climates so widely differ, and no one in those days had any notion of the diffusion of heat over the surface of the earth. When a schoolboy takes a glassful of liquid, and placing a loose piece of paper over it, inverts the glass without spilling a drop of the contents, he only astonishes another child by his performance, and yet this is the identical experiment which renders the name of Torricelli immortal. It is a variation of that experiment with which the burgomaster of Magdeburgh (Otto von Guerike) threw the Emperor and the princes of the empire at Ratisbon into speechless astonishment. Our children have more correct notions of nature and natural phenomena than had Plato! they may treat with ridicule the errors which Pliny has committed in his Natural History.

By the study of history, of philosophy, and of the classics, we obtain a knowledge of the intellectual world, the laws of thought, of mental inquiry, and of the spiritual nature of man. Whilst we hold communion with the spirits of the great and good of all ages, we derive from the experience of past centuries the power of soothing and governing the passions, and of softening the heart; we are enabled to comprehend man as he exists at the present time, since his moral nature remains ever the same. We are taught to embellish, and present, in the most engaging form, the principles of truth, of right, and of religion, and thus to made the most enduring impression upon the minds of others. History and philosophy, however, could not prevent men from being burnt for witchcraft. For when the great Kepler went to Tubingen to save his mother from the stake, he succeeded only by proving that she possessed none of the characteristic signs essential to a witch!

Only sixty years ago was chemistry, like a grain of seed from a ripe fruit, separated from the other physical sciences. With Cavendish and Priestley its new era began. Medicine, pharmacy, and the artisan's workshop, had prepared the soil upon which this seed was to germinate and to flourish. The foundation of the science is, as is well known, an apparently very simple theory of the phenomena of combustion We have now experienced the great benefits and blessings which have sprung and been diffused from this view. Since the discovery of *oxygen* the civilised world has undergone a revolution in manners and customs. The knowledge of the composition of the atmosphere, of the solid crust of the earth, and of water, and their influence upon the life of plants and animals, was linked with that discovery. The successful pursuit of innumerable trades and manufactures, the profitable separation of metals from their ores, also stand in the closest connection therewith. It may well be said that the material wealth of empires has increased many-fold since the time oxygen became known, and the fortunes of individuals have been augmented in proportion. Every discovery in chemistry has a tendency to bring forth similar fruits. Every application of its laws is capable of producing advantages to the state in some way or other, augmenting its powers or promoting its welfare.

In many respects chemistry is analogous to mathematics. On the one hand, the application of this latter science enables us to measure land, to erect buildings, and to raise weights, and, as in arithmetic, becomes an instrument, the skilful employment of which secures most obvious and universal advantages; on the other hand, mathematics enables us to draw correct logical conclusions according to definite rules, teach us a peculiar language, which allows us to express a series of such conclusions in the most simple manner, by lines and symbols intelligible to every one who understands this language; give us the power to deduce truths by means of certain operations with these lines and symbols; and furnish us with an insight into relations of things formerly obscure or unknown to us. The mechanician, the natural philosopher, the astronomer, employ mathematics as an indispensable instrument for the attainment of their ends. They must, indeed, be so practised in its management that its application becomes a mechanical habit, requiring only the exercise of memory. But it is not the mere instrument which plans and executes the work, but the human intellect. You will admit that without the power of observation, without judgment, without sagacity, all mathematical knowledge is useless. You may imagine a man who, favoured by a good memory, has rendered himself intimately acquainted with every theorem of mathematics, who has obtained an eminent degree of skilfulness in handling this instrument, but who is altogether unable to invent a problem for solution. If you propose to him a problem, and give him the conditions for the solutions of a question, he will succeed in obtaining an answer by performing the current operations with which he is familiar, and express it in a formula consisting of certain symbols, the meaning of which, however, is perfectly unintelligible to him, because he is deficient in other attainments essential for judging of its truth. Such a man is a mere calculating machine. But as soon as he possesses the capacity and the talent of proposing a question to himself, and testing the truth of his calculation by experiment, he becomes qualified to investigate nature. For from whence should he derive his problems if not from nature? He is denominated a mechanician, an astronomer, or a natural philosopher, if, starting from observation, he is able to ascertain the connection of certain phenomena and the causes producing them: and then is capable, not merely of expressing the results in a formula, in the language of the mathematician, but of making an application thereof, exhibiting his formula in the shape of a phenomenon or external fact, thereby testing its truth. The astronomer, the mechanician, the natural philosopher, therefore, in addition to mathematics, which they use only as an instrument, still require the art of observing and interpreting phenomena, the ability to present the results of abstract reasoning in a visible shape by means of a machine or some form of apparatus; in fact, to prove the correctness of their conclusions by experiment. The natural philosopher proposes to himself the solution of a problem, he endeavours to ascertain the causes of a given phenomenon, the variations it undergoes, and the conditions under which these changes take place. If his questions have been correctly put, and all the circumstances (the factors) taken into account, he succeeds in obtaining, by the aid of mathematical processes, a simple expression for the unknown quantity or relation which has been the object of his search. This expression or formula, translated into ordinary language, explains the mutual connection of the observed phenomena, or of the experiments which he has instituted; and the formula is correct, when it enables him to produce a certain series of new phenomena which are its corollaries.

Chemistry, in answering her own questions, proceeds in the same manner as experimental physics. She teaches the methods of discovering and determining the qualities of the various substances of which the crust of the earth is composed, and which form the constituents of animal and vegetable organisms. We study the properties of bodies, and the alterations they undergo in contact with others. All our observations, taken collectively, form a language. Every property, every alteration which we perceive in bodies, is a word in that language. Certain definite relations are manifested in the deportment of bodies toward each other, a similarity in form, or analogy in properties, or diversities in both respects. Such diversities are as numerous and various as the words of the most copious language, and they are no less varied in their signification and in the relations which they bear to our senses,

The verbal meaning conveyed by the properties of bodies,—to pursue the illustration,—changes according to the mode in which these elements are arranged. As in all languages, we have in that language whereby material bodies hold converse with us, articles, substantives, and verbs, with their variations of cases, declensions, and conjugations. We have also many synonymes; the same quantities of the same elements produce a poison, a remedy, or an aliment, volatile or a fixed body, according to thei manner of arrangement.

When we would understand the meaning of the properties of bodies, that is, of the words in which nature speaks to us, we use the alphabet to decipher and to read them; as, for instance, a fountain of mineral water in Savoy cures that remarkable enlargement of the thyroid gland denominated goitre, I put questions to that water, the combinations of the several letters in its answer informs me that it contains *iodine*. A man having partaken of some food, dies soon after, with all the symptoms of poisoning. The language of the phenomena, which is familiar to the chemist, tells him that arsenic, or corrosive sublimate, or some other body, was mixed with the food.

*(To be continued.)*

## CAOUTCHOUC MANUFACTURE.

This department of operative industry has, within a few years, acquired an importance equal to that of some of the older arts, and promises, ere long, to rival even the ancient textile fabrics in the variety of its designs and applications. The manufacture of caoutchouc has, at present, three principal branches

1. The condensation of the crude lumps or shreds of caoutchouc, as imported from South America, India, &c., into compact homogeneous blocks, and the cutting of these blocks into cakes or sheets for the stationer, surgeon, shoemaker, &c.

2. The filature of either the Indian rubber bottles, or the artificial sheet caoutchouc, into tapes and threads of any requisite length and fineness, which, being clothed with silk, cotton, linen, or woollen yarns, form the basis of elastic tissues of every kind.

3. The conversion of the refuse cuttings and coarser qualities of caoutchouc into a viscid varnish, which, being applied between two surfaces of cloth, constitutes the well-known double fabrics, impervious to water and air.

1. The caoutchouc, as imported in skinny shreds, fibrous balls, twisted concretions, cheese-like cakes, and irregular masses, is, more or less, impure, and sometimes fraudulently interstratified with earthy matter. It is cleansed by being cut into small pieces, and washed in warm water. It is now dried on iron trays, heated with steam, while being carefully stirred about to separate any remaining dirt, and is then passed through, between a pair of iron rolls, under a stream of water, whereby it gets a second washing, and becomes at the same time equalized by the separate pieces being blended together. The shreds and cuttings thus laminated, if still foul or heterogeneous, are thrown back into a kind of hopper over the rolls, set one-sixteenth of an inch apart, and passed several times through between them. The above method of preparation is that practised by Messrs. Keene and Co., of Lambeth, in their excellent manufactory, under a patent granted in October, 1836, to Mr. Christopher Nickels, a partner in the firm.

In the great establishment of the Joint-Stock Caoutchouc Company, at Tottenham, originally under the direction of Mr. Sievier, a gentleman distinguished no less by his genius and taste as a sculptor, than by his constructive talents, the preparatory rinsing and lamination are superseded by a process of washing practised in Mr. Nickels's second operation, commonly called the *grinding*, or, as it should more properly be styled, the *kneading*. The mill employed for agglutinating or incorporating the separate fragments and shreds of caoutchouc into a homogeneous elastic ball, is a cylindrical box or drum of cast iron, 8 or 9 inches in diameter, set on its side, and traversed in the line of its horizontal axis (also 8 or 9 inches long) by a shaft of wrought iron, furnished with three rows of projecting bars, or kneading arms, placed at angles of 120 deg. to each other. These act by rotation against 5 chisel-shaped teeth, which stand obliquely up from the front part of the bottom of the drum. The drum itself consists of 2 semi-cylinders; the under of which is made fast to a strong iron framing, and the upper is hinged to the under one behind, but bolted to it before, so as to form a cover or lid, which may be opened or laid back at pleasure, in order to examine the caoutchouc from time to time, and take it out when fully kneaded. In the centre of the lid a funnel is made fast, by which the cuttings and shreds of the Indian rubber are introduced, and a stream of water is made to trickle in, for washing away the foul matter often imbedded in it. The power required to turn the axis of one of these mills, as the drums or boxes are called, may be judged of from the fact, that if it be only 2 inches in diameter, it is readily twisted asunder, and requires to be 3 inches to withstand every strain produced by the fixed teeth holding the caoutchouc against the revolving arms. Five ponnds constitute a charge of the material.

One of the most remarkable phenomena of the kneading operation, is the prodigious heat disengaged in the alternate condensation and expansion of the caoutchouc. Though the water be cold as it trickles in, it soon becomes boiling hot, and emits copious vapours. When no water is admitted, the temperature rises much higher, so that the elastic lump, though a bad conductor of heat, cannot be safely touched with the hand. As we shall presently find that caoutchouc suffers no considerable or permanent diminution of its volume by the greatest pressure which can be applied, we must ascribe the heat evolved in the kneading process to the violent intestine movements excited throughout all the particles of the elastic mass.

During the steaming, much muddy water runs off through apertures in the bottom of the drum. In the course of half an hour's trituration, the various pieces become agglutinated into a soft, elastic, ovoid ball, of a reddish brown colour. This ball is now transferred into another similar iron drum, where it is exposed to the pricking and kneading action of 3 sets of chisel points, 5 in each set, that project from the revolving shaft at angles of 123 degrees to each other, and which encounter the resistance occasioned by five stationary chisel teeth, standing obliquely upwards from the bottom of the drum. Here the caoutchouc is kneaded dry along with a little quicklime. It soon gets very hot; discharges in steam through the punctures, the water and air which it had imbibed in the preceding washing operation; becomes, in consequence, more compact; and, in about an hour, assumes the dark brown colour of stationers' rubber. During all this time frequent explosions take place, from the expansion and sudden extrication of the imprisoned air and steam.

From the second set of drums the ball is transferred into a third set, whose revolving shaft, being furnished both with flat pressing bars, and parallel sharp chisels, perpendicular to it, exercises the twofold operation of pricking and kneading the mass, so as to condense the caoutchouc into a homogeneous solid. Seven of these finished balls, weighing, as above stated, 5 pounds each, are then introduced into a much larger iron drum of similar construction, but of much greater strength, whose shaft is studded all round with a formidable array of blunt chisels. Here the separate balls becomes perfectly incorporated into one mass, free from honeycomb cells or pores, and therefore fit for being squeezed into a rectangular or cylindrical form in a suitable cast-iron mould, by the action of a screw-press. When condensed to the utmost in this box, the lid is secured in its place by screw bolts, and the mould is set aside for several days, It is a curious fact, that Mr. Sievier has tried to give this moulding force, by the hydraulic press, without effect, as the cake of caoutchouc, after being so condensed, resists much more considerably than after the compressing action of the screw. The cake form generally preferred for the recomposed, ground, or milled caoutchouc, is a rectangular mass, about 18 inches long, 9 inches broad, and 5 inches thick.

This is sliced into cakes for the stationer, and into sheets for making tapes and threads of caoutchouc, by an ingenious self-acting machine, in which a straight steel blade, with its edge slanting downwards, is made to vibrate most rapidly to and fro in a horizontal plane; while the cake of caoutchouc, clamped or embraced at each side between two strong iron bars, is slowly advanced against the blade by screw-work, like that of the slide rest of a lathe. In cutting caoutchouc by knives of every form, it is essential that either the blade or the incision be constantly moistened with water; for otherwise the tool would immediately stick fast. As the above straight vibrating knife slants obliquely downwards, the sheet which it cuts off spontaneously turns up over the blade in proportion as it is detached from the bottom mass of the cake. The thicker slices afterwards cut by hand, with a wetted knife, into small parellelopipeds for the stationer, the sections being guided rectangularly by saw lines in a wooden frame. The wholesale price of these is now reduced to 2s. per pound. Slices may be cut off to almost any desired degree of thinness, by means of an adjusting screw —a mechanism that acts against a board which supports the bottom of the cake, and raises it by any aliquot part of an inch, the cutting blade being caused to vibrate always in the same horizontal plane. These thin slices constitute what is called sheet caoutchouc, and they serve tolerably for making tubes for pneumatic apparatus, and sheaths of every kind; since, if their two edges be cut obliquely with clean scissors, they may be made to coalesce, by gentle pressure, so intimately, that the line of junction cannot be discovered either by the inflation of a bag or tube thus formed.

The mode of recomposing the cuttings, shreads, and coarser lumps of caoutchouc into homogeneous elastic cake, specified by Mr. Nickels, for his patent, sealed October 24, 1836, is not essentially different from that above described. The cylinders of his mill are more capacious, are open at the sides like a cage, and do not require the washing apparatus, as the caoutchouc has been cleansed by previous lamination and rinsing. He completes the kneading operation, in this open cylinder, within the space of of about two hours, and afterwards squeezes the large ball so formed into the cheese form, in a mould subjected to the action of an hydraulic press. As he succeeds perfectly in making compact cakes in this way, his caoutchouc must differ somewhat in its physical constitution from that recomposed by Mr. Sievier's process. He uses a press of the power of 70 tons; such pressure, however, must not be applied suddenly, but progressively, at intervals of two or three minutes between each stroke; and when the pressing is complete, he suffers the caoutchouc to remain under pressure till it is cold, when he thrusts it out of the mould entirely, or, placing his mould in the slide-rest mechanism, he gradually raises the caoutchouc out of it, while the vibrating knife cuts it into slices in the manner already described. The elegant machine by which these sheets are now so easily and accurately sliced, was, I believe, originally contrived and constructed by Mr. Beale, engineer, Church-lane, Whitechapel.

*(To be continued.)*

## PROPAGATION BY LEAVES.

I HAVE been in the habit for the last three years of raising Camellia stocks from leaves, and I consider the plan an excellent one. The Camellia pæoniflora being the strongest growing sort with which I am acquainted, is the one I select for the purpose. In March, with a sharp knife, I cut off as many leaves close to the branch as I want, taking, of course, the buds off with them. The leaves are potted immediately in 48-sized pots, in peat and sand, and are placed about one-third their depth into the soil, and the pots are then plunged into a tan-bed where no fire-heat is employed; they are covered with a hand-glass, kept moderately moist, and shaded when necessary. These leaves strike root, grow vigorously, and in two seasons make good stocks for grafting on. This mode of raising Camellia stocks is very convenient, for it is often easier to procure leaves than grafts, and the plan answers well when leaves are sent from a distance. In April, 1843, a blossom of a new double Camellia was sent to me; it had travelled upwards of 300 miles, and was so dry that I could not discover its colour; there were, however, two or three leaves attached to it, one of which was treated as above, and I have now from it a very strong plant, 5 feet 6 inches in height, producing nine flower-buds ready to expand. The plant has been stopped twice in order to cause it to throw out branches, which are now eleven in number; the circumference of the stem is 1½ inch at the bottom. I likewise raise Orange stocks in a similar manner: the leaves are cut off in August, and are potted but not covered with hand-glasses. The stocks which I use for Orange grafting are Citrons, which being strong growers, make excellent plants by the following summer. The Citrons, I imagine, may however be grown much quicker by putting in the leaves in February instead of in August. I have no doubt that the plants will be sufficiently strong to be grafted by the end of July or early in August.—*Correspondent of the Gardener's Gazette.*

## VARIETIES.

*To take Impressions from Coins, &c.*—Make a thick solution of isinglass in water, and lay it hot on the medal; let it remain for twelve hours, then remove it, breathe on it and apply gold or silver leaf on the wrong side. Any colour may be given to the isinglass instead of gold or silver, by simple mixture.

*Curious Experiments in Optics.*—It is known that tartaric acid exercises a rotary power over light, and imparts to it its saline combinations; paratartaric acid, on the contrary, although of the same ponderal composition, does not possess this property. M. Mitcherlich, a Prussian chemist, has examined whether this would be the case under circumstances in which the two bodies would be similar, not only in their chemical composition, but in their chrystalline form and their physical properties; the result has confirmed the established principle; and thus (says M. Mitcherlich) we have two bodies, in which the nature and number of the atoms, their arrangement and their distance, are the same, and which are, nevertheless, distinguished by different optical properties.

*To gild or silver Writing.*—Let there be a little gum and lump sugar in the ink, you write with; when dry, breathe on it and apply the leaf.

Fig I

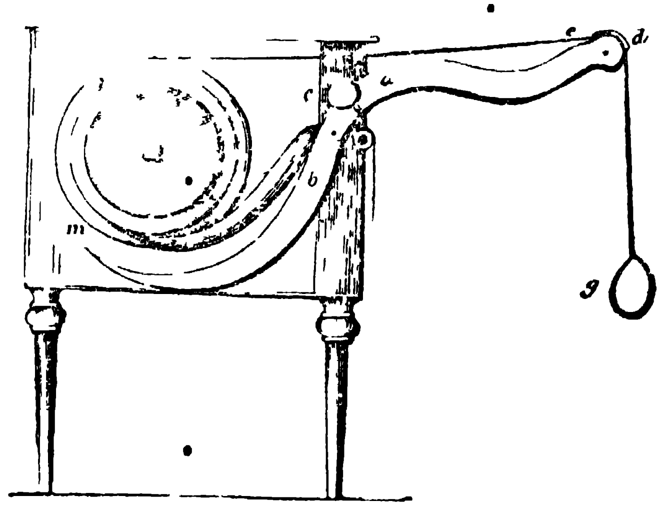
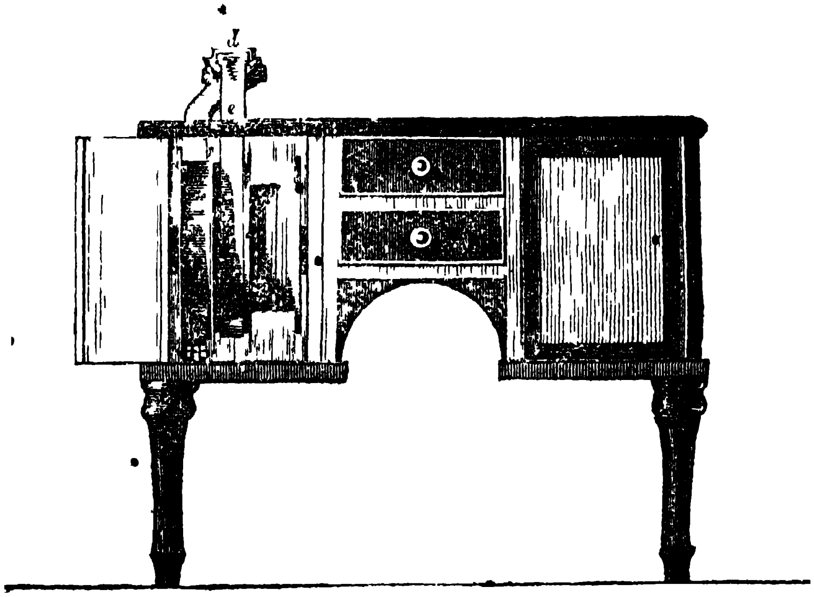



Fig 2



TAYLOR'S IMPROVED DOMESTIC FIRE ESCAPE.

## TAYLOR'S IMPROVED DOMESTIC FIRE ESCAPE.

THE many fatal instances of loss of life by fire, naturally leads us to examine and regard any attempt to provide for the means of escape at such an alarming crisis. Wherever danger or apprehension exists, every person who can afford to do so, should be provided with an apparatus that would enable him not only to preserve his own life, but the lives of others, which may be as valuable to him as his own.

Taylor's Patent Domestic Fire Escape, of which we present our readers with a drawing, seems admirably adapted for the intended purpose. It can be fitted to, and concealed in an ordinary dressing table, or other article of chamber furniture, and used with scarcely a moment's preparation. As soon as the person has attached himself to it, his own weight supplies all the regulating power, which produces an easy and gradual descent, entirely free from any concussion, the motion and velocity being the same throughout, whatever may be the height of the building. This power is obtained in so simple a manner by this invention, that it may truly be called the desideratum. The mechanical principle on which this Apparatus is constructed is so novel, and at the same time so appropriate, that although the check which is necessary in descending is given by the person's own weight, yet the heaviest man will not descend much quicker than a child; as soon as one person has reached the ground, and detached himself, he removes the pressure of a spring, which allows the band to be drawn up again with the greatest rapidity by means of a cord, which the act of descending has coiled reversely round the barrel. In this manner ten or twenty persons might descend in as many minutes.

*Description.* Fig. 1 is a sectional view of the machine, *a b* is a lever turning on a fulcrum at *c*, and formed with a hinge shoulder for the purpose of being turned back over the Apparatus when not in use, but acting as an entire lever when open; over one end of this lever at *d*, passes a band *e*, which is coiled round the barrel *f*, the end of the band is formed with a loop *g*, to which may be attached a bag, body belt, or other appendage. *m* is a spring, (the main feature of the invention), which being fixed at one end to the lever, presses at the other end against the barrel, with a force exactly proportioned to the weight supported by the lever or arm of the Apparatus, and forming the precise degree of friction or check to allow of a gradual and easy descent. The other division of the barrel shows the cord which has wound itself round during the descent, and is ready, when the weight of the person is removed, for drawing up the machine. The whole apparatus may be contained in a cubical space of about fifteen inches.

Fig. 2 shews the apparatus and machine shut up in an ordinary washing stand.

---

## CAOUTCHOUC MANUFACTURE.

(*Continued from page* 360.)

2. Filature of Caoutchouc for making elastic fabrics.

Messrs. Rattier and Guibal mounted in their factory at St. Denys, so long ago as the year 1836 or 1837, a machine, for cutting a disk of caoutchouc into a continuous fillet spirally, from its circumference towards its centre. This flat disc was made by pressing the bottom part of a bottle of Indian rubber in an iron mould.

A machine on the same principle was made the subject of a patent by Mr. Joshua Proctor Westhead, of Manchester, in February, 1836; and being constructed with the well-known precision of Manchester workmanship, it has been found to act perfectly well in cutting a disc of caoutchouc, from the circumference towards the centre spirally, into one continuous length of tape. For the service of this machine, the bottom of a bottle of India rubber of good quality being selected, is cut off and flattened by heat and pressure into a nearly round cake of uniform thickness. This cake is made fast at its centre by a screw nut and washer to the end of a horizontal shaft, which may be made to revolve with any desired velocity by means of appropriate pulleys and bands, at the same time that the edge of the disc of caoutchouc is acted on by a circular knife of cast steel, made to revolve 3000 times per minute, in a plane at right angles to that of the disc, and to advance upon its axis progressively, so as to pare off a continuous uniform tape or fillet from the circumference of the cake. During this cutting operation, the knife and caoutchouc are kept constantly moist with a slender stream of water. A succession of threads of any desired fineness is afterwards cut out of this fillet, by drawing it in a moist state through a guide slit, against the sharp edge of a revolving steel disc. This operation is dexterously performed by the hands of young girls. M M. Rattier and Guibal employed, at the abovementioned period, a mechanism consisting of a series of circular steel knives, fixed parallel to each other at minute distances, regulated by interposed washers upon a revolving shaft; which series of knives acted against another similar series, placed upon a parallel adjoining shaft, with the effect of cutting the tape throughout its length into eight or more threads at once. An improved modification of that apparatus is described and figured in the specification of Mr. Nickels's patent of October, 1836. He employs it for cutting into threads the tapes made from the recomposed caoutchouc.

The body of the bottle of India rubber, and in general any hollow cylinder of caoutchouc, is cut into tapes, by being first forced upon a mandril of soft wood of such dimensions as to keep it equally distended. This mandril is then secured to the shaft of a lathe, which has one end formed into a fine-threaded screw, that works in a fixed nut, so as to traverse from right to left by its rotation. A circular disc of steel, kept moist, revolves upon a shaft parallel to the preceding, at such a distance from it as to cut through the caoutchouc, so that, by the traverse movement of the mandril shaft, the hollow cylinder is cut spirally into a continuous fillet of a breadth equal to the thickness of the side of the cylinders of recomposed caoutchouc, for the purpose of being cut into fillets by such a machine.

It is probable that the threads formed from the best India rubber bottles, as imported from Para, are considerably stronger than those made from recomposed caoutchouc, and therefore much better adapted for making Mr. Sievier's patent elastic cordage. When, however, the kneading operation has been skilfully performed, I find that the threads of the *ground* caoutchouc, as it is incorrectly called by the workmen, answer well for every ordinary purpose of elastic fabrics, and are, of course, greatly more economical, from the much lower price of the material.

Threads of caoutchouc are readily pieced by paring the broken ends obliquely with scissors, and then pressing them together with clean fingers, taking care to admit no grease or moisture within the junction line. These threads must be deprived of their elasticity before they can be made subservient to any torsile or textile manufacture. Each thread is *inelasticated* individually in the act of reeling, by the tender boy or girl pressing it between his moist thumb and finger, so as to stretch it to at least eight times its natural length, while it is drawn rapidly through between them by the rotation of the power-driven reel. This extension is accompanied with condensation of the caoutchouc, and with very considerable disengagement of heat, as pointed out in Nicholson's Journal upwards of 30 years ago, by Mr. Gough, the blind philosopher of Kendal. I attempted to stretch the thread, in the act of reeling, but found the sensation of heat too painful for my unseasoned fingers. The reels, after being completely filled with the thread, are laid aside for some days, more or fewer, according to the quality of the caoutchouc, the recomposed requiring a longer period than the bottle material. When thus rendered inelastic, it is wound off upon bobbins of various sizes, adapted to various sizes of braiding, or other machines, where it is to be clothed with cotton or other yarn.

In the process of making the elastic tissues, the threads of caoutchouc being first of all deprived of their elasticity, are prepared for receiving a sheath upon the braiding machine. For this purpose they are stretched by hand, in the act of winding upon the reel, to 7 or 8 times their natural length, and left 2 or 3 weeks in that state of tension upon the reels. Thread thus *inelasticated* has a specific gra-gravity of no less than 0·948732: but when it has its elasticity restored, and its length reduced to its pristine state, by rubbing between the warm palms of the hands, the specific gravity of the same piece of thread is reduced to 0·925939. This phenomenon is akin to that exhibited in the process of wire-drawing, where the iron or brass gets condensed, hard, and brittle, while it disengages much heat: which the caoutchouc thread also does in a degree intolerable to unpractised fingers, as above mentioned.

The thread of the Joint-Stock Caoutchouc Company is numbered from 1 to 8. No. 1. is the finest, and has about 5000 yards in a pound weight; No. 4. has 2C00 in the pound weight; and No. 8. 700, being a very powerful thread. The finest is used for the finer elastic tissues, as for ladies' silver and gold elastic bracelets and bands. The ropes made by Mr. Sievier with the strongest of the above threads, clothed with hemp and worked in his gigantic braiding machine, possess, after they are re-elasticated by heat, an extraordinary strength and elasticity: and, from the nearly rectilinear direction of all the strands, can stand, it is said, double the strain of the best patent cordage of like diameter.

In treating of the manufacture of elastic fabrics, I have great pleasure in adverting to the ribbon looms at Holloway, which display to great advantage the mechanical genius of the patentee, Mr. Siever. Their productive powers may be inferred from the following statement:—5000 yards of 1-inch braces are woven weekly in one 18 ribbon loom, whereby the female operative, who has nothing to do but watch its automatic movements, earn 10s. a week: 3000 yards of 2-inch braces are woven upon a similar loom in the same time. But one of Mr. Sievier's most curious patent inventions, is that of producing by the shrinking of the caoutchouc threads in the foundation or warp of the stuff, the appearance of raised figures, closely resembling coach lace, in the weft. Thus, by a simple physical operation, there is produced, at an expense of one penny, an effect which could not be effected by mechanical means for less than one shilling.

3. Of the Water-proof double Fabrics.

The parings, the waste of the kneading operations above described, and the coarsest qualities of imported caoutchouc, such as the inelastic lumps from Para, are worked up into varnish, wherewith two surfaces of cloth are cemented, so as to form a compound fabric, impervious to air and water. The caoutchouc is dissolved either in petroleum (coal-tar) naptha, or oil of turpentine, by being triturated with either of the solvents in a close cast-iron vessel, with a stirring apparatus, moving by mechanical power. The heat generated during the attrition of the caoutchouc, is sufficient to favour the solution, without the application of fuel in any way. These triturating cylinders have been called pug mills by the workmen, because they are furnished with obliquely pressing and revolving arms, but in other respects they differ in construction. They are four feet in diameter, and make one turn in a second. Three days are required to complete the solution of one charge of the varnish materials. The proportion of the solvent oils varies with the object in view, being always much less in weight than the caoutchouc.

When the varnish is to be applied to very nice purposes, as bookbinding, &c., it must be rubbed into a homogeneous smooth paste, by putting it in a hopper, and letting it fall between a couple of parallel iron rolls, set almost in contact.

The wooden framework of the gallery in which the waterproof cloth is manufactured, should be at at least 50 yards long, to give ample room for extending, airing, and drying the pieces; it should be 2 yards wide, and not less than 5 high. It is formed of upright standards of wood, bound with three or four horizontal rails at the sides and the ends. At the end of the gallery, where the varnish is applied, the web which is to be smeared must be wound upon a beam, resembling in size and situation the cloth beam of the weaver's loom. The piece is thence drawn up and stretched in a horizontal direction over a bar, like the breast beam of a loom, whence it is extended in a somewhat slanting direction downwards, and passed over the edge of a horizontal bar. Above this bar, and parrallel to it, a steel-armed edge of wood is adjusted, so closely as to leave but a narrow slit for the passage of the varnish and the cloth. This horizontal slit may be widened or narrowed at pleasure by thumb screws, which lower or raise the movable upper board. The caoutchouc paste being plastered thickly with a long spatula of wood upon the down-sloped part of the web, which lies between the breast-beam and the above-described slit, the cloth is then drawn through the slit by means of cords in a horizontal direction along the lowest rails of the gallery, whereby it gets uniformly besmeared. As soon as the whole web, consisting of about 40 yards, is thus coated with the viscid varnish, it is extended horizontally upon rollers, in the upper part of the gallery, and left for a day or two to dry. A second and third coat are then applied in succession. Two such webs, or pieces, are next cemented face to face, by passing them, at the instant of their being brought into contact, through between a pair of wooden rollers, care being taken by the operator to prevent the formation of any creases, or twisting of the twofold web. The under one of the two pieces being intended for the lining, should be a couple of inches broader than the upper one, to insure the uniform covering of the latter, which is destined to form the outside of the garment. The double cloth is finally suspended in a well-ventilated stove room, till it becomes dry, and nearly free from smell. The parings cut from the broader edges of the under piece, are reserved for cementing the seams of cloaks and other articles of dress. The tape-like shreds of the double cloth are in great request among gardeners, for nailing up the twigs of wall shrubs.

Mr. Walton, of Sowerby-bridge, has recently substituted sheet India rubber for leather, in the construction of fillet cards for the cotton and tow manufactures. The superior elasticity of this article is said to prove advantageous in several respects.

Mr. Charles Keene, proprietor of the extensive and well-organized India-rubber factory in Lambeth, obtained a patent in March 1840, for applying a coat of caoutchouc to the outer surface of the flexible leather. The varnish of caoutchouc made with oil of turpentine, has so much lampblack incorporated with it, as to bring it to the consistence of dough. The edge of the doe-skin, buck-skin, or wash-leather, being introduced between a pair of wetted iron rollers, as much of the India-rubber compound, softened by a gentle heat, and rolled into a proper length as will cover the leather, is laid in the hollow between the leather and the moist cylinders. By their rotation, the coating is evenly effected. When the surface has become dry, it may be embossed or gilt, and varnished over with a solution of shellac, with a little Venice turpentine, in Alcohol. After two or three applications of this kind, the leather is passed through a pair of rollers, either smooth or embossed. When made up articles, such as shoes or portmanteaus, &c., are to be covered, the India-rubber varnish is used in a thinner state.—*Ure.*

## IMPROVEMENTS IN THE MANUFACTURE OF CANDLES.

Mr. Charles Humfrey, St. Mary-at-Hill, has lately patented improvements in the manufacture of candles.

The invention relates, firstly, to the manufacture of such candles as consist either entirely of lard, or of lard combined with other substances, especially with stearine; and, secondly, to the preparation of wicks for such and other candles, which are required to burn without snuffing.

In making candles of lard, or of lard combined with other materials, much inconvenience has been experienced from the tendency which the lard has to separate, in cooling, into a sort of granular structure, and the candles, made therewith, are speckled on the surface, and otherwise deteriorated in appearance: these disadvantages the patentee proposes to prevent, by suddenly chilling the candles, as soon as they are run into the moulds, and this he effects by plunging the moulds into cold water. He also states that he finds it advantageous to heat the moulds (in a steam box or otherwise), before filling them, which prevents a defect that these candles would otherwise be liable to, viz., the splitting-up of their surface into numerous small fissures, which occasionally appear when the candles are drawn from the moulds, but more usually after being exposed for a day or two. The moulds commonly employed by the English candle-makers are not used in this process, as those moulds being fixed in a wooden frame, of from half an inch to an inch in thickness, that portion of the mould which is imbedded in the wood is protected from the chilling effect of the water, and so much of the candle will be found to be speckled and defective; the patentee, therefore, uses detached moulds, with metal cups to them, such as are usually employed by the foreign manufacturers of stearine candles.

The improvement in treating and preparing wicks consists in dipping the wicks in a solution of borate of ammonia, and then drying them. The strength of the solution is important, and upon a correct adjustment of it the proper action of the wick depends; although, as such strength must vary with the quality of the cotton, the closeness of the plait of the wick, and the quality and proportion of the ingredients of which the candle is composed, no practical rule, sufficiently general to suit such continually varying circumstances, can be given; but assuming that the stearine is of good quality, the lard also good, and rather highly pressed, and mixed in the proportion of two-thirds of the former to one-third of the latter, and the wick such as is ordinarily used in composite candles, a solution of 25 grains, avoirdupoise, of crystallized borate of ammonia, in 1 oz., liquid measure, of distilled water, will be of the proper strength. The wicks of candles containing lard require the strongest solution, composite candles the next degree of strength, stearine candles weaker, and spermaceti weaker still.

In conclusion, the patentee says,—"Being aware that various methods of cooling the moulds of candles, by water and otherwise, for the purpose of expediting the manufacture, have heretofore been employed, I claim the processes herein-before firstly described, as applied to such candles only as consist of lard, or of lard combined with other materials, particularly with stearine; and, Secondly,—I claim the application and use of borate of ammonia, for the treatment and preparation of the wicks of candles, which, by their ordinary process of combustion, consume of themselves, and do not require to be snuffed."

## FLOOR-TILES.

We have been favoured with a specimen of glazed flooring tiles from Scinde, of such superior quality and beauty to any procurable in Bombay, that the subject of their importation seems well worthy of the consideration of the mercantile community. The aspect of the tiles must be familiar to most of those who have been on the Indus—specimens, indeed, are plentiful in Bombay. Those before us are 6½ inches square, and ¾ of an inch thick, admirably well-baked, and glazed blue and white, like old Dutch ware. One hundred will furnish 3½ yards of pavement for 2½ Rs. of price. The glaze is a true vitreous one, as perfectly made and applied apparently, as that on European earthenware. The floors of our lobbies and verandahs are here at present generally composed of blocks of trap, rough, cold, and comfortless-looking, though sufficiently strong and substantial, or of tiles imported from China. The stone is at once unseemly and expensive, and would rarely be employed could a more elegant and economical substitute be found. The

Chinese tiles are 14 inches square, and cost from 15 Rs. to 25 Rs. per 100. Or taking 20 Rs. as the average price, and assuming that something less are required to the square yard than seven tiles, at a cost of about Rs. 1 : 12 annas a yard—more than double the price of the Scindian tiles, which can, it is said, be imported here for betwixt 2 and 3 Rs a hundred—equivalent to 3½ yards of flooring, which will, on an average, cost less than 13 annas a yard. A verandah, or lobby, 15 feet by 30, could be paved with them for about 70 Rs, chunam, pavior work and all. They would exceed the Chinese tiles as well in strength as in cleanliness and beauty.—*Bombay Times.*

## ON THE BUSINESS OF THE MINT.

PROF. BRANDE recently delivered a Lecture at the Royal Institution, "On the Business of the Mint." For many successive years Prof Brande has taken as the subject of his annual communication to the members of the Royal Institution, some remarkable service rendered by physical science to the needs of civilized life. As the chief Professor at an Academy which has for its motto "illustrans commoda vitæ," he conceived that he effectually furthered its objects by giving philosophical explanations of such manufactures as those of gas, fermented fluids, and their compounds with metals (as in the case of vinegar and carbonate of lead), stearine, and its adulterations, &c.* Pursuing the same course, Prof. Brande narrated, at the meeting this evening, what may not unfitly be called the chemical and mechanical history of a mass of gold, from its importation into this country to its issue to the public in the form of coin. Gold is imported from South America, Africa (in the form of gold-dust), and from the Ural Mountains in Russia. The supply from this last-named source Mr. Murchison has shown to be continually increasing. This gold is sent to the Mint by the Bank. The Bank, however, first melts and also assays (or analyzes) it by its own assayer. The gold is sent in ingots—massive oblong pieces—each weighing 15 lbs. These, from the process just referred to, are of known purity and quality. When received at the Mint from the Bank, the ingots are weighed in the presence of responsible officers of both establishments. They are then delivered to the Master's assay-master for analysis. Prof. Brande here explained that, for the purposes of circulation, it was necessary that gold and silver coin should be mixed with an inferior metal in certain accurate proportions. This *alloy*, as it is called, is, in the case of gold, usually a mixture of copper and silver in equal proportions —but it is essential that the copper thus used should be perfectly pure. In the gold coin of this country, eleven parts of pure metal are combined with one part of alloy, while in the silver coin $\frac{18}{20}$ of alloy are considered sufficient for $11\frac{2}{20}$ parts of silver. The French standard is the same for both metals—viz. 9 metal and 1 alloy. Having thus been rendered less flexible, and more available for the purposes of coining, the ingot of gold is melted in a black-lead crucible; during this process it is carefully stirred by a black-lead rod to insure the equal diffusion of the alloy throughout the mass. Were this precaution neglected, the quality of the bar into which it is cast would not be uniform. And it is obvious that a scarcely appreciable variation in this respect might seriously deteriorate the value of coin. The same process is adopted in regard to silver, excepting that Mr. Morison has advantageously adopted cast iron, instead of black-lead, as the material of the melting-pot. Prof. Brande here noticed one of the discoveries of Dr. Wollaston as having a most important bearing on the chemical operation of the Mint. By rendering platinum malleable, and thus convertible into crucibles and retorts, Dr. Wollaston not only provided means for manufacturing sulphuric acid at a cheaper rate, but enabled that substance to be readily used in extracting silver from ingots of gold. The Refiner extracts at a small cost, the silver which generally accompanies masses of gold. And, as no seignorage is charged on coining, and as he is entitled to coined, in exchange for uncoined gold, without expense, whatever silver he can remove from his ingot is so much clear gain to him. The bar of gold is now consigned to the ancient company of *Moneyers*, and here the mechanical operations, which convert it into coin, commence. These, however, are necessarily controlled by chemical principles. When broken down, as it called, (*i. e.* squeezed to the thickness of the coin), the bar is *annealed*, (heated, that the metal may become tractible,) but heated out of contact with air, lest the alloy should burn. Prof. Brande described, and illustrated by models, the operation of the rolling-room; the extremely accurate uniformity in the thickness of the ribband of gold, from whence the blanks are struck, obtained by Sir J. Barton's machine. He then showed how, by means of most delicate adjustments, any minute variation in the quality of different parts of the ribband was compensated in the blank-cutting-machine. He explained Mr. Bolton's contrivance for making the atmospheric pressure the moving-power in this powerful, yet most accurate engine; and proceeded to describe how, after being again annealed, the blanks are stamped and milled.

Professor Brande briefly noticed what are called the trials of the pix: *i e.* the examinations into the quality and purity of the bullion before it is received by the Moneyers, and when, having been coined by them, it is about to be issued to the public. These examinations are always strictly private. The result, however, is sufficiently and most creditably notorious—the acknowledged purity of British coin. Prof. Brande concluded by calling attention to the manner in which the operations of the Mint ensured the quick production of coin of unimpeachable weight and fineness; how loss of interest on bullion was obviated: a national panic prevented by the rapidity of a coinage, which, though so quickly accomplished, will bear comparison, as to execution, with that of any country in the world.

*** We shall further illustrate this subject by giving in some future Numbers of our Magazine, a description of the machinery employed in this most important branch of our national economy, which we doubt not will prove highly interesting to our readers.—*Ed.*

## ANASTATIC PRINTING.

AN invention to which this name has been given has lately been brought before the public, and as it is a main purpose of this Magazine to bring forward any discovery tending in anywise to the advancement of science, we hasten to lay before our readers some particulars of the process and results of "Anastatic Printing."

The principal merits of the invention are, in the first place the method of repeating (something like a lithographic printing surface) the tracery of a wood block or copper-plate in such manner as immediately to yield impressions which are not in any way to be distinguished from the original engraved surface. This is effected by means of acids diluted to various degrees of strength, which act upon those parts of the plates remaining unprotected by the ink, and so leave the printing surface very slightly in relief. Another chief merit of the invention is the successful provision against the spreading of the ink under any degree of pressure, ensuring the repetition of the finest lines and sharpest edges with singular precision.

The following is a brief description of the preparation of a plate or cylinder, suppose a page of the Magazine about to be reprinted by this means. The sheet is first moistened with dilute acid and placed between blotting-paper to absorb any superfluous moisture, the ink neutralizes the acid, which is consequently pressed out from the blank spaces only, and etches them away. The paper is then carefully placed upon the plate with which the letter-press about to be transferred is in immediate contact, and the whole is passed under a press; on removal from which and on carefully disengaging the paper, the letters are found in reverse on the plate, which is then rubbed with a preparation of gum, after which the letters receive an addition of ink, which is immediately incorporated with that by which they are already formed. These operations are effected in a few minutes.

The surface of the plate round the letters is bitten in a very slight degree by the acid, and on the application of the ink it is rejected by the zinc, and is received only by the letters, which are charged with the ink by the common roller used in hand printing, each letter comes from the press as clear as if it had been imprinted by type metal, and the copies are so exact as not to be distinguished from the original sheet. The practibility of transferring letter-press specially prepared or quite recent, to stone or zinc has been long known, the main advantage, however, and a most important one, possessed by the zinc over the stone is its portability and being easily formed into a cylinder, for though we have chiefly spoken of a plate, we understand very extensive operations by means of cylinders are in contemplation. We have endeavoured to describe the process so as to make it understood by those of our readers who may not be conversant with lithographic manipulation, those who are will easily recognize some similarity in the methods of preparing the stone and the zinc as far as regards the gum &c.

And now a word or two on its probable utility, let us enquire how far it may, if carried out with energy, conduce to the progress of the times; to stock booksellers it cannot be received otherwise than an inestimable boon, since it will at least supersede the necessity of warehousing tons of stereotype blocks and paper. Henceforth there need only be printed short editions of heavy works, for if a work go off beyond the expectation of the publisher, reprints in abundance may be made from a single remaining copy at an expedient interval, and the advantage to the public *must* follow. We have mentioned only one advantage resulting from the introduction of this invention, it is impossible to speculate upon the uses to which Anastatic Printing may be applied, the great principal is a perfect adaptation to answer an end of incalculable public benefit, and if carried out to the extent it promises, a GREAT REVOLUTION in letters is INEVITABLE.

## THE MONSTER BELL FOR YORK MINSTER.

A BELL intended to be put up in the south tower of York Minster, has recently been manufactured at the foundry of Messrs. Mears, Whitechapel, it being larger than any other in the United Kingdom. Its weight exceeds twelve tons; it is 7 feet 7 inches in height, and its diameter is 8 feet 4 inches, being heavier by 7 tons than the celebrated "Tom" of Lincoln, and by 5 tons than "Old Tom" of Oxford. The metal took twelve days to cool, from the 18th of January when it was poured into the mould to the 30th ult.

The clapper is not yet put in, but this will weigh between 3 and 4 cwt. The tone of it is described as being exceedingly grand, and to be compared to the full swelling diapasons of an organ. The arms of the City of York, and those of the Archbishop (the Cross keys), are on the bell in opposite positions to each other. The following inscription in Lombardian characters is round the upper rim:—"In sanctæ et æternæ Trinitatis honorem pecunia sponte collata Eboracenses faciendum curaverunt in usum ecclesiæ metrop. B. Petri ebor." and on the lower rim are the words, "Anno salutis MDCCCXLV Victoriæ, reg. VIII. Edwardi Archiepi XXXVIII. C. et G. Mears, Londoni, fecerunt." The cost of it is about £2,000, this having been raised by voluntary subscription as alluded to in the above inscription. It is intended by the executive Committee previous to its removal to the Cathedral at York, where it will be conveyed by railway, that the public should have an opportunity of seeing the bell, (which is to be named "Peter of York,") and which it will require the united efforts of twenty horses to draw.

## IMPROVEMENTS IN WOOLLEN CARDING-ENGINES.

HENRY BROWN and THOMAS WALKER, of Selkirk, have recently obtained a patent for improvements in woollen carding engines.

This invention consists chiefly in receiving the wool from the finishing-cylinder of a wollen carding-engine, upon a travelling endless band of wire cards, placed beneath the cylinder, and subtending, in a greater or less degree, from a right angle therewith, according as the nature of the fibrous material may require.

The endless band of wire cards is kept rigid, and distended in breadth, by nailing to its under surface narrow strips of wood, of a triangular form, which are also so secured to a piece of cloth, to keep them in their proper positions; and the whole is enclosed in a long frame, with a roller at each end, formed with suitable flutes to receive the strips of wood, as the endless band passes around them. The frame is capable of being slightly raised or lowered, to regu- the position of the endless band, as the band should never be in close contact with the cards of the finishing cylinder, but only approximating thereto; and the frame has also a joint beneath the right-hand end of the finishing-cylinder, to admit of raising or lowering that part of the endless band which is opposed to the cylinder.

When the fibres of wool, that are stripped off the finishing-cylinder by the teeth of the endless band, are free of the cylinder, they are acted upon by a comb-bar, which has the effect of forming them into "a well-defined continuous roving;" this bar is placed in an angular direction across the upper surface of the endless band, and an oscillating movement is communicated to it, causing it to convey the fibres from the opposite side of the band to the side where they are discharged.

The roving, thus formed, is received between two endless bands, placed horizontally, and nearly in a line with the upper surface of the endless band of wire cards; but these bands travel one-fourth faster than the latter, and have a lateral movement, directly contrary to each other; by this means the roving becomes lengthened and compressed, and it is conveyed to the machinery by which the remaining operations for converting it into thread are performed.

Over the endless band of wire cards, near the left-hand end of the long frame, before mentioned, a small roller is mounted, in a horizontal position, at an angle of about forty-five degree to the length of the band; and this roller is charged with emery, for the purpose of smoothing, equalizing, and sharpening the teeth of the cards.

The patentees claim, Firstly,—the mode of applying an endless belt of wire cards for removing the wool from a carding-engine, as herein described; that is, by drawing it from the cylinder nearly at right angles therewith, for forming a continuous roving; Secondly,—the application of a roller charged with emery, placed at a angle of forty-five degrees, for the purpose of preparing and sharpening the teeth of the wire cards; Thirdly,—the application of a comb-bar for forming a roving directly from the fibrous deposits conveyed by the endless card from the finishing cylinder; Fourthly, —the application of the endless belts, in combination with the other improvements, for compressing and finishing the roving.

## ON THE LIQUEFACTION AND SOLIDIFICATION OF GASEOUS BODIES.

At a recent meeting of the members of the Royal Institution, Professor Faraday delivered a most interesing lecture, "On the Liquefaction and Solidification of Gaseous Bodies."

Before commencing his lecture, he read an extract from a letter written by Professor Liebig, of Giessen, shortly after his visit to this country, in which the learned writer said, the thing which struck him most in England was, the persuasion that only those works that had a practical tendency attracted attention and commanded respect, whilst those which were purely scientific were almost unknown; and yet the latter were the true sources from which the others flowed. In Germany, added Liebig, it was the contrary; but he did not say that that was better: in his opinion the golden medium was the proper course. Mr. Faraday then proceeded with his lecture.

The condensation of gases (said the Professor) had been brought before the public some years ago. A gas was one of those substances in an aerial form which remained permanent under the ordinary circumstances of temperature and pressure, whilst vapour was like gas, but which, under ordinary circumstances, was condensable again into liquid. It was at one time thought that all gases were perfectly elastic fluids; but by his researches, he had succeeded in turning into vapour the following nine gases: namely, chlorine, muriatic acid, sulphurous acid, sulphuretted hydrogen, carbonic acid, euchlorine, nitrous oxide, cyanogen, and ammonia. One of these, namely, carbonic acid, the late celebrated Thillourier, of Paris, had, after many experiments, obtained in a solid state; and Bunsun had subsequently obtained also cyanogen in a similar condition. But although continued attempts had been made to solidify the other seven, and by immersion in deep water a pressure of 200 atmospheres, *i. e.* of 3,000 lb. to a square inch, had been produced, still they have been unattended with success. He would explain what he believed to be the reason of the failure. If he took a bottle half filled with ether (and this was Latour's experiment), and applied to it heat, the ether would rise in vapour, and so would continue, until the vapour was much condensed. At last, the liquor below and the vapour above would be of as nearly the same weight as possible, and the least degree of additional heat would turn the liquor into vapour; or, if taken away, convert the vapour into liquor. Observe what happened. At that temperature of ether no pressure could bring the vapour into a liquid state; at a lower temperature it would. He believed, then, the reason why so many had failed in liquefying and solidifying gases was, that although they could procure the immense pressure he had mentioned, they could not obtain a degree of temperature sufficiently low. He would explain in what manner he had succeeded. He had taken as his basis carbonic acid gas in a solid state, as produced by Thillourier. A quantity of carbonic acid, in partly a liquid and partly a vapour state, being confined in a tube, the expansion of the vapour forced the liquor through an orifice in the side into a cylindrical brass box; and being acted on by a rapid current of air, the liquid carbonic acid was immediately converted into a solid substance like snow. Its temperature in that state was 70 degrees below 0 of Fahrenheit; but though he took that as his basis, it was not low enough for the purpose of his experiments. The temperature must, therefore, be further decreased. It had been demonstated by Thillourier, that if ether were applied to solid carbonic acid, the temperature could be reduced to even 105 degrees below Fahrenheit; but a lower degree was still required, and that was obtained by exhausting the air. His object, then, was to combine this extreme degree of cold with great pressure, in his experiments on gases. The means by which he effected it he thus described:—A quantity of gas in a glass vessel was forced by a condensing pump into a tube, inserted in the receiver of an air-pump; that part of the tube inserted in the receiver was made of common bottle glass (the strongest kind for experiments, and capable of bearing an enormous pressure) in the shape of a retort, and the bent or lower part of the tube lying immersed in the cold bath (produced by solid carbonic acid combined with ether, after the air had been exhausted) gas in a liquid, and, by an increased degree of pressures in a solid state, could be obtained. The learned professor illustrated the truth of the principle by producing olefiant gas in a liquid state, and observed that he had succeeded in obtaining in the same condition phosphorous hydrogen, hydriotic acid, hydrobromic acid, fluoboron and fluosilicon; and in a solid form sulphurous acid, sulphuretted hydrogen, euchlorine, nitrous oxide, hydriodic acid, and hydrobromic acid. He had made carbonic acid the type of the others, but he thought that nitrous oxide would give a power as temperature as far below carbonic acid as that was below common ice. He saw no reason why the same result might not be obtained from oxygen, hydrygen, and nitrogen; and in fact, he had hoped that evening to have shown oxygen in a liquefied state, but he had failed in his experiments, not because his principle was wrong, but from the porous, and hence, imperfect nature of the vessels used. With respect to hydrogen, he had had indications in the course of his experiments that it would be found to be a metal of a most subtile nature.

The theatre was filled, and the learned Professor, as he detailed the progress and wonderful results of his researches, was listened to with the most profound attention.

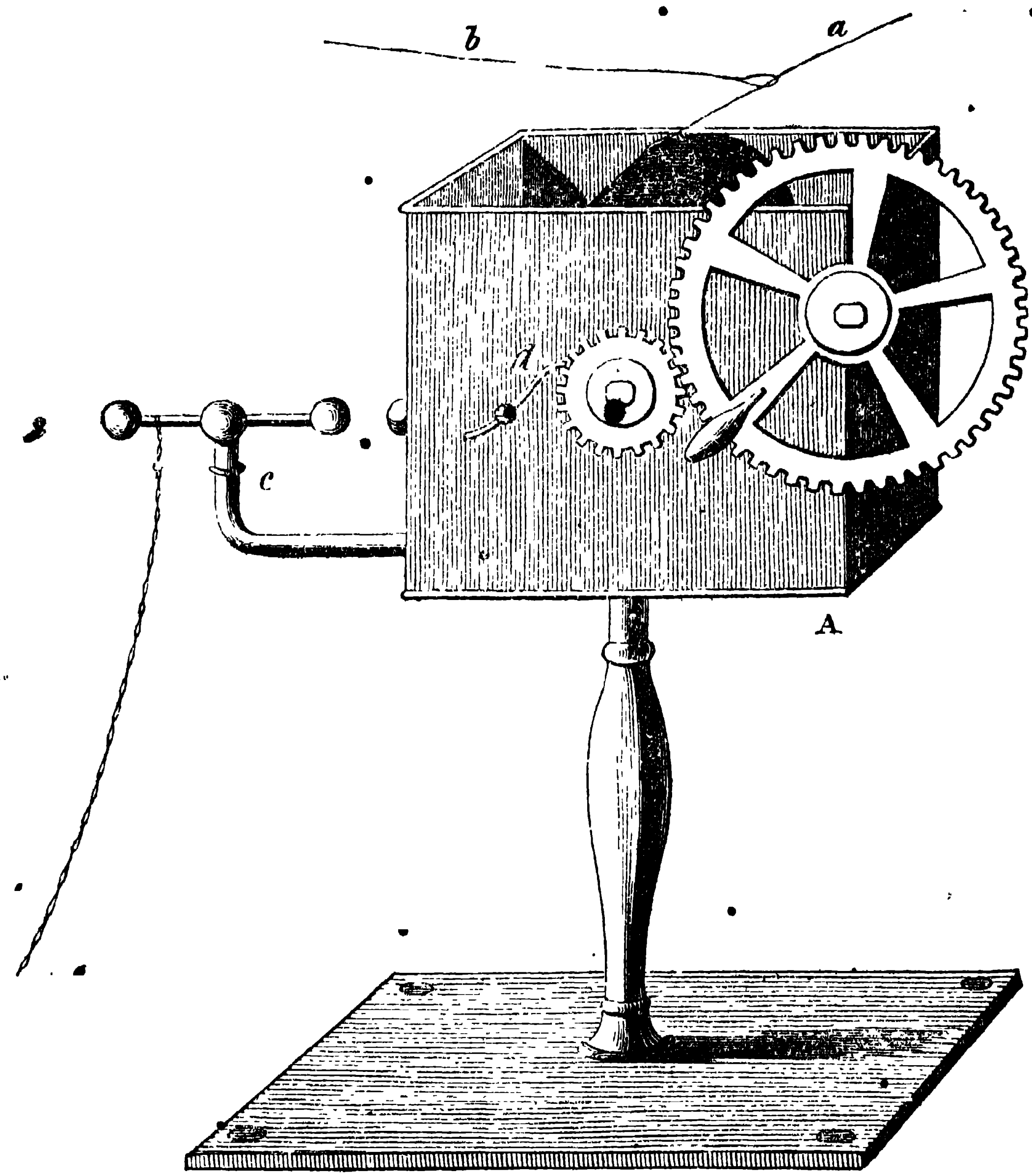
## THE GREAT BRITAIN STEAM SHIP.

Since the arrival of this extraordinary vessel at Blackwall, the pier has been daily crowded with spectators, who have thronged thither to see her as she lies at her moorings. She certainly is an object of great curiosity, and well worth the inspection. Upon getting on board, the visitor is struck with surprise at her immense length; for, upon stepping on deck from the gangway, if he look towards the bows or the stern, in either case the length from where he stands towards each extremity is more than that of a tolerably large steamer, and, upon proceeding aft, and looking along the whole length of the ship towards the bows, the distance appears almost incredible. Some little idea may be formed of its immensity when it is stated that the Great Britain is upwards of one hundred feet, or one-third longer than any of our largest three deckers, her length being three hundred and twenty-two feet, while the length of the Trafalgar, and other first-rate men-of-war, is only two hundred and five feet. The beam of the Great Britain is fifty-one feet. Here, however, the line of battle ships have the advantage, for they are from fifty-four to fifty-six feet; and the Queen is even sixty feet in breadth. The accomodation which the Great Britain offers for passengers is very extensive; there are cabins, with sleeping berths, for two hundred and fifty persons Upon descending below, by the stairs on either side of the quarter-deck, immediately abaft the fourth mast, the after and principal promenade, saloon, and state room are gained. This is directly under the quarter-deck, and runs the whole length of the after part of the ship. It is lighted and ventilated by eleven sky-lights above, and by the after-cabin windows, and forms an excellent promenade in wet weather. It is surrounded by cabins capable of berthing upwards of seventy persons, besides two large cabins, fitted up with sofas and tables, as sitting-rooms for the ladies. Immediately under the promenade saloon is the principal saloon and dining-room; here, as above, the saloon is surrounded by cabins, capable of berthing forty-four persons. There are two dining tables, which are placed fore and aft, one on each side, at which upwards of one hundred and fifty persons can dine without the least inconvenience. In the fore part of the ship there is a promenade saloon on the main deck, and a dining one on the lower deck, with cabins surrounding each, and capable of affording accommodation, in sleeping or dining, to the same number of persons as the after saloons and cabins. The engine-room is placed between the fore and after-cabins. The engines are a wonderful piece of mechanism, and are well worthy of inspection. There are four of them, weighing altogether 340 tons. The boilers weigh 200 tons, and hold 200 tons of water. The united power of the engines is of 1,000 horses; the main shaft is 28 inches in diameter in the centre, and 24 inches in the bearings, it is bored through by a hole 10 inches in diameter, and a stream of cold water passes through the cranks and this hole when the engines are at work. The screw-shaft is in one long and two short, or coupling parts; the part next the engine solid, 28 feet by 16 inches diameter; there is a hollow intermediate shaft 65 feet by 2 feet 8 inches; the total length of the screw-shaft is 130 feet, and the weight 38 tons; the main drum is 18 feet diameter, and drives four chains weighing seven tons. The screw shaft drum is six feet diameter, and the weight, with the pull when working, is equal to 85 tons on the bearings of the main shaft. The screw is of six arms, 15 feet 6 inches diameter, 25 feet pitch, and weighs four tons; the six masts of this vessel present a singular appearance; they are fitted up with iron rigging, adopted in consequence of offering two-thirds less resistance than hemp—a great point in going head to wind. It was wished that five should have been the complement, but there was some difficulty in adjusting that number, and the alternative was either four or six. Economy of labour is the principle by which the Directors have been actuated in rigging this ship. Nothing is so difficult to handle, under a variety of circumstances, as the sails of a steamer unless the engine be stopped, and that can never be allowed in Atlantic steamers when onwards, and for ever onwards is the rule. The greater the number of masts, the more handy the sails, and the smaller the number of seamen required to handle them. If this ship had been rigged as ships ordinarily are, she would require the same complement of men as a large frigate. Divided as the canvas is and reduced, 30 or 40 seamen before the mast is enough for her. There is but one sail, the square mainsail, which under any circumstances can require all hands to furl it. Five masts of the six are hinged for lowering when contrary gales shall have set in, as the westerlies do at certain seasons of the year, prevailing for months in the Atlantic. To a seaman's eye they have a look of insecurity, but if the strain which a fixed mast will stand is compensated by additional shrouding and stays, either in strength or quantity, the same end is attained. The after mast could not be stepped in the ordinary manner, on account of the space occupied by the screw shaft.

## VARIETIES.

*Proposed Method of Cleaning Statues exposed to the Air.*—It has long been remarked that the stone staircase of the bronze obelisk to the memory of the Bavarians who fell in the campaign of Russia, was perfectly clear from green mould in the parts washed by the rain. M. Jobard, of Brussels, is of opinion that the oxide of the copper carried down with the rain destroys this vegetation; and recommends that a solution of copper should be tried in the cleaning of statues covered with vegetable matter.

*The Blackbird.*—It is grevious to think that this bird, whose melodious voice gives such pleasure to the ear, and lends a charm to the ramble through the grove, must, for the sake of a little fruit, meet with the usual persecution. Its food, in spring and early summer, consists of a larvæ of insects, with worms and snails. The enormous number of slugs and snails, so injurious to vegetation, which are eaten by blackbirds, should at least save them, on the score of gratitude, from the general destruction.




THE ELECTRICAL KITE.

## THE ELECTRICAL KITE.

We are indebted for the following remarks, to Noad's interesting lectures on Electricity.

The experiments with the electrical kite are very interesting, but great caution is required in conducting them. When thunder-clouds are about, the string should never be allowed to pass through the hand while raising the kite, even though it have a good connection with the ground: indeed, even under a cloudless sky, during a smart north-east breeze, I have frequently experienced very unpleasant shocks whilst letting out the string. By employing, however, the little apparatus shown in the engraving, complete security is insured, and I strongly recommend it to the notice of kite experimenters. A is a square copper box supported on a stout glass pillar (not less than two inches thick), and firmly cemented into a base-board, which is secured to the ground by strong iron pegs nine inches long, passing through the holes and driven into the ground. The box contains a reel, round which the wired string is wound: it is turned by a glass handle fixed on the multiplying wheel. *d* is a small catch moved by a key furnished with a glass handle, by which the reel may be stopped when required without touching the string. *c* is a Lane's electrometer provided with a screw adjustment, by which the distance between the brass balls may be regulated with the greatest nicety; it is connected with the ground by a chain or wire. The method of using this apparatus will immediately be understood. When the kite, (which may be simply a silk handkerchief, stretched on a cross of light wood) is raised a sufficient height from the ground for the wind to act upon it, the string need no longer be held in the hand, the kite draws it from the reel, and the experimenter, by means of the catch and key, has it under his complete controul. When a sufficient quantity of string has been taken out, a silk cord, two or three yards long, is thrown over the string, and, by means of a running noose, tightened upon it, and the other end made fast to a post; by this means the strain is taken off the box. On ordinary occasions, that is, when no unusual exhibitions of Electricity are anticipated, I generally set the balls of the discharger about one-fifth of an inch apart, and, instead of connecting the sliding wire with the earth, put it in communication with the interior coating of a Leyden phial. In a few minutes, sparks pass between the balls, and on fine dry days, when the wind is in the north, or north-east, with about half a mile of wired string out, I have frequently had discharges at the rate of one a minute from the jar, through a striking distance of one-fourth of an inch, for hours together. In order to test the species of Electricity collected, I cause the jar to discharge through a helix of copper-wire, enclosing a needle: after five or six explosions have passed, the needle becomes magnetized, the direction of the poles indicating the manner in which the jar was charged. If the helix be a *right-handed* one, that is, one in which the convolutions take the same direction as that in which the hands of a watch move, then, if the jar be charged *positively*, that extremity of the needle lying in the coil, which is nearest the *negative* or outside coating of the jar, will become a north pole. If the helix be left-handed, the results are exactly the reverse.

It is most interesting and instructive to watch the effect of clouds passing near the kite, their presence being invariably indicated by the increased rapidity of the discharges between the balls: the distance at which the Electricity is communicated is indeed astonishing. I have frequently observed a very marked alteration in the discharges from the approach of a single and small cloud before it could have reached within half a mile of the kite, and I have often astonished bystanders who have been amusing themselves by drawing small sparks from the string with their knuckles, by watching the opportunity presented by the approach of one of these clouds, and then desiring them to repeat their experiment, and the result has generally been a shock which has taught them to treat the apparatus with far greater respect than before.

One of the first things that the kite experimenter will probably notice, is the peculiar pungency of the spark: we are accustomed to receive sparks an inch long from the prime conductor of an electrical machine, for amusement; it would not, however, be safe to approach a kite-string from which sparks of such length might be drawn. The shock from sparks half an inch long are generally very severe, and resembling more the shock from a highly charged Leyden phial, than that from the prime conductor: the length of the spark is not, however, altogether the criterion of the intensity of the Electricity, which depends upon the quantity of string extended, and more still upon the state of the atmosphere.

Mr. Sturgeon's kite experiments appear to have been very extensive. "I have made," says he, "upwards of five hundred electric kite experiments, under almost every circumstance of weather, at various times of the day and night, and in every season of the year; I have experimented on Shooter's Hill, and on the low lands on the Woolwich and Welling sides of it, and the experiments in the three different places within an hour of each other; I have done the same on the Chatham lines, and in the valley on the Chatham side of them; on Norwood Hill, and in the plain at Addiscombe: also on the top of the monument in London, and on the top of some of the high hills in Westmorland and in the North Riding of Yorkshire; and in every case I have found the atmosphere *positive* with regard to the ground. I have floated three kites at the same time at very different altitudes, and have uniformly found the highest to be *positive* to the other two; and the centre kite *positive* to that which was below it: consequently the lowest was negative to the two above it, but still positive to the ground on which I was standing. I have made more than twenty experiments of this kind, and the results (with the exception of electric tension) were invariably the same, showing most decidedly that the atmosphere in its undisturbed electric state is more abundantly charged than the earth, and, as far as I have been able to explore it, still more abundantly in the upper than in the lower strata."

On the evening of the 14th of June, 1834, Mr. Sturgeon sent up a kite during a thunder storm at Woolwich, and the following is the description he gives of the phenomena observed:—"The wind had abated to such a degree before I arrived in the barrack field, and the rain fell so heavily during the time I was there. that it was with some difficulty that I got the kite afloat, and when up, its greatest altitude, as I imagine, did not exceed fifty yards. The silken cord also which had been intended for the insulator soon become so completely wet that it was no insulator at all; notwithstanding all these impediments being in the way, I was much gratified with the display of the electric matter issuing from the end of the string of the wire, one end of which was laid on the ground, and the other attached to the silk at about four inches distance from the reel of the kite-string. An uninterrupted play of the fluid was seen over the four inches of wet silken cord, not in sparks, but in a bundle of quivering purple ramifications, producing a noise similar to that produced by springing a watchman's rattle. Very large sparks, however, were frequently seen between the lower end of the wire (which rested on the grass) and the ground; and several parts of the string towards the kite where the wire was broken were occasionally beautifully illuminated. The noise from the string in the air was like to the hissing of an immense flock of geese, with an occasional rattling or scraping sort of noise.

"Two non-commissioned officers of the Royal Artillery were standing by me the whole of the time. Unaware of the consequence, they would very gladly have approached close to the string; and it was not until I had convinced them of the danger of touching or even coming near to it at a time when the lightning was playing about us in every direction, that I could dissuade them from gratifying their curiosity too far—probably at the expense of their lives. We anxiously and stedfastly watched what was going on at the end of the string, and the display was beautiful beyond description. The reel was occasionally enveloped in a blaze of purple arborized electrical fire, whose numberless branches ramified over the silken cord and through the air to the blades of grass, which also became luminous on their points and edges over a surface of some yards in circumference. We also saw a complete globe of fire pass over the silken cord between the wire and the reel of the kite-string. The soldiers thought it about the size of a musket-ball. It was exceedingly brilliant, and the only one that we noticed."

## COATING IRON NAILS, &c.

A PATENT has recently been obtained by Benjamin Blackwell, Newcastle, and William Norris, Exeter, for an improvement in coating iron nails, screws, nuts, bolts, and other articles made of iron, with certain other metals.

In coating iron with copper by electro-deposition, it has been found that the iron is liable to be corroded, and that frequently, either during the operation, or afterwards, an oxide of iron is formed upon the article, beneath the copper coating. To prevent the articles from being thus injured, is the object of the present invention; which consists in case-hardening, or coating with lead, or an alloy of lead, nails, screws, nuts, bolts, and other articles, made of iron, previous to coating them with copper by electro-deposition.

The case-hardening may be performed by any of the ordinary methods; the mode adopted by the patentees consists in removing from the surface of the articles any scales that may adhere thereto, and then placing them, with some parings of hoof or horn, or bone-dust, in a crucible or iron box, well luted, and subjecting them to a red heat; the articles being removed as soon as a very thin film of case-hardened surface is obtained.

The iron articles may be coated with lead, or an alloy thereof, by first cleaning their surface, and then dipping them into the molten metal, in the same manner as is practised for coating iron with tin. The alloys of lead, preferred by the patentees, are two in number:—the first is formed by the addition, to any given quantity of lead, of from one-fifth to one-tenth of tin, and one of antimony.

After receiving this first coating, the articles are ready to be placed in a solution of copper, and in the circuit of a galvanic battery; this should be done while the articles are yet hot from the first operation, and the battery should be kept at a temperature between 80° and 100° Fahr.

The patentees claim, as their invention, submitting iron, or articles of iron, to a process of being coated with copper, by galvanic means, after such articles have been case-hardened, or after they have received a coating of lead, or an alloy of lead.

## DRY ROT.

DAMP is not only a cause of decay, but essential to it; while, on the other hand, absolute wet, especially at a low temperature, prevents it. This latter must be understood to imply more than the partial immersion to which log-rafts are usually subject; for that is a practice unquestionably injurious to the timber. Piling and planking under damp foundations, notwithstanding the incontrovertible instances which can be adduced of their long endurance, are practices decidedly bad; for the decay of the timber is little less than certain: the sinking of the superstructure must obviously keep pace with it, and the settlement being irregular, must produce fractures in the edifice. Again we say, if the wet is perfect, the result is otherwise. Old refuse-wood that has been lying about in timber yards, imbibing moisture from the earth, makes bad bearers for logs; for it is more or less decayed, and therefore infectious. To bed timbers in mortar, which is liable to continue long in a humid state, is bad; under such circumstances decay may be expected: to prevent this chance, it was enacted by the 19th Car. 2, cap. 3, that bond and plates, the ends of girders, &c., should be bedded in loam instead of mortar; it may be here remarked that sawn timbers are, in their sides, more subject to the influence of moisture than such as have been split; for, as the saw cuts through the fibres, more ready access is afforded to the moisture; for this reason cleft pales are the most durable. Hasty finishing on damp walls delays drying, and must induce premature decay where timbers are confined: drying therefore should, in favourable weather, be accelerated by a free admission of air, and in the night by fires, but not too strong, for that would cause the wood-work to shrink and crack.

The confinement of timbers under most circumstances is attended with the worst consequences; yet a partial ventilation tends, as an able writer has expressed it, to "fan the flame" of decay, and hasten rather than prevent it: floors in general do not afford good facilities for ventilation, and are therefore very liable to decay; the joints of even well-ventilated framing frequently afford illustration of this; for when the timber has not been thoroughly seasoned, the moisture which there seeks escape, and (from the parts being neither perfectly close nor yet sufficiently open to allow dampness to evaporate) is confined, invariably induces decay. Timbering to basement floors, and in close cellars, is destroyed in a very short time.

Damp combined with warmth is, as a destroying agent, still more active than simple damp alone—the heat being understood as insufficient to carry off the moisture by evaporation; and the higher the temperature, with a corresponding degree of moisture, the more rapid the decay. The kind of composition produced in this way is called rot, and is of two kinds, distinguished as *wet rot* and *dry rot;* these proceed from the same primary causes, the difference between them being constituted by the disparity in the evaporation; where that is free, and disperses the gaseous products of the putrefaction, we have wet rot; where there is not a free circulation of pure atmospheric air, to absorb all the moisture and carry off these products, they combine in the formation of a parasitical fungus called ***boletus lachrymans***, belonging to the botanical class *cryptogamia*, and thus we have dry rot: of this serious evil it is important to be well aware :—

Dry rot, externally, first makes it appearance as a mildew, or rather a delicate white vegetation, that looks like such. This stage of the disease, if not one more advanced, is almost invariably found to be arrived at in the American timber brought over to this country in the confined and heated holds of ships; its next step is a collecting together of the fibres of the vegetation into a more decided form, somewhat like hoar-frost; after which it speedily assumes the leathery, compact character of the fungus, forming into leaves, spreading rapidly in all directions and over all materials, and frequently ascending the walls to a considerable height, the colour variable—white, greyish white, and violet, light or decided brown, &c. To give a forcible idea of the serious extent to which this disease will attain when once it takes root and is left unarrested, we shall collect some scattered cases. In the memoirs of Pepys, who was secretary to the Admiralty during the reigns of Charles II. and James II., reference is made to a commission which was appointed to inquire into the state of the navy, and from which it appears that thirty ships, called new ships, "for want of proper care and attention, had toad-stools growing in their holds as big as one's fists, and were in so complete a state of decay, that some of the planks had dropped from their sides." In the *European Magazine* for December, 1811, it is stated that, "about 1798, there was, at Woolwich, a ship in so bad a state, that the deck sunk with a man's weight, and the orange and brown-coloured fungi were hanging, in the shape of inverted cones, from deck to deck." In the *Transactions of the Society of Arts*, vol. xxi. p. 294, we find that "an oak barn floor, which had been laid twelve years, began to shake upon the joists, and, on examination, was found to be quite rotton in various parts; the planks, 2½ inches in thickness, were nearly eaten through, except the outside, which was glossy, and apparently without blemish. The rotten wood was partly in the state of an impalpable powder, of a snuff-colour, other parts were black, and the rest clearly fungus. No earth was near the wood."

In timber which had been only superficially seasoned, and the heartward sap of which has never been discharged, this disease is produced internally, and has been known to convert the entire substance of a beam, excepting only the external inch or two of thickness to which the seasoning had penetrated, into a fine, white, and thread-like vegetation, uniting in a thick fungous coat at the ends, the semblance being that of a perfectly sound beam, thus serving as a mask to mislead the inexperienced. In this internal rot, a spongy or fungous substance is formed between the fibres.

The first symptoms of rottenness in timber are swelling, discoloration, and mouldiness, accompanied with a musty smell; in its greater advance the fibres are found to shrink lengthways and break, presenting many deep fissures across the wood; the fibres crumble readily to a fine snuff-like powder, but retain, when undisturbed, much of their natural appearance.

The prevention of dry rot or growth of fungus, has engaged the attention of scientific men for a very long period; and much floundering has there been in their meritorious endeavours towards accomplishing this desirable object. Some of the means tried, while calculated to prevent vegetation, were found to introduce evils as great as those they were intended to obviate; even now, although much has been achieved, it is to be feared it remains, in a great measure, a *vexata questio.* The most favourite theory has been that of impregnating the pores of the wood with some such substance as should arrest putrefaction, and materials have sometimes been introduced for this purpose which produced an effect just the opposite of what was anticipated. About 1670 a Mr. Jackson, with a view to the prevention of decay, obtained permission to prepare some timber to be used in the national yards, by immersing it in a solution of salt water, lime, muriate of soda, potash, Epsom salts, &c., the result of which dose was, that the vessels built with it were rendered more perishable than if they had been constructed of unprepared timber. Between 1768 and 1773, a practice prevailed of saturating the timbers of ships with common salt, but this was found to cause a rapid corrosion of the iron fastenings, and to fill the vessels between decks with a continual damp vapour. Subsequently, mundic, found in the mines of Devonshire, was employed, in a state of fusion, to eradicate present, and prevent future growth; but whether its efficacy was proved by time, we have not been able to ascertain.

Quick-lime, with damp, has been found to accelerate putrefaction; but when dry, and in such large quantity as to absorb all moisture from the wood, the latter is hardened and rendered durable; vessels long in the lime-trade have afforded proof of this fact. White-wash or lime-water has been seriously recommended for use between the decks of ships, as being unfavourable to vegetation. Smoke-drying, oven-drying, scorching, and charring, have the effect of hardening wood, contributing to its durability, and preventing and destroying infection; but they may only be adopted with timber which has previously undergone a thorough seasoning. Steaming is also understood to prevent dry-rot. The piles supposed to have been driven by order of Julius Cæsar, when he forded the Thames at Cowey Stakes, near Shepperton, were charred; and when taken up some five-and thirty years ago, were found in a complete state, free from decay. The incorruptibility of charcoal is well known, whether it be buried in the earth, exposed to the atmospheric action, or to that of water; the beams of the theatre of Herculaneum, which were reduced to that state by lava, were, after a period of nearly eighteen centuries, found to be perfect; the charred feet of posts which are put into the ground afford proof of its efficacy; the flag-ship, *Royal William*, at Spithead, built in 1719, the inner surface of the planks of which only were charred, was an example of great durability. Amongst other advantages, rats will not touch charcoal, neither will the white ants and cockroaches, so common in the Indies, commit their depredations where charring has been employed.

But the methods which have most engrossed the public attention of late years are those respectively distinguished as Kyan's, Payne's, Burnett's, patent &c. In the year 1833 to 1836, at the Arsenal, Woolwich, experiments were instituted, having for their object the establishing or otherwise the claims of that first mentioned, and the results of which were of a very satisfactory nature: the Kyanised specimens generally, which were submitted to the fungus-pit, when taken out at the end of three years, being sound, while duplicate pieces, unprepared, were found in various stages of decay. Certain questions, however, presented themselves:—1st. Whether the impregnation to which the timber had been subjected might not be removeable by some cause, and perhaps generate an atmosphere noxious and injurious to health. 2nd, Whether the strength of the timber were impaired or otherwise. The first was satisfactorily determined by Dr. Faraday, who proved by experiment that the combination was not simply mechanical but chemical. and that a permanently compound material was formed; the second was solved by experiments made by Capt. Alderson, C. E., upon ash and Christiana deal, and which shewed that the rigidity of the timber was enhanced, but its strength in some measure impaired; its specific gravity being also somewhat diminished. Another question yet remains open.—how far, since the impregnation has not been traced to a depth greater than half an inch, does this process meet our requirements? and, after the satisfactory conclusion arrived at, as above related, and the evidence of the facts upon which it was so reasonably founded, how are we to meet the assertion of Mr. Pritchard. C E., of Shoreham, made in 1812?—"The sleepers Kyanised five years ago, and in use at the W. I Dock warehouses, have been discovered to decay rapidly; and the wooden tanks at the Anti-Dry-Rot Company's principal yard are decayed:" but more from this gentleman hereafter. Mr. Kyan's infusion is corrosive sublimate, and the process consists in submersing the timber in tanks for about a week, then taking it out and drying: Sir Humphrey Davy had previously recommended a weak solution of the same thing, to be used as a wash where rot had made its appearance. Dr. Birkbeck made a favourable exposition of the process as pursued by Dr. Kyan; Sir John Barrow and the Duke of Portland impugn it; and Lord Manners and Dr. Moore follow on the same side The Paynising process, besides professing to preserve timber from dry-rot and the ravages of insects, is said to render it uninflammable, or at least to deprive it in a great measure of combustibility.—*The Builder.*

## ON THE MANUFACTURING OF IRON AND STEEL.

Mr. Charles Low, of Robinson's-row, Kingsland, has recently patented certain improvements in the making or manufacturing of iron and steel.

These improvements consist in the use of the following materials in the manufacture of malleable iron and steel: viz., oxide of manganese, plumbago, charcoal, and nitrate of potash, soda, or lime, (preference being given to the ordinary saltpetre of commerce.)

The above materials are mixed in the proportion of 42 lbs. of oxide of manganese, 8 lbs. of plumbago, 14 lbs. of wood charcoal, and 2 lbs. of saltpetre; and 66 lbs. of this mixture are thrown into the blast furnace with each charge of ore likely to produce 480 lbs. of metal. It may be introduced, with equal advantage, into the puddling furnace, when the pig-iron is in a fused state, by throwing a few pounds of it upon the surface of the metal, every few minutes, thoroughly incorporating it therewith, by stirring, until the 66 lbs. have been used, or until the metal begins to thicken, or "come to natu :" it is then balled, &c., as usual. The mixture may also be employed, in like proportions, for improving the quality of iron in the cupola or other furnace used by founders.

Another part of this invention consists in the application of the mixture to the manufacture of cast-steel, from malleable iron, which has been made by the above processes. For this purpose, 2 or 3 lbs. of the mixture are added to every 30 lbs. of steel, when in the melting pots, during its conversion into cast-steel. Or the object may be more immediately effected by adding the ingredients (in the same relative proportions as for steel) to the malleable iron, made as above; and then the application of a moderate heat will fuse the iron in contact with the mixture, and immediately convert it into cast-steel.

The mixture should be ground previous to use; for the puddling furnace, it should be brought to a moderately fine powder, and the patentee prefers to introduce it at the top of the furnace, through a hopper or tube, which will spread it more evenly than if distributed by hand through the furnace-door; for the blast furnace and cupola, the powder may be in a coarser state.

The patentee says, "I do not claim the exact proportions above described, as they must somewhat vary for different qualities of iron ore and iron, or of the ingredients themselves; nor do I claim the use of any of the aforesaid ingredients separately, as they may have been made use of before; but I claim the use of them collectively, in the manufacture of iron or steel, either in the blast furnace, puddling furnace, cupola, or other furnace, or in the melting pot.

## IMPROVED PLASTIC COMPOSITION.

A Patent has lately been granted to Mrs. Marshall, of Manchester, for a certain improved plastic composition, applicable to the fine arts, and to useful and ornamental purposes. This improved plastic composition, denominated by the inventor "patent intonaco," consists of the following formula:—To six parts, by measure, of vegetable gluten, gelatine, or albumen, add one part of animal gluten, gelatine, or albumen, boiled to the consistence at which a joiner uses his glue; add one twenty-fourth part of oil, or of animal fat; and if the vegetable matters used, be (as most British vegetables are) deficient in the principle of caoutchouc, this must be supplied by adding a forty-eighth part of India-rubber. These materials, called the "bind" must be very intimately united, and when at the boiling point or not much below it, must have from thirty to thirty-four pounds of sulphate of lime worked into them till quite smooth. This is the pure intonaco: To bring the above to weight, instead of measure, and assuming rice or starch of any kind as the vegetable used, then it will be thus:—One pound of vegetable matter, a quarter of a pound of animal matter, half a pound of oil or animal fat, a quarter of a pound of India-rubber, twelve pounds of water, and thirty pounds of sulphate of lime. These proportions may be changed or even reversed; the product will still be a substance extremely plastic when wet, and extremely hard when dry; but these are given as the proportions productive of the best results. Any vegetable gluten, gelatine, or albumen, even that from sea-weed, may be used; but the product of boiled rice, Indian wheat, buck-wheat, wheat-flour, sago, tapioca, arrow-root, and starch of every description, is the best. When too much damaged to be used for food, these articles are still available for making this intonaco, provided the glutinous quality has not been destroyed by fermentation or otherwise. Any animal gluten, gelatine, or albumen, may be used, even the water in which fish has been boiled; but the product obtained by using common joiner's glue (or the glue obtained by macerating bones in weak muriatic acid) is the best. Any kind of oil or animal fat may be used; but the product obtained by the use of linseed oil is preferred. The best and most convenient form of India-rubber for making the intonaco, is Macintosh's patent India-rubber varnish. The intonaco being made as above, it must be worked up into the state suited for the purpose to which it is to be applied: if for plastering walls, it must be used of rather thicker consistency than common plaster. The walls must be brought to a smooth surface by the use of common lime or mortar, and the applied intonaco one-fourth of an inch in thickness, and at once brought to a fine surface, skimming being neither necessary nor advantageous to it. When fully set, it is to be polished, by using a Water-of-Ayr stone, or any other method the operator finds best: it will polish better when quite dry, but the operation is then more tedious. The time requisite for the intonaco to set will vary from two to seven hours, but it may be detained for any number of hours, up to twenty-four, by the addition of a certain proportion of pure sulphate of barytes, and its best qualities are at the same time heightened by this mixture; it dries in from twenty-four to forty-eight hours. When intended to make imitation of marble, the pieces of colored intonaco are to be stuck upon the wall, or any other surface, in the proper pattern, and then trowelled smooth. Pillars, pilasters, &c., may be made with lath, well spread with good lime, and the intonaco applied when the lime is nearly but not quite dry, or it may be re-damped for the purpose. When intended to be coloured all through the colour must be intimately mixed with the bind, previous to adding the sulphate of lime. The pure intonaco will firmly agglomerate any pulverized body, even metal filings, mixed with the boiling bind, before the sulphate of lime is added. A useful species of fuel may even be made, by agglomerating with it saw-dust and coal-culm: it burns not unlike charcoal. The following are the best proportions for the cement for architectural use:—Into six quarts of the bind (at the heat above mentioned,) work in eighteen pounds of dry hill or river sand, and two pounds of white or red lead, as the colour may be desired; when fully combined, add as much sulphate of lime as will bring it to the desired thickness, and spread it immediately; when dry, it is very hard, and by repeated coats of oil may be rendered waterproof, and also very highly fire-proof. If the sand cannot be procured dry, then the strength of the bind must be as much increased as will balance the probable quantity of water introduced by the sand; but dry sand is best. The following may be named as the principle uses of the intonaco:—as a fire and water-resisting plaster for walls, interior and exterior;—imitations of marble and other stones;—architectural mouldings and ornaments;—for covering the unplanted side of fruit walls, to prevent the radiation of heat on that side, so that it takes place entirely on the side with the plants, and at the same time removing from the garden landscape unsightly lines of red brick walls;—for ornamental garden architecture, alcoves, grottos, rock-work, &c.;—for covering wooden shelving, in shops and warehouses, as a preservative from fire;—for imitations of ancient wainscoating, and all other manner of carving in wood;—as a ground for gilding, possessing advantages over every other in use;—as a ground for decorative painting in fresco, tecco-tempora, and encaustic; and a new style peculiar to itself and more rapid in execution than any now in use;—for making casts and models of all natural forms even of landscapes;—for making tesselated pavements, and ornamental tiles;—as paint for ceiling and walls; and for all domestic uses to which marble is at present applied; as baths, wash-hand stands, plinths and pedestals, mantel-pieces, hearths, and sides of grates.

## COFFEE.

THE following account of the dietetic qualities of this aromatic berry will be read with interest. In most countries it is a decided favourite, on account of its exhilarating qualities; and, doubtless, were it taken in moderate quantity, with the proper accompaniments of cream and sugar, it would not impair the digestive power, nor injure the constitution in any way; but when it is taken in the shape of a very concentrated infusion, without either sugar or cream, as by the Turks, and other nations, it must have a pernicious effect on the stomach, and, indeed, determined coffee drinkers are generally afflicted with heartburn and indigestion, and were it not for the defensive and dilutory action of solid viands, and nutritious liquids, the stomachs of many of them would be completely destroyed. But, the best way of dealing with this important question, as regards the public health, is to quote the result of a REPORT lately made by medical and other commissioners, to the Swedish government on the subject. It seems that the inhabitants of the province of Dalecarlia, in Sweden, had until the end of the last century, been considered to be the most healthful, the handsomest, the most beautiful, and the most happy of all the inhabitants of Sweden. About that period, however it was observed that a great variety of maladies, *till then unknown*, appeared and worked a considerable change in the general health; moreover, that the people had fallen from that condition of ease and pecuniary comfort, which they had hitherto maintained. It was observed also, that in partcular districts of the province, *no change* had taken place; that the inhabitants enjoyed the best possible health; and that their circumstances remained as heretofore. The solicitude of the government authorities being directed to these facts, and enquiries into their causes instituted, the result (which was only recently published) is, *that the use of coffee is the sole cause of the sinister change which has taken place in the health and condition of the people*; that wherever the people have *abstained* from this beverage, their health and circumstances have in all respects, remained *unchanged*. The REPORT in question, goes so minutely into particulars, that it seems impossible to be mistaken as to the validity of the causes which it assigns for the effects in question. Supposing, therefore, the above inference to be correct, may it not be questioned, whether the premature loss of beauty among the females of *Switzerland*, the peculiar tint which overspreads their complexions, though hardy mountaineers; and the universal ill health which prevails among them, may not be attributed to the habitual, nay *twice-a-day* use, of this fragrant, though perhaps noxious berry? of which, there are consumed in Switzerland, no less than *Twenty millions of pounds* annually.

## IMPROVEMENTS IN THE MANUFACTURE OF SOAP.

A PATENT has lately been granted to Charles Watterson, of Manchester, for his invention of certain improvements in the manufacture of soap. These improvements consist chiefly in the peculiar method or process of mixing or combining the oil or fatty matters employed, with caustic soda, and in subsequently adding water, for the purpose of converting such mixture or produce into soap. By means of this invention, it is stated that the soap is rendered of a purer and more efficient nature; and also that a considerable economy of time is effected in the operation; the soap being sufficiently hard for sale or use in the course of a few hours, instead of several days, as is the case under the ordinary process of manufacturing. The ingredients employed are nearly the same as in common use, namely, 1, all animal and vegetable oils, either mixed or separately; 2, liquid caustic soda, of the strength of 32 per cent; 5, water as free from earthy salts or metallic oxides as can be obtained.

The improved process of manufacture is as follows:—To make half a ton of soap, put into a pan 7 feet in diameter, and about 2 feet deep, 784 lbs., say, of raw palm oil; as soon as the same has become fluid, add, gradually, 407 lbs. more or less (acording to the quality of soap required) of liquid caustic soda, of the strength above specified, taking care to mix the ingredients thoroughly by an instru- adapted to the purpose. The heat must then be increased, and the mixture constantly moved about, to prevent it from caking on the bottom of the pan. After continuing the operation, and at the end of three or four hours, the mixture assumes a whitish appearance, and by continuing the heat the whole of the aqueous part is entirely evaporated, and the mass reduced to a perfectly dry state. The heat is now increased, and in a short time the mass becomes again of a liquid form, and changes to a brownish color, which indicates that the combination of the oil with the alkali is effected. The fire is then speedily withdrawn, and the stirring is continued so long as any fear of scorching is apprehended. When this is over, the first part, or day's operation, is concluded, and the pan may be locked up, for the purpose of cooling, or for the night, by the excise officer. The second part of the operation consists in breaking up or grinding the product, now in a solid form, into a state of powder. To this add 45 gallons of pure water (or slightly more or less,) and thoroughly agitate the mixture for about half an hour. The heat is then applied, and the contents of the pan raised to the boiling point, and kept so for about three hours, during which time the stirring and agitation must be continued. So soon as the evaporation has been carried to the desired extent, and the soap appears of a proper consistency, it is allowed to cool gradually. The whole contents of the pan (no leys or waste accruing from the operation,) while yet in a liquid state, are now put into the ordinary frames and left to cool. The day following, the contents of the frame will be found hard enough for cutting, in the usual way; and as soon as cut up, the soap is in a fit state for sale and use.

## ENGINEERING IN EGYPT.

On the 28th of November, a dry dock at Alexandria, which has been about eight years in execution and has cost Mehemet Ali half a million sterling, was opened, and the first vessel hauled in. According to the *Times*, it is constructed in deep water; and the engineer, a Frenchman, of the name of Mougel, had great difficulties to contend with from the nature of the soil, besides labouring under a peculiar disadvantage, owing to there being no tides in this port. The dock has been made on the model of that of Toulon; its length is 243 feet and its width 72 feet, taken on a level with the sea. M. Mougel will shortly leave for France, and it is said that he has received from Mehemet Ali instructions to take all the necessary mesures for the construction of the "barrage" of the Nile, which work, if ever completed, will be a great boon to Egypt. The site fixed upon, at present, for this purpose is the point of ramification of the Rosetta and Damietta branches of the river, about ten miles below Cario. It will consist of two bridges, one over each branch of the Nile, both joining at the exteme point of the Delta. The bridges will be formed of a certain number of arches, and one arch of each bridge will be made with a lock, for the purpose of navigation. In the centre of the Delta, will be opened several canals, to which the water of the Nile will be allowed ingress, as it may be required.

## MUTUAL RELATION OF THE SCIENCES.

(*Continued from page* 358.)

There was a time when chemistry, in common with astronomy and all the physical sciences, was nothing more than an art, founded on empirical practice, subject only to rules discovered by experience; but since the causes of the changes in bodies which it effects, and their laws, *i. e.* the reasons of its rules, have become known, the empiric art has lost its value and importance. The acquisition of skill in manipulation by laborious and long-continued application, the tedious methods, and endless precautionary measures formerly necessary to success in chemical manufactures, have become wholly needless since a correct knowledge of causes has been obtained. The strange apparatus and utensils of the chemist of former ages, their stoves and stills, are now mere matters of curiosity. The success of an experiment, or a process, depends far less upon mechanical skill, than upon knowledge. Discoveries are made, not by manual dexterity, but by skill in the combining of means, and by the powers of thought and reflection.

In our lecture-room we teach the letters of the alphabet; in our laboratory their use. It is in the latter that the student acquires a readiness in reading the language of phenomena, that opportunities are furnished to him of learning the rules of combinations, of applying them, and of gaining a ready dexterity in their application. As soon as these signs, letters, and words, have become formed into an intellectual language there is no longer any danger of their being lost, or obliterated from his mind. With a knowledge of this language he may explore unknown regions, gather information, and make discoveries wherever its signs are current. This language enables him to understand the manners, customs, and wants prevailing in those regions. He may, indeed, without this knowledge, cross the frontiers of the known, and pass into the unknown territory; but he exposes himself to innumerable misunderstandings and errors. He asks for bread and he receives a stone.

The true philosopher always seeks to explain and illustrate the facts of nature by creating phenomena; that is, by experiments, the devising and discovery of which is his task, and by which he causes the object of his investigation to speak, as it were, intelligibly to him. No single isolated phenomenon, taken by itself, can furnish us with its own explanation; it is by tracing its connections, by studying and arranging its antecedents and consequents, and well observing their several links, that we attain to a comprehension of it, and an understanding of its true cause. For we must never forget that every phenomenon has its reason, every effect its *cause*.

Such opinions as that the creative energy of nature produces the most various kinds of plants and animals out of putrid matter, without seeds or sperm; that nature abhors a vacuum; that iron and phosphorus are produced in the living body of animals, and the like, are emanations of ignorance and indolence, and display men's incapacity to discover the true origin and causes of things. But a thousand unconnected observations have no more value, as a demonstrative proof, than a single one. A hundred weight of error will not form one grain of truth. If we do not succeed in discovering causes by our researches, we have no right to create them by the imagination; we must not allow mere fancy to proceed beyond the bounds of our knowledge. Thus, when we have learned that infusorial animalculæ are propagated by eggs, it only remains for us to inquire how the eggs are conveyed to where we find them. From the moment the imagination is allowed to solve questions left undecided by researches, investigation ceases, truth remains unascertained, and there is not only this negative evil, but in error we create a monster, envious, malignant, and obstinate, which, when at length truth endeavours to make its way, crosses its path, combats, and strives to annihilate it! Thus it was in the time of Galileo; and thus it is still, everywhere, in every science, where mere hypotheses are admitto usurp the place of truth.

If we acknowledge the incompleteness of our researches, and simply confess our inability to answer the questions which arise as we contemplate the phenomena of nature, those questions remain as problems for futurity to solve, and excite the attention and exertions of thousands; zeal is kindled and kept alive, and in process of time their solution will certainly be accomplished. But if we create and give currency to imaginary explanations, inquiry is arrested, the mind becomes satisfied by mistaking the error for truth, and resting therein, and the progress of inquiry, as well as of truth, is impeded or altogether stayed. The imagination may thus create a hundred thousand errors in a hundred thousand cases; and yet nothing is more injurious to science, nothing more retards its advancement, than a single false doctrine promulgated and adopted, since it is infinitely difficult to root out old prejudices, and this precisely because that which is false or erroneous has been cherished as truth.

It is certainly not conformable to a true philosophy of nature to attempt an explanation of the processes of assimilation and secretion, before we have obtained a correct knowledge of *aliments*, and the sources whence they originate, and before *albumen, casein, blood, bile, cerebral substance, et cetera*, had been subjected to a searching investigation. Before these substances have been successfully analysed, they are mere words, the meaning of which is unknown. How could it be expected that any useful information should be derived from the mere terms, until the properties and relations of the substances themselves are known, and we have traced the metamorphoses they undergo when in contact with other bodies?

The cause of the phenomena of life is a force, which does not act at sensible distances; its activity becomes manifest only when the aliments or the blood come into immediate contact with the organ destined for their reception and alteration. Chemical power manifests itself precisely in the same manner; indeed there are no causes in nature producing motion or change in bodies—no powers more closely analogous to each other—than the chemical and vital powers. We know that wherever different substance are brought into contact with each other, chemical actions take place. To suppose that one of the most energetic powers of nature should take no part in the processes of animal organisms, although in those organisms all the conditions under which it commonly manifests its activity are united, would be against every established rule for the proper study of nature. But so far from there being any foundation for the opinion that the chemical actions are subject to the vital power, so as to become inoperative or imperceptible to us, the chemical effects of oxygen (for example) are manifest in full activity during every second of life. Moreover, urea, allantoin, the acid which is found in ants and water-beetles, namely formic acid, oxalic acid, the oils of valerian root, of the spiræa ulmaria, of the gualtheria procumbens, are products of the vital processes; but is their production attributable to the *vis vitæ?*

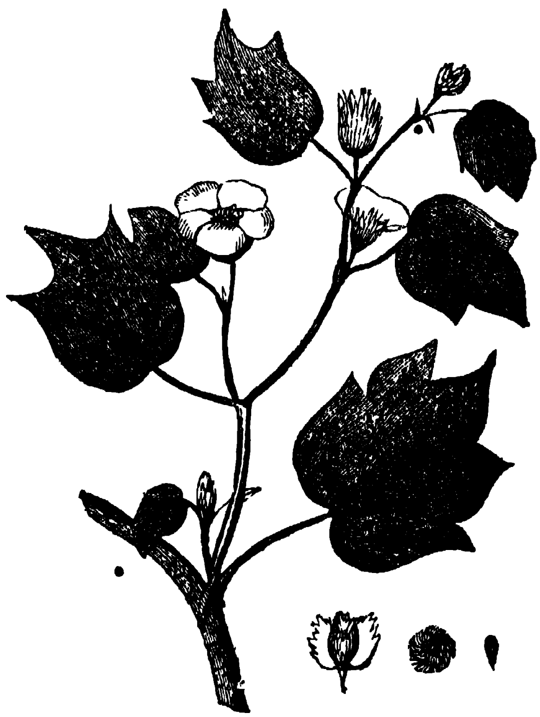
*(To be continued.)*

## VARIETIES.

*The Upas Tree.*—A living plant of this celebrated tree has beeen lately presented to the Horticultural Society by the East India Company, and is now growing in the Chiswick Gardens. It is in perfect health, and notwithstanding the fables of Dutch travellers, perpetuated by Darwin, may be approached with safety. It is, however, so virulent a poison that no prudent person would handle it without proper precaution.

*Lamp Glasses.*—A very simple but effective precaution is employed in Paris, to prevent the breaking of lamp glasses by the sudden application of heat. Before they are used, a glazier cuts or scratches the base of the glass with a diamond, and afterwards sudden heat may be applied without danger.

*Bourbon Cotton.*



*Sea Island Cotton.*

THE COTTON PLANT.

## NATURAL HISTORY OF COTTON.

THE filamentous down which invests the seeds of the *gossypium*, a plant of the natural order malvaceæ or mallows, is the substance called in English commerce cotton-wool, and in French *coton en laine*, from its resemblance to the fibrous fleece of the sheep. It is usually white, of various shades of purity; but it is sometimes cream-coloured, and at others iron-yellow or tawny. The filaments, when viewed in a good achromatic microscope, appear to be for the most part riband-formed or flattened cylinders, with a thickened list at either edge, and veins of embroidery running along the middle. They vary in length from half an inch to one inch and three-quarters; and in breadth from $\frac{1}{700}$ to $\frac{1}{3500}$ of an inch, tapering always to a fine point at their ends. These variations in length and breadth belong to plants of different growths and countries, the filaments being pretty uniform in the average product of each particular crop. The lustre of cotton, as seen in the microscope, is pearly, whereas that of flax is vitreous. Whether a cylinder or a riband, the cotton fibre is seldom or never straight like that of flax, but is either twisted right and left or coiled like a cork-screw. Those of the best Sea Island, the most valuable species of cotton, very commonly appear to be beautiful spiral springs, singularly adapted to the spinning process, readily entwining with, and sliding over, each other, during the formation of a thread, with an easy elastic force. There are no feathery margins, as some writers have described.

The word cotton may be traced most clearly to the language of Arabia, a country where the plant is indigenous, where it was probably applied to clothing purposes in the infancy of the human race, and whence, undoubtedly, it was brought into Western Europe at the era of the Mahometan conquest. The textile down is called in Arabia gotn or gootn, which signifies also soft; a word evidently identical with the Spanish godon, or algoden, formed like alkali and alkohol of the prefix article a' and the noun.

Gossypium or cotton constitutes a perfectly natural family of plants, in which the specific differences are remarkably slight. Since the filamentous down, which invests the seeds, differs exceedingly in quality and value in different varieties of the plant, corresponding botanical distinctions have been sought after with great assiduity, but hitherto with very little success. Indeed, M. Decandolle, one of the most eminent botanists of the age, confesses that the family gossypium stand much in need of more minute investigation.

The botanical characters have been taken from the leaves, the stipules, the glands, the spots, the colour, the hairs on the stem, and the durability of the plant. The leaves are subject to great variations in the form of their sub-divisions or lobes, not merely in the same species but in the same individual shrub. On one stem may be found two or three very different forms of foliage, resulting from evil climate, and cultivation. Glands have been noted as distinctive of peculiar species, but they may be found in all the gossypiums; nay, on the same shrubs, some leaves may be observed having only one gland, and others with two or even three glands.

The stipules are generally uniform in shape and direction. The colour, the spots, and the hairiness of the stems or branches, are too variable to form subjects of specific distinction. Nor is the durability of the plant constant in the same species. The shrub cultivated as an annual at Malta, under the incorrect title of gossypium herbaceum, may under certain circumstances last for several years. Thus the cotton growers at Motril in Spain raised many of their cotton plantations from Maltese seeds, and yet they found the shrubs live for six or even ten years. This change of the longevity of the plant is partly due to husbandry and partly to climate.

It may also be remarked, that all the lands which bear cotton in Spain are situated near the sea-coast, and that they produce perennial plants, but no annual ones. There they will thrive for eight or ten years, provided they encounter no accidental frost. In the second year they attain to the height of seven feet and a half, if they are not pruned across the stem If thus cut they will send out lateral shoots three feet long. Cavanilles gave the name *Gossypium Peruvianum* to a variety which he saw in the province of Valencia, but there is not a cotton plantation in Spain where he might not have several different shrubs equally well marked with that fancied species. From the intermixture of seeds such a confusion has arisen in the descriptions of the gossypium, that modern botanists have hardly been able to refer any particular cotton wool to a particular species of plant, or to refer the plants now growing to those described by authors two centuries ago.

## THE CHEMIST AND HORTICULTURIST.

CHEMISTRY and Horticulture may now be fairly said to have shaken hands. The chemist no longer disdains to recognise a field worthy of his labours; and the Horticulturist is prepared to accept all the services which Chemistry may render him. Nevertheless, though no longer strangers to each other, they labour under the disadvantage of speaking different languages; and a few words from a mutual friend may not be amiss, to explain by what means this obstacle to their understanding each other may be removed. These may be very briefly described. The chemist must condescend to deliver himself less scientifically, and the farmer and gardener must dare to think more philosophically. We will begin with the former in illustrating this piece of simple, but not unimportant advice.

There is hardly any phenomenon in nature which may not be explained in a great variety of ways, according to the length we go in tracing them to first, secondary, intermediate, or proximate causes; and, as far as it goes, each explanation may be equally correct. This variety of explanations, however, is a cause of much doubt and disbelief to the uninitiated, who cannot perceive that they are all derived from the same fundamental principle: and it would therefore be far better, in addressing them, to refer them to that principle at once, because it cannot fail to be one with which their observation on other matters has already rendered them familiar. In fact, the fundamental principles in the economy of nature are very few, and their action is so perceptible and diversified, that any explanation based upon them is comprehensible to the humblest capacity; whereas, elaborately tracing a phenomenon to some other phenomenon a few stages nearer to the prime cause, is not only unsatisfactory, but, involving the necessity of using a technical nomenclature, is, to ninety-nine out of a hundred, altogether unintelligible. Therefore, we repeat, when instructing the non-scientific, the chemist should refer them to the prime cause at once; for thus, though he may not enable them, like himself, to *demonstrate* that the phenomenon in question must be due to it, he will satisfy them that *it is so* (which is practically all that is wanted), just as you may satisfy a carpenter that two sides of a triangle are greater than the third, by referring them to the fundamental axiom that a straight line is the shortest line between any two points, without dragging him over Euclid's "asses' bridge" to prove it. Conversely, in explaining the effect of any cause, the chemist should at once show his horticultural pupil what nature has been about, by exhibiting to him her intention in the last stage of her operations; for, by howsoever elaborate a process she may work, she uniformly exhibits herself at last as having arrived at very simple means for accomplishing her object. Thus, with manures. Nothing can exceed, to the eye of a chemist, the elaborate ingenuity by which nature converts our common farm-yard manure into a food for plants; but a mere theoretical explanation of the process to a farmer unacquainted with the vocabulary of chemistry, and with the chemical properties of gases, salts, &c., is useless. It would afford neither amusement or instruction.

Show him, on the contrary, what nature has been aiming at, by exhibiting her at the last stage, when her preparation for feeding the plant is complete—show him that she has all the time been labouring to render the vegetable and and animal substances in the manure *soluble in water*, in order that they may avail themselves of the penetrating power and capillary attraction of that element to enter into the root and ascend into the body of the plant—and then he will perfectly understand what *he* ought also to aim at in the *artificial* preparation of manures, and his own rude way will quickly rival the chemist, from his more frequent opportunities of observation in detecting what mismanagment defeats it, and what modes of treatment are calculated to aid it. To explain to him that too much fermentation neutralises this, or volatilises that, is only rendering phenomena, which is invisible to his eye, incomprehensible to his mind. The time may come when it will be otherwise; but *at present*, simple means must be adopted to make the farmer familiar with chemical theories. Indeed, this is the proper, because the natural, mode of introduction to every science. In teaching a youth the science of mechanics, for instance, would you not make him acquainted with effect produced by a mechanical power, before you attempted to teach him the theory of its action? By observation, indeed, thus properly directed, horticulture and agriculture may in time furnish us with self-taught chemists, as a pastoral life has furnished us with self-taught astronomers.

We have said, moreover, that not only must the chemist condescend to speak less scientifically, but that the farmer and gardener must begin to speak, or rather to *think*, more philosophically. For instance, in applying caustic lime to certain soils, how common it is to hear our most intelligent farmers speak of the lime as *destroying* the vegetable matter with which the soil is overcharged. When he comes to consider that the best, if not the only, means for *replenishing* an exhausted vegetable soil is the addition of decomposed vegetable matter, and that caustic lime not only decomposes vegetable matter, but fixes it in a state fit for the nutriment of plants by rendering it *soluble in water*, he will adopt a more correct phraseology; and the use of a correct phraseology in any science or business has more effect in giving a proper direction to our ideas than people in general are aware of. Whatever we may *mean* by a term, if it is erroneously applied, it will eventually lead others, and even ourselves, into errors of principle and practice. By the united efforts of the chemist and agriculturist in the method we have pointed out—the one to *simplify*, and the other to *improve* his language—they will quickly come to understand each other without difficulty or danger of confusion; and what is more, it will be the first step of approximation towards their arriving at a language which shall be common to them both; and then, and not until then, shall we be fully justified in admitting AGRICULTURAL CHEMISTRY among the recognized and established sciences.

---

*To the Editor of the Magazine of Science.*

SIR,

I have tried the light of a Camphine Lamp with the low power of a Gas-microscope, and find it has a very good effect, far superior to any that could be obtained with the Argand Lamp in common use, with the Lucernal Microscope, Magic Lanthorn, or Dissolving Views. If the burner were of considerable diameter, I think it would render these instruments very much more convenient than (owing to the trouble of obtaining gas, or to insufficient illumination) they now are,

I remain, Sir,

Your obedient servant,

HENRY S. TURRELL.

*Montpellier House, Brighton.*

---

## MUTUAL RELATION OF THE SCIENCES.

(*Continued from page* 376.)

We are able to produce all these compounds by chemical processes. The chemist produces the crystalline substance found in the fluid of the allantoin of the cow, from the execrements of snakes and birds; he makes urea from charred blood; sugar, formic acid, and oxalic acid from saw-dust; the volatile oil of spirææ ulmaria, of gualtheria procumbens, from willow-bark; the volatile oil of valerian from potatoes. Thus we have successful examples enough to justify us in entertaining the hope that we shall. ere long, succeed in producing *quinine* and *morphine*, and those combinations of elements of which *albumen* and *fibrine*, or muscular fibre, consist, with all their characteristic properties.

Let us, however, carefully distinguish those effects which belong to the chemical, from those which depend peculiarly upon the vital power, and we shall be in the right channel for obtaining an insight into the latter. The chemist will never be able to produce an eye, a leaf, or a hair. But we know, with absolute certainty, that the formation of hydrocyanic acid in bitter almonds, of sinapine in mustard, and of sugar in germinating seeds, are results of chemical decomposition. We see that the stomach of a calf, when dead, with the addition of some hydrochloric acid, acts upon flesh, and upon coagulated albumen, precisely in the same manner as the living stomach acts; that is, these aliments become soluble, and are, in fact, digested. All this justifies us in inferring, that by this method of investigating nature, we shall arrive at a clear comprehension of the metamorphoses which aliments undergo in the living organism, and of the action of remedies.

Without a profound study of chemistry and natural philosophy, physiology and medicine will obtain no light to guide them in the performance of their most important offices, that is, in the investigation of the laws of life, the vital processes, and the removal o abnormal states of the organism. Without a knowledge of chemical actions the nature and effects of the vital force cannot be fathomed; the scientific physician can expect to derive assistance from chemistry only when he shall be able to put his questions to the chemist correctly.

Commerce and the arts have already derived immeasurable advantages from the progress of chemistry; mineralogy has become a new science since regard has been had to the composition of minerals and the chemical relations of their constituents. If the composition and chemical nature of rocks and strata are not in like manner investigated (and this has hitherto been much neglected), it will be impossible to effect any considerable progress in geology. Chemistry, moreover, is the foundation of agriculture, and it is impossible to accomplish a scientific consolidation of this important art without a knowledge of the constituents of the soil, and the aliments essential to the life of plants.

Without an acquaintance with chemistry, the statesman must remain a stranger to the vital interests of the state, to the means of its organic development and improvement; his attention cannot be sufficiently alive, nor his perception adequately acute, to what is really useful or injurious to his country,—to society. The highest economic or material interests of a country, the advantageous production and increase of food for man and animals, the preservation and restoration of health, are closely linked with the advancement and diffusion of the natural sciences, especially of chemistry.

Without the knowledge of natural phenomena, and the laws by which they are governed and controlled, the human mind is capable of forming no adequate conception of the goodness and unfathomable wisdom of the Creator; for whatever images the most cultivated mind and the most exalted imagination may be capable of inventing, these will appear, when compared with the realities of nature, but glittering and unsubstantial bubbles!

The great desideratum of the present age is practically manifested in the establishment of schools in which the natural sciences occupy the most prominent place in the course of instruction.

From these schools a generation will spring up, vigorous in understanding, qualified to acomplish all that is truly great, and to bring forth fruits of universal usefulness. Through them the resources, strength, and wealth of empires will be incalculably increased; and when, by the increase of knowledge, the weight which presses on human existence is lightened, the difficulties of obtaining subsistence lessened, and man is, in a great measure, disencumbered from the pressure of earthly cares and troubles, he will be able to devote his mind, with freer exertions and purer aim, to the highest purposes of his being.—*Liebig.*

---

## RAILWAY BARS.

At a recent meeting of the members of the Institution of Civil Engineers, a paper was read by Mr. Barlow, on the different modes of confining railway bars in their chains. Of the numerous methods which have been tried for keying the rails in the the chairs, it would appear that the one now most generally practised is that of parallel compressed wooden keys, but even to these Mr. Barlow states several objections, which, in his opinion, counterbalance the advantage of their elasticity and tendency to assume their original dimensions when exposed in a damp atmosphere. Being of small dimensions and placed just at the surface of the ballast, they decay rapidly; they swell and shrink with every change of temperature, thus becoming loose in dry weather, and requiring constant driving up, which soon destroys them. On the Midland Counties Railway the duration of the wooden joint keys has not exceeded five years, and at the present price of compressed keys, which varies from 8*l.* to 12*l.* per thousand, the expense of renewal of keys per mile per annum at the latter rate would be 10*l.* 2*s.* 6*d.* for a line with 3 feet bearings, and 8*l.* 9*s.* with 3 feet 9 inches bearings. This induced Mr. Barlow to try hollow wrought-iron keys made like the Russel gas-tube, but of such a form as to bear equally against the jaw of the chair, the middle web of the rail, and the top and bottom flanches. This form and substance it has been found gave great stability, held the rails firmly in their places, and yet possessed such elasticity as to neutralize the effect of the travelling of the wheels over the chairs, and rendered the motion of the carriages peculiarly smooth and agreeable. A number of experiments were given, wherein the great superiority of these keys, in their inherent qualities and their cost, over all other kinds was satisfactorily shewn. They have now been used for a considerable period on the Midland Counties, the South-Eastern, the Warwick and Leamington, and other railways; and in the discussion which ensued, several engineers expressed themselves so well pleased with them, that they intended to introduce them in all their new works.

## THE PRESERVATION OF WOOD.

In the last Number of the Magazine of Science, we published a paper on "Dry Rot," and we propose as an appropriate sequel to it, to insert the following remarks from the *Annales de Chimie et de Physique*, by Dr. Boucherie, who contrasts the increasing consumption and the rapid decay of timber, with its slow rate of production, which makes its necessary to economize its employment. He adverts to the many projects for its preservation, and the methods subsequently proposed, to many of which he objects from their uselessness; to others from the slow and superficial manner in which timbers part with their contained fluids, or absorb new ones by simple immersion, (circumstances long since proved by Duhamel;) and to all from their *expense*, the ultimate test of general application.

He argues, that all the changes in wood are attributable to the soluble parts they contain, which either give rise to fermentation or decay, or serve as food for the worms that so rapidly penetrate even the hardest woods. As the results of analysis he says, that sound timbers contain from three to seven per cent. of soluble matters, and the decayed and worm-eaten rarely two, commonly less than one per cent.; he therefore concludes that "since the soluble matters of the wood were the causes of the changes it undergoes, it is necessary to its preservation, either to abstract the soluble parts in any way, or to render them insoluble by introducing substances which should render them infermentable or inalimentary;" which he considers may be done by many of the metallic salts and earthly chlorides.

Dr. Boucherie shows, by parallel experiments upon "vegetable matters very susceptible of decomposition, as flour, the pulps of carrot and beet-root, the melon, &c., (which only differ from wood, of which they possess the origin and constitution, by the greater proportion of the soluble matter which they contain,)" that in the natural states they rapidly alter, but are preserved by the pyrolignite of iron, (pyrolignite *brut* de fer,) a cheaper material than the corrosive sublimate commonly used, and one very desirable in every respect. He presumed that by immersing the end of a tree *immediately after it was felled* into a liquid, the vital energies not having ceased, the tree would then absorb such fluid through all its pores, by a process which he calls aspiration; and in this fortunate surmise he was entirely successful. This led step by step to numerous practical results, which their inventor enumerates as follows, and describes in separate chapters.

1st. "For protecting the woods from the dry or wet rot."

2nd. "For augmenting their hardness."

3rd. "For preserving and developing their flexibility and their elasticity."

4th. "For rendering impossible the changes of form (*jeu*) they undergo, and the splits (*disjonctions*) which take place when they are brought into use, or are submitted to atmospheric changes."

5th, "For greatly reducing their inflammability and conbustibility."

6th. "For giving them various and lasting colours and odours."

We shall endeavour to convey a general notion of the methods in the same order.

1. Durability. He took a poplar tree, measuring 28 *metres* in height and 40 *centimetres* diameter, simply divided from its root with its branches and leaves undisturbed, and immersed it erect to the depth of 20 *centimetres* in a vessel containing pyrolignite of iron; in six days it was entirely impregnated even to the leaves, and had absorbed the large quantity of three *hectolitres*. This method required powerful lifting apparatus, and a support for the tree to lean against, and was therefore objectionable.

He repeatedly operated upon trees lying on the ground, by attaching to their bases waterproof bags containing the liquid: the experiments were varied in many ways; sometimes portions of the branches were lopped off, but the crown or tuft was always left upon the principal stem; at other times the aspiration was effected by boring detached holes near the earth supplied with different fluids, which gave rise to all kinds of diversities; and other trees were pierced entirely through, and a horizontal cut extending to within an inch or so of each side was made with a thick saw, leaving only sufficient wood for the support of the trees.

For fear of losing the trees upon which he had the opportunity of experimenting, the process was not deferred beyond 24, 36, or 48 hours after they were felled, as the vigour of the absorption was found to abate rapidly after the first day, and that at about the tenth day it was scarcely perceptible: it was also found the aspiration entirely failed in *dead* wood, whether occurring at the heart of old trees, or at parts of other from any accidental interruption of the flow of the sap during the growth; and also that resinous trees absorbed the fluids less rapidly than others.

Observations were also made of the quantities of the liquids taken up; these, when of a neutral kind, as the chloride of soda, often equalled in bulk that of the wood itself, without causing any addition to its weight; the acid and alkaline fluids were less abundantly absorbed, apparently from contracting the vessels by their astringent action. It is stated that the pyrolignite of iron effected the preservation of the substance when equal to less than a fiftieth of the weight of the green wood. These points are all separately treated in the original paper.

2. The hardness of the wood was considered by various workmen to be more than doubled by the action of the pyrolignite.

3. The flexibility, (due to a certain presence of moisture,) was increased in a remarkable manner by the chloride of lime and other deliquescent salts, the degree of elasticity depending upon their greater or less concentration. As a cheap substitute for the above, the stagnant water of salt marshes was adopted, with a fifth of the pyrolignite, for the greater certainty of preservation. Pieces of prepared deal, 3 *millimetres* thick and 60 *centimetres* long, were capable of being twisted and bent in all directions, as into screws, also into three circular coils; the wood immediately regained its figure when released; this condition lasted eighteen months, that is, until the time his paper was read.

4. The warping and splitting, principally due to the continual effect of the atmosphere in abstracting and restoring the moisture, was stayed by impregnating the wood with a weak infusion of the chloride, so as always to retain it to a certain degree moist; one-fifth of the pyrolignite was also added in this case. The seasoning of the wood was also considered to be expedited by the process, and which was not found to interfere with the ordinary use of oil-paint, &c. Large boards of the prepared wood, some of which were painted on one or both sides, and similar boards of unprepared wood, were compared; at the end of twelve months, the former were perfect as to form, the latter were warped and twisted as usual.

5. The inflammability and combustibilily of the woods were also prevented by the earthy chlorides, which fuse on their surfaces by the application of heat, and render them difficult of ignition. Two similar cabins were built of prepared and of ordinary wood respectively, and similar fires were lighted in each; the latter was entirely burned, the other was barely blackened.

6. In respect to colours infused by the aspiratory process, the vegetables colours were found to answer less perfectly than the mineral, and the latter succeeded best when the colour was introduced at two processes, so that the chemical change, (that of ordinary dyeing,) occurred in the pores of the wood itself Odorous matters, required to be infused in weak alcoholic solutions, or essential oils, they were considered to be equally durable with those supplied by the hand of nature; and resins similarly introduced were found to increase amazingly the inflammability of the woods, and to render them impervious to water.

In a word, the method promises the means of working almost any desired change in the constitution and properties of woods, when the fluids are presented to them before the vitality of the tree has ceased. It is true we have as yet only two years' trial of these experiments, but they have been scien tifically deduced, and their inventor is still engaged in prosecuting them. It is to be hoped, and also expected, that these interesting and flattering promises of success will be realized, and even extended, when tried by that most severe of all tests, time.

## GALVANISM.

The following account of the rise and progress of Galvanism, taken from the life of Sir H. Davy, will, we doubt not, be read with peculiar interest by all our readers, and especially by those whose taste and inclination lead them to cultivate that branch of philosophical science, in which such important discoveries have been and are daily being made. The author of the book before us introduces the subject by stating, that:—"The History of Galvanism may be divided into six grand epochs; each being distinguished by the discovery of facts variously interesting from their novelty, and from the extent and importance of their applications.

"It cannot be expected that I should enter into a minute history of the science; such a labour would require a distinct work for its accomplishment. I shall therefore follow the plan of the architect, who, in presenting a finished drawing of a part, sketches a faint outline of the whole edifice to which it belongs, in order that its fair proportions may appear in proper breadth and relief.

"The first Epoch may be considered as arising out of the fundamental fact* discovered by Galvani in 1790—that the contact of two different metals with the nerve of a recently killed frog will excite distinct muscular contractions.

"The second Epoch may be dated from the discovery of what might be termed *Organic* Galvanism, or the production of its influence, without the presence of animal organs, by the peculiar action of metals upon water, as first observed by Dr. Ash.

"The third Epoch will long be celebrated on account of the discovery of the accumulation of the Galvanic power, by the invention of the pile of Volta, made known in the first year of the present century, and which so distinctly exhibited the the analogy between Galvanism and Electricity, that the energy thus excited is now generally spoken of as '*Voltaic Electricity*.'

"The fourth Epoch may be considered as founded upon the knowledge of the general connexion between the excitement of Voltaic electricity and chemical changes.

"The fifth Epoch is exclusively indebted for its origin to Davy—the establishment of the general law, that Galvanism decomposes all compound bodies, and that the decomposition takes place in a certain determinate manner.

"The sixth and last Epoch is founded upon the discovery of the relations subsisting between electricity and magnetism; giving origin to a new branch of science, which has been distinguished by the name of 'Electro-Magnetism.'

"Galvani, from the moment of his first discovery, always referred the effects he produced to an electrical origin; but he considered that the metals employed merely acted as conductors, which effected a communication between the different parts of an animal, naturally, or by some process of nature, in opposite states of electricity, and that the muscular contractions took place during the restoration of the equilibrium.

"Until the researches of Dr. Ash, Ritter, Fabroni, and Creve, had been made known, the Galvanic influence was generally considered as existing only in the living organs of animals, from which it might be elicited by certain processes.

"In the Bakerian Lecture read before the Royal Society in 1826, Davy, in giving a retrospective view of the progress of Electro-chemical Science, very justly remarks, that the true origin of all that has been done in this department of philosophy was the accidental discovery of Nicholson and Carlisle, of the decomposition of water by the pile of Volta, on the 30th of April, in the year 1800; which was immediately followed by that of the decomposition of certain metallic solutions, and by the observation of the separation of alkali on the negative plates of the apparatus. Mr. Cruickshank, in pursuing these experiments, obtained many new and important results such, as the decomposition of the *muriates, of magnesia. soda* and *ammonia;* and also observed the fact, that alkaline matter always appeared at the negative, and *acid* matter at the positive pole.

"No sooner had Davy become acquainted with the

* As many of our readers may be unacquainted with the real accident, as we may term it, to which this discovery owes its origin, we subjoin the following — Galvani, a Professor of Anatomy at Boulogne, was engaged in making some experiments on Animal Irritability, and it happened that the wife of the Professor, being consumptive, was advised to take as a nutritive article of food, some soup, made of the flesh of *frogs* several of these animals recently killed and skinned, were lying on a table in the laboratory, close to an electrical machine, with which a pupil of the professor was making experiments. While the machine was in action, he chanced to touch the bare nerve of the leg of one of the frogs with the blade of a knife that he held in his hand, when, suddenly, the whole limb was thrown into violent convulsion. Galvani was not himself present when this occurred; but received the account from his wife, and being struck with the singularity of the phenomenon, he lost no time in repeating the experiment, and in investigating the cause · he found that it was only when a spark was drawn from the prime conductor, and when the knife or any other good conductor was in contact with the nerve that the contractions took place; and pursuing the investigation with unwearied industry, he at length discovered that the effect was independent of the electrical machine, and might be equally well produced by making a metallic communication between the *outside muscle* and *crural nerve*.

Galvani had previously entertained notions respecting the agency of Electricity, in producing muscular action these new experiments therefore, as they seemed to favour his views, had with him more than ordinary interest. He immediately ascribed the convulsive movements in the limb to electrical agency, and explained them by comparing the muscle of an animal to a Leyden phial, charged by the accumulation of Electricity on its surface, while he imagined that the nerve belonging to it performed the function of a wire, communicating with the interior of the phial, which would, of course, be charged *negatively*. In this state of things, if a communication by a good conductor were made between the muscle and nerve, a restoration of the electric equilibrium, and a contraction of the fibres would ensue.

It had been observed many years before, that, when a piece of silver is placed upon the tongue, and a piece of zinc or lead under it, a slight sensation and a peculiar saline taste is experienced whenever the ends of the metals are brought into contact, and, that if one metal be placed between the upper lip and the gums, the eyes are affected as by a flash of light, when contact between the metals is established, though no such effect is noticed as long as the metals are kept separate · these previous observations do not, however, at all interfere with the originality to which Galvani has a most undoubted claim, as they excited no attention, and called forth no efforts of the mind. It is curious to notice how frequently the progress of discovery in the sciences is influenced by fortuitous circumstances, and in no case is it more striking than in the present. Had Galvani been as good an electrician as he was an anatomist, it is probable that the convulsions of the frog would have occasioned him no surprise; he would immediately have seen that the animal formed part of a system of bodies under *induction*, and he would have considered the movements of the limbs of the frog as evidence of nothing more than a high electroscopic sensibility in its nerves.

curious experiments of Nicholson and Carlisle, than as we learn from a letter to Mr. Gilbert, bearing the date of July, 1800, that he proceeded to repeat them. Indeed, it was the early habit of his mind not only to originate enquiries, but without delay to examine the novel results of other philosophers; and in numerous instances it would seem, that he only required to confirm their accuracy before he succeeded in rendering the application of them subservient to farther discovery. This was certainly the case with respect to the subject before us: he was a discoverer as soon as he became an enquirer. It is admirable to observe with what a quick perception he discovered the various bearings of a new fact and with what ingenuity he appropriated it for the explanation of previously obscure phenomena. In referring to the "Additional Observations" appended to his "Chemical Researches," we shall find that the moment he became acquainted with the experiments of Dr. Ash, he proceeded to enquire how far the facts previously noticed by himself, of the conversion of nitrous *gas* into nitrous *oxide*, by exposure to wetted zinc, might depend upon galvanic action.

"In the month of September 1800, he published his first paper on the subject of Galvanic Electricity, which was followed by six others, in which he so far extended the original experiment of Nicholson and Carlisle, as to show that oxygen and hydrogen might be evolved from separate portions of water, though vegetable and even animal substances intervened; and conceiving that all decompositions might be *polar*, he electrized different compounds at the different extremities, and found that sulphur and metallic bodies appeared at the *negative* pole, and oxygen and azote at the *positive* pole, though the bodies furnishing them were separated from each other. Here was the dawn of the Electro-chemical theory.

"In a letter to Mr. Gilbert, he announced his opinion that Galvanism is a process principally chemical; and in a subsequent communication to the same gentleman, written on the eve of his departure from Bristol to the Royal Institution, we discover a farther developement of the same theory, which, although modified by future researches, became, as we shall hereafter find, materially instrumental in establishing juster views of the nature of Voltaic action.

(*To be continued.*)

---

## MIGNONETTE.

Mignonette is a native of Egypt, and was introduced into Britain about the year 1754; but it has become so generally diffused, both here and in France, that it has become in a degree naturalised. It is not long since that we read an account of its growing upon the walls of an old ruined chateau, in the neighbourhood of Paris, springing out from every crevice where the seed could obtain a lodging place, and literally covering the walls with its odorous blossoms. In the *March aux Fleurs* and the markets here, thousands of pots of it are annually sold, and the window of the peasant, as well as the saloon of the opulent, is decorated throughout the season with pots of this favourite plant. The mignonette is of remarkably simple growth in the open ground, and when once the seeds are planted, it will retain possession of the soil, springing up from self-sown seeds, and flowering early and abundantly every season. Successive sowings in May and July will afford a constant supply of neat and compact plants, filled with flowers. In rich moist soil the plants grow luxuriantly and spread out widely, but have a very scanty display of flowers; it is in a dry and rather hard soil that they show themselves to the best advantage; for in such a situation they bloom early, and, without spreading out their recumbent branches too far, are, at the same time, overloaded with blossoms. Those cultivators therefore, who would have the plants in the greatest perfection, should select the dryest spot in the garden, and sow the seeds thickly. But it is for the production of good plants for flowering in the winter that we commenced these remarks. To bloom the mignonette in good perfection from the decay of the out-door plants in the autumn, until the return of the flowers in the spring, it is necessary that there should be two successive sowings, viz., one in August, for blooming about Christmas, and another in September, for blooming from February till May. Select for the purpose as many pots as are wanted; fill them with a compost mixed in about the following proportions, viz. one half good light loam, one quarter leaf mould, and one quarter coarse sand. First give the pots a good drainage, for the health of the plants depends much on this; then fill them up to within half an inch of the rim, giving the pot a slight rap to settle the soil well; level the surface, sow the seed thickly, and cover it with about an eighth of an inch of the same compost. A frame (an old cucumber bed will answer) should then be ready to receive the pots; set them so that they will not be far from the glass, and give a gentle watering; put on the sashes, and shade with a mat in the middle of the day, if the sun is too powerful, until the plants are well up. Give water cautiously and in small quantities, as the plants will damp off if they are kept too wet. Thin out the plants, leaving only three or four in a pot. In the month of November or December, according to the mildness of the season, the plants should be removed to the green house or parlour; in the former place they should placed on a shelf within two feet of the glass, and if nearer they will thrive better. Water should be given sparingly, and when the plants get up an inch or two, the tops of each should be pinched out in order to make them branch well. They will now grow slowly, and early in January will come into bloom. In the parlour they should be set as near the window-sash as possible, and in the most airy part of the room.

When the plants have done blooming in the spring they may be turned out into the border, where they will throw out new branches and make good plants for bloom all the summer.

## NEW REMEDIES FOR GOUT.

***From a paper in the Medical Gazette,***
***By Alexander Ure.***

Manganese, in the state of proto-carbonate, is present in the waters of Mariedbad, Carlsbad, and other German springs, whither gouty invalids annually resort in quest of health; in the state of oxide, it forms one of the normal constituents of the bones. It was first shown by M. C. G. Gmelin, of Tubingen (*Versuche uber die Wirkungen des Baryts, &c,*) 1824, p. 96), that the manganese salts when injected into the blood-vessels augmented the biliary secretion to such a degree, as to produce a deep yellow staining of the coats of the intestines, and of the great vessels in the vicinity. According to M. A.

Barbet (*Journal de Chimie Medicale*, tom v., p. 534), muriate of manganese forms a main ingredient of a nostrum sold in Paris, under the name of the deobstruent powder of Rouviere. This, taken for a few days, is said to procure abundant bilious evacuations.

If a drachm of sulphate of manganese be dissolved in about half a pint of Water, and swallowed before breakfast, it will generally occasion after the lapse of an hour or so, one or more liquid stools.

Sulphate of manganese has a cooling and bitter taste, resembling that of Glauber salt. D. Thomson (*Chemistry of Inorganic Bodies*, vol. ii., p. 587) says, " It may be administered as a cathartic, in doses of from half an ounce to an ounce." I have always found a much smaller quantity suffice, and should be reluctant to give it to that extent. It acts most efficiently when dissolved in a considerable quantity of water. On particular occasions, infusion of senna furnishes a useful adjunct.

In order to abate the erethism of the vessels of the gouty articulation, to further the absorption of effused fluids, and to arrest the recurrence of attacks which, in the long run, lead to distortion and ankylosis, the topical employment of Acetic Ether and Rectified Coal Naphtha will be found highly serviceable. The former was first introduced to the notice of the profession by M. Sedillot, in the *Transactions of the Medical Society of Paris* (No. x., Mess. An. 5), but never seems to have attracted attention here. Acetic ether generally determines a speedy sedative agency in the more acute stage of the malady, when applied with gentle friction over the whole of the affected surface, to the amount of half an ounce every twelve hours, provided after each friction the patient is kept warm in bed. In the sub-acute form of the disease, I have witnessed very beneficial effects from simply pencilling over the part with a camel-hair brush dipped in naphtha. In some instances, indeed, this seemed to have the power of warding off an impending paroxysm. I was first led to try it in gouty cases, from being told by an extensive manufacturer of the article near Birmingham, that affections of the joints were unknown among his workmen, while they were common enough among the operatives of other factories in the neighbourhood.

Coal naphtha is a pure hydro-carbon, almost identical in nature and properties with the naphtha which occurs native on the shores of the Caspian sea, in Persia, and other countries of Asia. The latter, alluded to by Herodotus, has been used from a remote period by some of the nations of the east, against the very ailment in question. Thus, Dioscorides (Lib. i. c. 85) says, " Podagris articulorum doloribus lethargisque prodest ;" and Bontius (*Hist. Nat.* p. 17,) in describing what he calls "a noble species of naphtha" brought from Sumatra, and highly prized for its medicinal virtues by the Javanese, concludes as follows : "Partibus affectis illitum miraculi instar ægros consolatur"

Naphtha topically applied imparts a feeling of warmth, sometimes accompanied with slight tingling. It acts obviously upon the principle of a mild but penetrating counter-stimulent, determining contraction of the capillaries, increase in the rapidity of their circulation, and progressive absorption of liquid effusion.

As a remedial agent, seemingly endowed with qualities capable of counteracting and removing tophaceous deposition, Silicate of Potash, the *liquor of flints* of the older chemists, deserves a trial. This salt passes through the system unchanged, and can be detected in the urine of animals to which it has been given by the mouth. It exercises a very powerful solvent action upon the urate of soda. I have prescribed it for one or two patients in doses of ten and fifteen grains twice a day, dissolved in six or eight ounces of water, with apparent benefit.

---

## VARIETIES.

*Effect of hot water on flowers.*—The following fact is deserving of record, as an interesting addition to what has hitherto been discovered on the subject of vegetable physiology, and as enabling the lovers of flowers to prolong for a day the enjoyment of their short-lived beauty. Most flowers begin to fade after being kept twenty-four hours in water; a few may be revived by substituting fresh water; but all the most fugacious (such as the poppy, and perhaps one or two others, excepted) may be completely restored by the use of hot water. For this purpose place the flowers in scalding water, deep enough to cover about one-third of the length of the stem, and by the time the water has become cold, the flowers will have become erect and fresh; then cut off the coddled ends, and put the flowers into cold water.

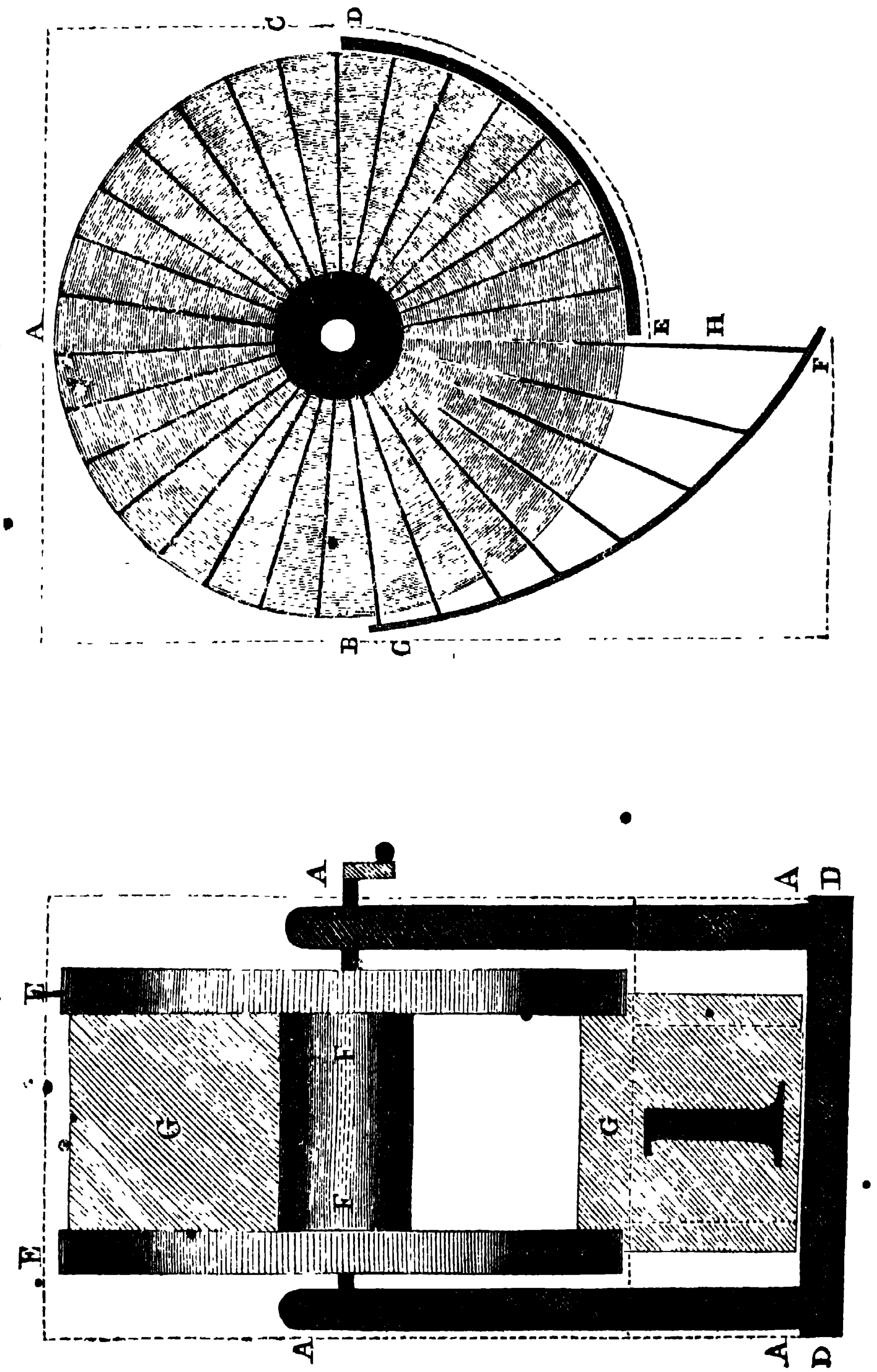
*Water Colour for Rooms.*—Take a quantity of potatoes and boil them—then bruise them, and pour on boiling water until a pretty thick mixture is obtained, which is to be passed through a sieve. With boiling water then make a thick mixture of whitening, and put it to the potatoe mixture. To give colour, if white is not wanted, add the different-coloured ochres, lamp black, &c. according to circumstances. This paint dries quickly, is very durable, and has a good appearance to the eye.

*Use of the Walnut Tree.*—Walnuts yield half their own weight in oil, whose flavour is considered equal to that of the finest Lucca oil. This very fruitful tree, which we see flourishing along the high road, and in the orchards of the peasants, is one of great utility to the German; his furniture is made from it, the leaves dye a good black, and he feeds his cattle with the shells of the nuts that have supplied his oil. This is leaving out of the question its use as a nut.

*Substitute for White Lead.*—The great amount of mortality among painters and manufacturers of paint, arising from the deleterious effluvia of white lead, is well known, and has frequently directed the attention of chemists to the discovery of an innocuous substitute. Hitherto the attempt has been fruitless; at least so far as we are aware, no other substance has taken the place of the common pigment. It would appear, however, from the report of the Paris Academy of Sciences, that M. de Ruolz has at length succeeded in producing a preparation possessing all the economical properties of white lead, without partaking of its offensive character. This substance is the oxide of antimony, which is distinguished by the following qualities :—Its colour is very pure white, rivalling the finest silver white; it is easily ground, and forms with oil an unctuous and cohesive mixture; compared with the white lead of Holland, its property of concealing is as 46 to 22; and mixed with other paints, it gives a much clearer and softer tone than white-lead. It may be obtained, according to M. de Ruolz, from the natural sulphuret of antimony, and at a third of the cost of ordinary white paint.

Fig. 2.

Fig. 1.




MACHINE FOR SHOWING THE DAY OF THE MONTH.

*To the Editor of the Magazine of Science.*

SIR,

I take the liberty of sending you an invention for showing the day of the Month, in a a very simple manner, and yet combining many advantages over those that have been invented for the same purpose.

Fig. 1. is a front view of the Machine, without its case, the dotted lines show in what manner the case should be put on, so as to allow the figures to be seen at the bottom through a glass window, which will prevent the dust from getting to the apparatus inside. D D is the bottom of the box, A A A A are the supports upon which the wheel E E revolves, a spindle is fixed to the wheel with a small handle at one end, by which the wheel is turned round; F F is the body of the wheel upon which the sides E E are fixed; G G are two of the slides, the top one being within the wheel and the bottom one having come out of the wheel (within $\frac{7}{8}$ of its length) so as to show the day of the month.

Fig. 2. is a side sectional view and explains the working of the slides; A B C is one side of the wheel, there are thirty-one grooves made round the wheel in equal divisions, to the depth of one-half the thickness of the wheel, then the other sides are put on the body F F Fig. 1. they must exactly correspond to each other, we then get thirty-one pieces of tin made so that they will easily slide in and out of these grooves, and paint upon the first number one, on the next number two, and so on up to number thirty one, the piece of curved polished metal D E is to prevent the slides from coming out before they get to the point E, which when they arrive at, there being no longer any obstruction they come out and show the day of the month as at H, (but they must not come entirely out of the grooves) and as the wheel turns round the curved incline G F pushes them into their places.

The dotted lines show how the case is made for the machine, in the front it is curved to the form of the wheel, so as to allow a better view of the figures at the bottom.

The peculiar merit of this invention consists in getting so many large figures into so small a compass which looks more compact, and they are easily seen at a long distance, which makes the machine suitable for a counting house.

Yours respectfully,
J. P. J.

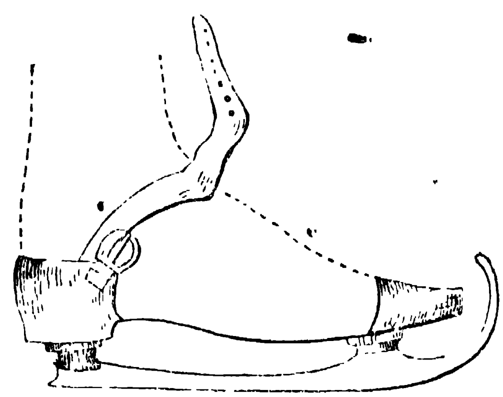
## THE IMPROVED SKATE.

*To the Editor of the Magazine of Science.*

SIR,

In adopting a new plan, it is advisable to ascertain what are defects of the old one, and make sure that in the improvement these defects are remedied. Most of your readers who are skaters will be aware of many imperfections in the common skate, they are principally the following:—

On account of the screw attached to the heel of the skate which injures the boot and causes great trouble in fixing on, and great annoyance through sometimes remaining fast in the heel of the boot after the skate is taken off. Perhaps the gimblet requisite to bore the hole for the screw has been left at home. or if brought is too large, perhaps too small. Supposing, however, that the skater has been so fortunate as to escape all these evils, and after a quarter of an hour's perseverance and patience he succeeds in getting the skates fixed on and is fairly on the ice, by the time he has proceeded a hundred yards he finds that the toe of his skates has slipped from the centre of his foot, and is standing at an angle of 15 degrees from where it ought to be, the consequence is that the prominent parts of the face is brought in rather unpleasant contact with the ice: but, however, though thrown on his beam ends for a while he soon rights, little worse perhaps if we except having his proboscis swollen to twice its usual dimensions. After skating some time the feet begin to swell and ache, owing to being tightly strapped to a flat surface where the foot receives no support except on the ball of the foot and heel. These are the principal defects in the skate generally used, to obviate which I have contrived the following plan:



in the first place the bottom or plate on which the foot rests is shaped so that the sole of the foot may receive support in every part. 2nd. A toe and heel piece are made of sheet brass in which the foot fits similar to the spring clog used by ladies, so that the skate cannot slip either to the right or left hand, and lastly, no screw or pins are required as the foot fits tightly into the skate, and is secured by one broad strap fixed to the heel piece. I have had a pair made for my own use and they answer very well. A supposed objection might arise that they would be too heavy, to this I may say that my own pair weighs exactly $2\frac{1}{2}$ lbs. (and they are an extra size, 12 in. long) being little if any heavier than wooden ones, but I am aware there is a still greater objection which will prevent their coming into general use. Each skater would require them made to fit his own measure, and unless he could meet with a handy whitesmith that could make them under his own superintendance, he would fail in his object. The skates may be made to spring like the patent skates if preferred, they also require to be made "rights and lefts." The bottom plate is made of thin sheet iron.

I remain, Sir,
Your obedient servant,
J. H. NICHOLSON.

*Lancaster, Feb. 15th*, 1845.

## GALVANISM.

(*Continued from page* 383.)

"As soon as it was discovered that galvanic power might be excited by the contact of metals, without the interposition of animal organs, it was imagined that the electricity was set in motion by the contact of bodies possessing different conducting powers, without any reference to the chemical action which accompanied the process. This theory was natually suggested by the fact discovered by Mr. Bennett several years before—that *electricity is excited by the mere contact of different metals:* thus, when a plate of copper and another of zinc, each furnished with an insulating glass handle, are made to touch by their flat surfaces, the zinc, after separation, exhibit *positive*, and the copper *negative* electricity. In this case, it is fair to conclude that a certain quantity of electricity had moved from the copper to the zinc.

"On trying other metals, Volta found that similar phenomena arose: from which properly such bodies have been denominated '*motors*' of electricity, and the process which takes place *electro-motion:* terms which have since been sanctioned and adopted by Davy.

"It is on this transference of electricity from one surface to another, by simple contact, that Volta explains the action of the pile invented by himself, as well as that of all similar arrangements The interposed fluids, on this hypothesis, have no effect as chemical agents, in producing the phenomena; they merely act as conductors of the electricity.

"We have seen how early Davy had observed the intimate connexion subsisting between the electrical effect, and the chemical changes going on in the pile, and that he accordingly drew the conclusion of the dependence of the one upon the other. In fact, the most powerful Voltaic combinations are those formed by substances that act chemically upon each other with the greatest energy; while such as undergo no chemical change exhibit no electrical powers. thus zinc, copper, and nitric acid form a powerful battery; whilst silver, gold, and water, which do not act upon each other, produce no sensible effect in a series of the same number.

"Although, in this obscure region of research, we are as yet unable to discover the nature of the power by which electricity is accumulated, it was a considerable step towards a true theory to have ascertained the insufficiency of the proposition that had been offered in explanation of the phenomena.

"An investigation into the chemical activity of the pile led Davy to the discovery of a new series of facts, which subsequently formed the basis of his first communication read before the Royal Society.

"All the combinations analagous to the Voltaic pile had hitherto consisted of a series containing, at least, *two* metallic bodies, (or one metal and charcoal) and a stratum of fluid. Davy discovered that an accumulation of galvanic energy, exactly similar to that in the common pile, might be produced by the arrangement of *single* metallic plates with *different* strata of fluids; so that, instead of composing a battery with *two* metals and *one* fluid, he succeeded in constructing it with *one* metal and *two* fluids; provided always that oxidation, or some equivalent chemical change, should proceed on one of the metallic surfaces only.

"In describing these combinations of a single metal with two fluids, he divides them into three classes, following in the arrangement the order of time with regard to their discovery.

"In the First Class, one side of the matallic plate is oxidated; in the Second, a sulphuret is formed on one of its surfaces; and in the Third, both sides are acted upon, the metal becoming a *sulphuret* on one of its surfaces, and an *oxide* on the other.

"The apparatus which he employed for these experiments is preserved in the laboratory of the Royal Institution. It consists of a trough, containing grooves capable of receiving the edges of the different plates necessary for the arrangement, one half of which are composed of horn, the other half of some one metal.

"When the apparatus was used, the cells were filled, in the galvanic order, with the different solutions, according to the class of the combination, and connected in pairs with each other by slips of moistened cloth carried over the non-conducting plates.

"At the meeting of the Royal Society, following that on which the above interesting facts were communicated, Dr. Wollaston presented a memoir of considerable importance, entitled, "Experiments on the Chemical Production and agency of Electricity;" in which he strongly advocates the truth of that theory which recognises metallic oxidation as the *primary* cause of the Voltaic phenomena. This paper is also farther important as it proves, by most ingeniously devised experiments, not only the similarity of the means by which both common and galvanic electricity are excited, but also the resemblance existing between their effects; showing, in fact, that they are both essentially the same, and confirming the opinion, that all the apparent differences may depend upon differences in intensity and quantity.

"Acting upon this principle, Dr. Wollaston succeeded in producing a very close imitation of the chemical action of galvanism by common electricity; such, for example, as the decomposition of water, and other effects of oxidation and deoxidation. In the prosecution of this train of research, he displays, in a very striking manner, that attention to minute arrangement which so remarkably characterised all his manipulations. I particularly allude to the expedients by which he reduced the extremity of a gold wire, in order to apportion the strength of the electric charge to the quantity of water submitted to its influence.

"Although it is now very generally admitted, that the chemical agency of the fluids upon the metals employed is highly essential to the maintenance of Voltaic action, there still remains considerable doubt as to how far we are entitled to regard it as the first in the order of phenomena.

"At a later period of his researches, Davy suggested as a correction, or rather modification, of the theory of Volta, that the electro-motion produced by the contact of the metals might be the primary cause of the chemical changes; and that such changes were in no other way efficient, than in restoring the electric equilibrium thus disturbed: it was farther held, that this equilibrium could not be permanent, that it could in fact be only momentary; since, in consequence of the imperfect conducting power of the interposed fluid, the zinc and copper-plates, by their electro-motive power, would again assume their opposite states of electricity: and that these alternate changes would occur, as long as any of the fluid remained undecomposed. In a Voltaic arrangement, then, there would appear to exist, if the expression may be allowed, a kind of electrical see-saw; the apposition of the metals destroying the equilibrium, and the resulting chemical changes again restoring it. It has, however, been very justly observed, that the application of electricity, as an instrument of chemical decomposition, has most fortunately no connexion with such theories, and that the study of its effects may be carried on without reference to any hypothetical notions concerning the origin of the phenomena.

"The constant appearance of acid and alkaline matter in pure water, when submitted to the influence of the Voltaic pile, gave rise to the most extravagant speculations and discordant hypothesis. Various statements were made, both in Italy and England, respecting the *generation* of muriatic acid, and that of the fixed alkalies, under these circumstances. Mr. Sylvester affirmed, that if two separate portions of water were electrised out of the contact of substances containing alkaline or acid matter, acid and alkali would, nevertheless, be produced.

"Some philosophers sought to explain the phenomenon from the salts contained in the fluids of the trough, which they imagined might, by some unsuspected channel, find their way into the water under generation. Others believed that they were actually *generated* by the union of the electric fluid with the water, or with one or both of its elements; so that, up to the time of Davy's masterly researches, the subject was involved in the greatest obscurity: and whether the saline matter was liberated from unknown combinations, or at once formed by the union of its elements, was a question upon which the greatest chemists entertained different opinions.

"The Bakerian Lecture, read before the Royal Society on the 20th of November 1806, not only set this question for ever at rest, but unfolded the mysteries of general Voltaic action; and, as far as theory goes, may also be said to have perfected our knowledge of the chemical agencies of the pile.

"This grand display of scientific light burst upon Europe like a splendid meteor, throwing its radiance into the deepest recesses, and opening to the view of the philosopher new and unexpected regions.

"I shall endeavour to offer as popular a review of this celebrated memoir, as the abstruse and complicated nature of its subject will allow; and I shall be careful in pointing out the successive stages of the enquiry; for we are all too much in the habit of exclusively looking after results; whereas an examination of the steps by which they were attained is far more important, not only to the fame of the discoverer, but to ourselves, as the means of instruction.

"The subjects investigated in this memoir are arranged under the following divisions.

"1. On the changes produced in Water by Electricity.

"2. On the agencies of Electricity in the decomposition of various compound Bodies.

"3. On the transfer of certain constituent Parts of Bodies by the action of Electricity.

"4. On the passage of Acids, Alkalies, and other Substances, through various attracting chemical menstrua, by means of Electricity.

"5. Some general Observations on these Phenomena, and on the mode of Decomposition and Transition.

"6. On the General Principles of the chemical changes produced by Electricity.

"7. On the Relations between the Electrical Energies of Bodies and their Chemical Affinities.

"8. On the mode of action of the Pile of Volta, with Experimental Elucidations.

"9. On some General Illustrations and Applications of foregoing facts and principles.

"With respect to the first of these divisions, comprehending a history of the changes produced in water by electricity, it is worthy of particular notice, that as early as the year 1800, while residing at Bristol, Davy had discovered that when separate portions of distilled water, filling two glass tubes connected by moist bladders, or any moist animal or vegetable substance, were submitted to the electrical action of the Voltaic pile, by means of gold wires, a *nitro-muriatic* solution of gold appeared in the tube containing the positive wire, and a solution of soda in the opposite tube; but he soon ascertained that the muriatic acid owed its appearance to the animal or vegetable matters employed; for when the same fibres of cotton were used in successive experiments, and washed after every process in a weak solution of nitric acid, the water in the apparatus containing them, though acted upon for a great length of time with a very strong power, produced no effect upon a solution of nitrate of silver.

"In every case in which he had procured much soda, the glass at the point of contact with the wire seemed considerably eroded; when by substituting an agate for a glass cup, no fixed saline matter could be obtained. Its source therefore, in the former case, was evidently the glass.

"With respect to Mr. Sylvester's experiment, already noticed, it was sufficient to say that he conducted his process in a vessel of *pipe-clay*, which not only contains lime, but may also include in its composition some of the combinations of a fixed alkali.

"On resuming the enquiry, it was Davy's first care to remove every possible source of impurity: he according procured cups of agate, which, previously to being filled, were boiled for several hours in distilled water; and a piece of very white and transparent *amianthus*, a substance first proposed for this purpose by Dr. Wollaston, having been similarly purified, was made to connect the vessels together. Thus was every apparent source of fallacy removed; but still, after having been exposed to Voltaic action for forty-eight hours, the water in the positive cup gave indications of muriatic acid, and that in the negative cup, of soda! The result was as embarrassing as it was unexpected: but it was far from convincing him that the bodies thus obtained were *generated*:—but whence arose the saline matter?

(*To be continued.*)

---

## THE COSSU.

The history of this invaluable and almost unknown plant is singular. It is the most valuable of all remedies for the tapeworm. In 1823, I passed through Paris, the French botanists had just given the name of *Brayer*, to an Abyssinian anthelonin-thick they extolled to the skies, and decreed all the honours of the academy to the discoverer, Dr. Brayer, of Constantinople. Three years after I had a letter from Dr. B., asking me to write to Abyssinia for a provision of the invaluable Cossu, and enclosing a treatise on its virtues. He had never been in Abyssinia. In the meantime Mr. Coffin arrived in Egypt from Abyssinia, and brought a quantity of it, which he prized as the apple of his eye. He gave me some ounces of it, part of which

I gave to Dr. Ramage and others. Arriving in England, I found in Bruce an accurate description and drawing of this plant, there called Cossu, or Bankesia Abyssinia, after Sir Joseph Banks. The flowers only are used in medicine. The dose is an infusion of three or four drachms in a pint of boiling water. Of all remedies for the worms this is the only specific. The tree grows to the height of twenty feet, the leaf about four inches long. The flower consists of five petals, short pistil and stamina.—*Madden's Travels through Palestine, Nubia, &c,*

## THE DIAMOND.

The diamond is the hardest substance in nature, and in common with some other crystalline bodies, it is harder at the natural angles and edges, and also at the natural coat or skin, than within or in its general substance. Its peculiar hardness is probably altogether due to its highly crystalline form, as by analysis the diamond, charcoal, and plumbago, are found to be nearly identical; the first is absolutely pure carbon, the others are nearly so.

The principal use of the diamond is for jewellery, its preparation for which will be touched upon in the slightest possible manner, but from its peculiar hardness the diamond fulfils some more really important although less *brilliant* services as tools, without which several curious and highly valuable processes must be altogether abandoned, and others accomplished in an inferior although more costly manner by other means.

The diamond is prepared for the purposes of jewellery by three distinct processes, namely splitting, cutting and polishing, which will be adverted to in a very few lines. In order to split off the portions not required, the stone is fixed in a ball of cement, about as large as a walnut, the line of division is sawn a little way with a pointed diamond fixed in another ball of cement, and the stone is afterwards split with the blunted edge of a razor struck with a hammer; the small fragments removed, when they are too small for jewellery, are called *Diamond bort.*

In cutting, two stones are operated upon at once; they are cemented in the ends of two sticks, which are supported on the edges of a box three or four inches wide, rested against two pins as fulcra, and forcibly rubbed against each other; by which means they abrade each other in nearly flat planes and remove a fine dust called *diamond powder*, which falls through the fine holes in the bottom of the box, and is there collected.

The diamonds are lastly polished upon an iron lap or *skive*, charged with diamond powder, the stone being guided mechanically; it is fixed by soft solder in a copper cup or *dop*, attached by a stout copper-wire to the end of the *pincers*, a flat board terminating at the other extremity in two feet, which rest upon a fixed support, the whole forming a long and very shallow triangular stool, loaded at the end near the stone. In the last two processes the stone is re-adjusted for producing each separate facet.

The invaluable instrument, the glazier's diamond, although employed for a considerable period, was for the first time investigated scientifically by Dr. Wollaston in 1816, who pronounced its operation to depend upon a peculiarity of crystallization in the diamond, the facets of which are frequently *round* instead of flat, and therefore the edges are *circular* instead of straight. The rounded edge first indents the glass, and then slightly separates its particles, forming a shallow fissure, with a splitting rather than cutting action, none of the material being removed.—*Holtzapffel.*

## COCHINEAL PLANTATION, ALGIERS.

The Cochineal Cactus has been frequently exhibited, and it is not uncommon to see them with the insect, which is, when dried, the Cochineal of commerce, living and propagating upon it. It is still called a Cactus by many, but in the fashionable vice of dividing and sub-dividing generas this takes the name of Opuntia. The French are not in quite so much hurry in these matters, and, therefore, M. Simounet, in a paper forwarded to the ***Journal de Pharm.*** calls the plant ***Cactus Cochinilifera.*** He seems to have established a plantation of this remarkable plant, for the purpose of breeding Cochineal in Algiers; and chiefly from a clever detail of considerable length we learn the particulars sufficiently to give the following abridged account. It seems that France pays yearly, to strangers, a tribute of nine or ten millions (of francs) for the Cochineal which she uses. Struck with this important consideration, M. Simounet wished to turn to profitable account, as regards the national interest, the knowledge which a year's residence in the neighbourhood of Valence, in Spain, had enabled him to acquire, with reference to the education and propagation of the Cochineal.

At his suggestion, several agriculturists of Algiers, engaged in the cultivation of the insect, and a model cochineal plantation (*nopalerie*) was estabished in the experimental garden at Algiers, through the exertions of M. Hardy, its director.

The following details are from a communication received from M. Simounet.

### DESCRIPTION OF THE COCHINEAL.

1. *Physical Characters of the Male Insect.*—The male Cochineal differs entirely from the female, It is a dipterous insect, having two transparent wings; six feet, each terminated by a small, very sharp claw; two antennæ, composed of nine articulations, covered with a silky down, and six black and immoveable eyes. Its red body is covered with a white dust, its abdomen is terminated by two white silky hairs. The length from the head to the extremity of the abdomen is one millimetre; the size is that of an oblong louse.

The period of maturity of the male Cochineal is not the same as that of the female. Like the latter, he fixes himself on the cactus, but his body is not equally developed. Instead of enlarging, he becomes covered with down, at the expense of which down, after the lapse of a month and a half, a cocoon is formed. The two hairs which issue from his posterior extremity serve to keep the cocoon always open. At the fecundating period, a month and a half after his birth, he issues backwards from his envelope, and flies from one female to another; afterwards he dies and disappears.

2. ***Physical Characters of the Female Cochineal***—The female Cochineal presents the aspect of an elliptical pea. Its body is composed of an indeterminate number of rings, giving it the appearance of a curled-up annilede. Its colour is blackish.

The body is covered with a white pulverulent down, which, being impermeable by water, serves as a defence against the inclemency of the seasons.

The feet are six in number, having two articulations, and each terminated by a pointed claw.

There are two cylindrical antennæ, composed of three articulations, of which the last is rather the longest,

Between the two upper feet are situated the organs of nutrition. These organs are composed of a small gland, and a canal of the diameter of a hair, and of a red colour, showing that the plant on which it feeds is introduced into the cellular system.

The Cochineal is really viviparous, and survives the production of its little family, The number brought forth, according to my observations, is not 632,777, as stated by a Spanish author, but about 300.

The female Cochineal is that to which we shall direct especial attention here, as she alone forms the article of commerce, and the substance so much prized for its colouring properties. It is from the female insect that carmine and the different lakes are prepared. She certainly affords one of the most valuable colours employed in the art of dyeing. On this account the insects merit a greater degree of attention than has hitherto been devoted to them.

PROPAGATION OF THE COCHINEAL.

*Choice of the Cactus.*—The cochineal does not thrive well, excepting on the cactus cochinillifera, and there are several reasons for this, In the first place, the hairy surface of this plant facilitates the peregrinations of the young insects. If there should happen to be much wind, not only do the feet of the insects catch in these small hairs, but the two surfaces adhere at a number of points, and its position is thus retained. It has been proved that the Cacti of Africa may be employed for the propagation of Cochineal, but less advantageously than the other, as the least wind dislodges the insect.—Moreover, the cactus cochinillifera produces a fruit which has always a purple colour; and according to Pelletier's analysis, this plant contains the colouring matter of carmine, and of the insect which affords this valuable product.

*Arrangements of a Cactus Plantation.*—In establishing this, it is desirable to select a spot of ground sheltered, as much as possible, from the north winds; the ground should be laid out in furrows, and well freed from weeds. Slips of the Cactus having been procured, they should be exposed to the air for a few days, so that the part at which they have been cut may become dry. The season best adapted for making the plantation is summer. The slips should be planted in rows, at a distance of 39 inches from each other; the rows should be two yards apart, for convenience in collecting the Cochineal. The plants should be watered every fifteen days in summer. The ground should be turned up once a year with the mattock or plough. The fruit of the plants should be taken off as it appears, so that the plants themselves may retain the properties, of which they would otherwise be exhausted by the fruit. The plants should not be allowed to grow more than about sixty inches in height, the branches being spread out in the form of a fan. The plants, having attained the proper growth, may now be employed for the propagation of the Cochineal.

*Method of placing the Cochineal on the Cactus.*—In Spain they prepare for this purpose small cylindrical cases about two inches long, and about two thirds of an inch in diameter, open at one end. A palm leaf is used for making these cases, the network of the leaf allowing a sufficient opening for the insect to pass through. These cases are intended to contain a dozen of the female insects; fifty such cases are attached to a Cactus by means of small thorns obtained from the Cactus ferox; metallic points for fixing them must be avoided, as the wounds occasioned by them injure the plants. The period at which the Cochineal is about to produce its young is known from the appearance of a small drop of a coloured substance at the posterior part of the insect. This is also the period for the collection of the insect.

*Method of collecting the Cochineal.*—In the first place, by means of a knife made of reed, the insects intended for reproduction must be carefully detached, and placed in the small cases already described, ready to be fixed on the plants after they have been properly washed and brushed. This first operation being concluded, cloths are to be spread on the ground under the plants, and, with a brush made from the palm, all the insects which remain are brushed off; this constitutes the available product. Three gatherings may be made in the year; in May, July, and October. After each collection it is very important to clean the plants with brushes and even to wash them, so as to remove all the white matter deposited by the previous crop of Cochineal, With careful attention to these directions, the plants may be made to serve for the propagation of the insect for five or six years.

*Method of killing the Cochineal.*—Several methods have been adopted for killing the insect. In Spain boiling water is used; mere exposure to the sun has been recommended, also the placing the insects on plates in an oven But all these methods are imperfect, as they sensibly alter the quality of the colouring matter. The following method, is recommended as being, under all circumstances, the best and most convenient:—Expose the insects to the heat of a water-bath, and dry them at a high temperature without exposure to light. The quality of the cochineal obtained in this way was equal to that most esteemed in commerce.

*Enemies to the Cochineal.*—The enemies to the Cochineal are, first, a small snail which fixes itself on the Cactus, and which is easily removed on examining the plants every eight days. Another of these enemies is the *cocinelle* (lady cow), called by the Spaniards *pintillos*. This insect produces great ravages. The means for effecting its destruction occasions the greatest amount of trouble connected with the plantation. The eggs which produce the larvæ of this insect (and it is in the state of larvæ that it is so destructive to the cochineal), are generally found at the base of the cactus. There is another insect which has been observed only in Africa, and which requires to be especially guarded against; it is the *forbicina*. These get into the little cases in which the female cochineal, intended to stock the plants, are placed, and they devour the cochineal, This evil may be obviated by closing the openings to the cases with muslin after introducing the cochineal.

## THE ATOMIC THEORY.

(FROM LIEBIG'S CHEMISTRY.)

THE human mind is never disposed to remain satisfied with the knowledge of mere facts, whether particular or general. It ever seeks to ascertain wherefore things are so? Why such and such phenomena occur? What is the cause of the general laws which we have reached in our investigations? It will, therefore, be readily imagined that an inquiry into the *cause* of that fixed and unalterable proportion in which bodies combine with each other must have occupied the mind of philosophical chemists. There must certainly be *some cause* which renders impossible the combination of elements in any other than certain definite proportions, *something* which opposes an invincible obstacle to any diminution or augmentation of these relative proportions.

The fixed and invariable amounts of the combining proportions or equivalents of bodies are the manifestations of this hidden cause, but these manifestations from the limit of the domain of true philosophical investigation; the cause itself is beyond our powers of perception,—our sphere of research, —and can only be a subject for the exercise of the imagination—for speculative ingenuity.

In endeavouring to develop the theory which at present prevails respecting the cause of the unchangeableness of chemical proportions, let me entreat you to bear in mind that its truth or falsehood has nothing whatever to do with the natural law itself. The latter is the expression of universal experience; it remains true, invariably and immutably, whatever may be our notions respecting its cause, and however these may, from time to time, vary and change.

A very ancient opinion respecting the nature of matter, well known as the theory of atoms, is exceedingly well adapted to render the law of definite proportions intelligible to our understanding. The application of this theory in modern times to the phenomena of Chemistry, and many investigations arising therefrom, extending and completing our knowledge of the law of definite proportionals, have highly distinguished the name of DALTON.

The atomic theory supposes that the space occupied by a solid, fluid, or aeriform body, is not in every part filled with matter, but that every such substance has pores, or interstices, between its particles of solid matter, which pores are not like those of a piece of wood, visible, but that they are of an infinitely smaller size. According to this view all bodies consist of exceedingly minute particles placed at a certain distance from each other, so that there exists between every two particles, a space not filled with the matter composing the substance itself.

It must be admitted that this view of the nature of matter, is highly probable. We can compress a volume of air into a space a thousand times smaller than it originally occupied, and even fluid and solid substances are capable of being compressed into less space than they fill under ordinary circumstances, by mechanical pressure. A billiard-ball thrown with considerable force upon a hard substance becomes flattened, and, after rebounding, resumes its spherical form. All bodies expand and fill a larger space when heated, and contract into a smaller space when exposed to a low temperature.

All these well known facts manifestly prove that the space which a body occupies at any given time depends upon accidental circumstances; that this space varies by the operation of many causes which expand or contract it. Now, if we must assume that the place within any body, occupied by one of its smallest particles, cannot at the same time be occupied by a second and a third particle, we cannot help drawing the conclusion that the augmentation or diminution of its volume which we have described, is a consequence of a greater or less distance between its particles,—that every particle of which the body is made up is surrounded by unfilled space. Thus, in a pound of fluid water, the particles of the water must evidently be nearer to each other than they are in a pound of steam, which occupies a space 1700 times greater than a pound of fluid water.

This theory affords us an intelligible insight into a number of phenomena, which, although simple in themselves, have hitherto been altogether inexplicable upon any other supposition.

Again, the atomic theory pre-supposes that the small particles composing the mass of any substance are incapable of further division,—that they are indivisible particles or *atoms*, a term applied to the ultimate particles of bodies, derived from the Greek.

It is impossible for the human mind to imagine particles of matter to be absolutely indisvisible, since they cannot be infinitely small in a mathematical sense, that is to say, altogether without extension; and if extended, they cannot be indivisible. Moreover, these ultimate particles have a certain weight; and how minute soever we may assume this weight to be, yet we cannot consider the division of a particle possessing weight to be impossible, into two, three, nay, into a hundred parts. We must, therefore, assume that the ultimate atoms of bodies are only physically indivisible; they are only incapable of further subdivision so far as our powers of perception enables us to judge

A physical *atom* in this sense then, is a conglomeration of innumerable smaller imaginary particles, held together by a force or forces more powerful than all the means at our command for their further subdivision or dissolution.

With respect to these atoms, and the meaning the chemist attaches to the term, it is precisely analogous to the opinion held respecting certain substances as to their being elements, or simple, uncompounded bodies.

The fifty-six substances at present known and supposed to be simple bodies or elements are so considered, not absolutely, but only relatively to our powers, because we are not able by any means we possess at present to decompose them,—that is, to separate them into still more simple elements: and, adhering to the true principles of natural philosophy, we call them simple bodies or elements; until experience shall demonstrate them to be compound.

The history of science presents us with abundant illustrations of the supreme importance of a strict adherence to this rule of philosophical inquiry,—errors, false facts, and fallacious theories innumerable and incalculably mischievous, having invariably followed the transgression of the limits of experience.

Without disputing the infinite divisibility of matter, as the mathematician asserts, the chemist merely evinces the immovable standing of his science upon the solid foundation of experience, when he assumes the existence of physical ATOMS as in incontrovertible truth.

A professor of Tübingen has endeavoured, by an ingenious illustration, to render the atomic theory of chemists more intelligible. He compares atoms to the heavenly bodies, which, in comparison with the extent of the space in which they are suspended, are infinitely small, that is, are *atoms*. Innumerable suns, with their planets and attendant satellites, move in infinite space, at definite and measured distances from each other; they are individually indivisible, inasmuch as there exists no force capable of separating them into parts, tearing off from them anything material, or altering their size or form in such a degree as to be perceptible, or to impair or disturb their relation to the other heavenly bodies, but they are not invisible *per se*.

In this sense the whole universe coalesces into one immense body, the atoms of which—that is, suns, planets, and satellites—are indivisible and immutable!

According to the atomic theory then, a piece of glass, of cinnabar, of iron, &c., is a heap or conglomeration of atoms of glass, cinnabar, iron, &c., the connection of which, in masses, depends upon the power or attraction of cohesion. The smallest particle we can imagine of the iron is still *iron*. But we know, with incontrovertible certainty, with respect to the cinnabar, that its smallest particle, although physically indivisible, is made of still smaller particles; that is, that it must contain particles of sulphur and particles of mercury; and we further know the relative proportions, by weight, of these two substances contained in the physically ultimate particle of cinnabar.

The iron consists of homogeneous atoms of iron; the cinnabar also consists of homogeneous atoms, each of which is cinnabar; but these latter atoms are not simple, like those of the iron, but they are capable of being separated into constituent parts: they are homogeneous as far as our powers of perception reach, but we nevertheless know their nature to be compound. We may, by the mere mechanical processes of filing, trituration, &c., reduce a piece of cinnabar into an innumerable quantity of small particles, but no merely mechanical force will enable us to overcome that power by which the heterogeneous particles forming the constituents of a complex atom like that of cinnabar are kept united.

It is precisely in this that chemical affinity differs from the power of cohesion, or cohesive attraction, as it is called,—that it becomes active and manifest only when *dissimilar* atoms are brought into contact with each other; and since it is impossible that atoms should penetrate and become mutually diffused throughout each other, it follows that such compound atoms must be formed by the aggregation, or grouping side by side, of the simple atoms, in consequence of the power of affinity acting so as to associate them into compound atoms,—one atom of one simple body being aggregated with one, two, three, or more atoms of another body, and so on,—every such group being a part exactly analogous to the mass of a substance perceptible to our senses. Thus, we may properly suppose the very smallest particle of cinnabar we can imagine, consists of a group of two atoms, namely, one atom of mercury, and one atom of sulphur.

When we consider that a thousand pounds weight of cinnabar contains exactly the same relative proportions of mercury and of sulphur as a single pound, or a single grain,—and although a piece of cinnabar large enough to be manifest to our senses, must contain, perhaps, millions of *atoms* of cinnabar, —yet it must be evident that in every single atom, equally as in the mass made up of millions of atoms, 101 parts of mercury are invariably united to 16 of sulphur. If we decompose cinnabar by means of iron, the atom of mercury is displaced, and an atom of iron is substituted for it. Or if we replace the sulphur of the cinnabar by oxygen, one atom of oxgen takes the place of the atom of sulphur.

(*To be continued.*)

## VARIETIES.

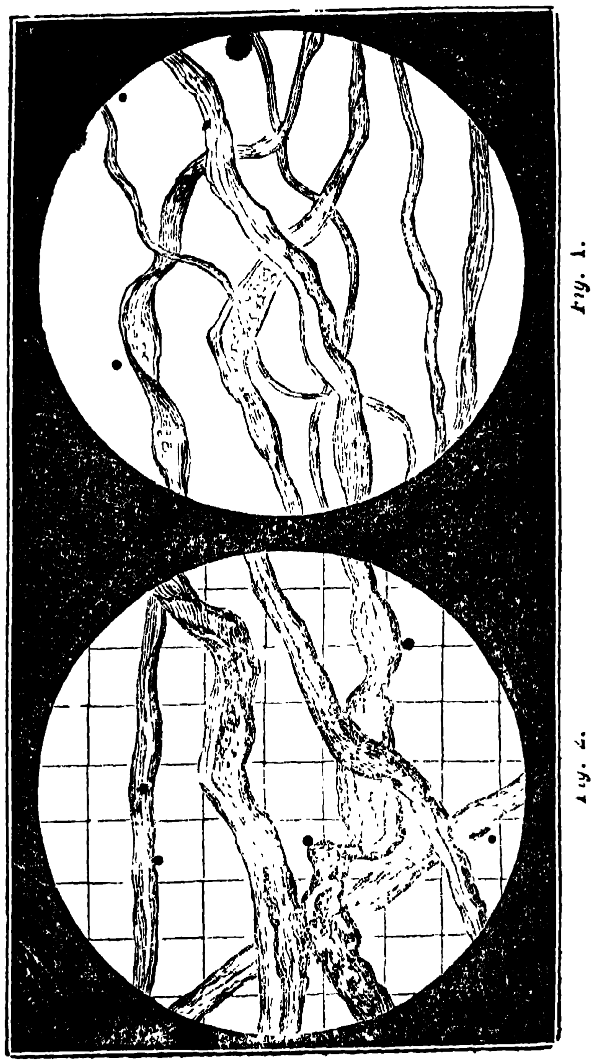
*Perkins' Transfer Engraving.*—Mr. Perkins' admirable process of transfer engraving may be thus explained. A soft steel plate was first engraved with the required subject in the most finished style of art, either by hand or mechanically, or the two combined, and the plate was then hardened. A decarbonized steel cylinder was next rolled over the hardened plate by powerful machinery until the engraved impression appeared in relief, the hollow lines of the original becoming ridges upon the cylinder. The roller was re-converted to the condition of ordinary steel and hardened, after which it served for returning the impression to any number of decarbonized plates, each of which became absolutely a *counterpart* of the original; and each plate when hardened would yield the enormous number of 150,000 impressions without any perceptible difference between the first and the last. In the event of any accident occurring to the transfer roller, the original plate still existed, from which another or any required number of rollers could be made, and from these rollers any number of new plates, each capable of producing as many impressions as above cited.—*Holtzapffel.*

*To mend China.*—Take a piece of flint glass, beat it to a fine powder, and grind it extremely fine on a painter's stone with the white of an egg, and it joins china without rivetting, so that no art can break it in the same place.

*To render Shoes Water-proof.*—Mix a pint of drying oil, two ounces of yellow wax, two ounces of turpentine, and half an ounce of Burgundy pitch, carefully over a slow fire. Lay the mixture, whilst hot on the boots or shoes with a sponge or soft brush; and when they are dry, lay it on again and again, until the leather becomes quite saturated, that is to say, will hold no more. Let them then be put away, and not be worn until they are perfectly dry and elastic; they will afterward be found not only impenetrable to wet, but soft and pliable, and of much greater durability.

*How to eat Strawberries.*—Most of our readers know how to grow Strawberries, and many have doubtless seen them served up with cream and sugar, but give us the Italian dressing for a Strawberry before all others. It makes a splendid dish in a dessert, and is sure to please nine out of ten persons at table. The operation is simple. Take off the stalks from as many berries as will form one layer at the bottom of a dish; sift some fine loaf-sugar over them; then place another layer, and sift again; each layer will be found smaller than the preceding. When there are five or six layers, cut a fresh lemon and squeeze the juice all over them. Before they are helped, let them be gently disturbed that they may all have the benefit of the lemon-juice and sugar. They may be eaten of heartily without danger, which is more than can be said of strawberries and cream; and, generally speaking, those who have eaten them with the Italian dressing, will never eat them any other way, if they can help it.

Fig. 1.—Surat Cotton. Fig. 2.—Smyrna Cotton.




MICROSCOPIC VIEW OF COTTON FILAMENTS.

## THE COTTON PLANT.

In the prosecution of our notices of the Culture and Cultivation of the Cotton Plant, and introductory to our promised description of the manufacture of this most important commodity, we present our readers with a microscopic view of cotton filaments of two descriptions, viz. the Surat Cotton, and Smyrna Cotton.

'The fibres terminate usually in very fine points, abruptly tapered. To these points the mechanical irritation of cotton, when applied to ulcerated surfaces, may probably be ascribed; and possibly in some measure to the exceedingly fine edges of the ribands. Flax or lint consists of smooth cylinders, and is therefore free from the irritating quality. The entanglement of cotton filaments, to which their superior spinning properties are owing, may be ascribed chiefly to their spiral structure, and elasticity; so that when one is pulled out, it draws forth many others. If, during this extrication of the filaments, a twisting motion be communicated to them, they will form a cohesive thread. The finer, the more uniform, the more cylindrico-spiral, the longer and more elastic the filaments are, the more capable they will be of forming fine yarn. When they are short, and consist of rather broad and flimsy ribands, they will be ill adapted to machine spinning, though still susceptible of being spun by the tact of delicate fingers. We can thus understand how the Hindoo women manage to spin fine yarn from the Dacca cotton, which is the growth of an unequable wool consisting of flimsy ribands, like most of the India cottons.

The most intelligent manufacturers at Dacca, says Roxburgh, think that the great difference between the Dacca muslin and that of other places, lies in the spinning, and allow little for the influence of the soil, or the variety of the *gossypium herbaceum*, which is cultivated at Dacca.

There can be no doubt that the cotton filaments are hollow cylinders, prior to the dry state of maturation, they then become flattened and tortuous, in a greater or less degree. The more nearly cylindrical they remain, the stronger and more pliant to the spindle will they be found. On these accounts, as well as from their greater length, the filaments of the Sea-island, Egyptian, Guiana, and Brazilian cottons hold a higher value in the market, than the Upland, Georgian, or the East Indian. In examining a sample of cotton wool, the spinner draws it out slowly between the fore-fingers and thumbs of his two hands, and observes how the filaments successively escape from pressure. He then draws out the staple in the other direction, and thus alternately from hand to hand. In this manner he judges of the length, smoothness, fineness, and strength of the cotton. Of the strength, however, a better judgment may be formed in the yarn, by seeing what weight will break it.

One sort of cotton is seldom worked up alone in our cotton-mills, but two or three different kinds are frequently mixed together. Thus the cheap and short stapled cottons of India, must be allowed and carded along with some of the American cottons, to make them work to the best advantage. Much of the success and profit of the cotton spinner, depends on the skilful blending of dissimilar cottons, whereby one kind is made to conceal or supply the defects of another.

## GALVANISM.

(*Continued from page* 388.)

"And did the agate, after every precaution, still contain some very minute portion of saline matter, not easily discoverable by chemical tests? To determine this question, the experiment was repeated a second, a third and a fourth time: the quantities of saline matter diminished in every successive operation, which sufficiently proved that the agate must at least have been *one* of the sources sought for; but four additional repetitions of the process convinced the operator that it could not be the only one; that there must exist some other source from which the alkali proceeded, since it continued to appear to the last, in quantities sufficiently distinct, and apparently equal, in every experiment. This was extremely perplexing: every precaution had been taken—the agate cups had even been included in glass vessels, out of the reach of the circulating air—all the acting materials had been repeatedly washed with distilled water; and no part of them in contact with the fluid had ever touched the fingers.

"The water itself then, however pure it might appear, must have furnished the alkali. The experiments were repeated in cones of the purest gold, and the water contained in them was submitted to Voltaic action for fourteen hours; the result was, that the acid increased in quantity as the experiment proceeded, and at length became even sour to the taste. On the contrary, the alkaline properties of the fluid in the opposite cone shortly obtained a certain intensity, and remained stationary.

"On the application of heat, the alkaline indications became less vivid, although there always remained, after the operation, sufficient evidence to prove that a portion at least was fixed, although probably mixed with ammonia.

"The acid, as far as its properties could be examined, agreed with those of pure nitrous acid, having an excess of nitrous gas.

"It was now impossible to doubt that the water held in solution some substance which was capable of yielding alkaline matter, but which, from the minuteness of its quantity, had soon been exhausted.

"The next step, therefore, was to submit the water to a still more rigorous examination, which he did by evaporating it in a vessel of silver; when he had the satisfaction to discover the $\frac{1}{70}$th of a grain of saline matter.

"The water, thus purified in a vessel of silver, was again subjected to Voltaic action in the cones of gold. After two hours, there was only the slightest possible indication of alkali; and this was not, as before, *fixed*, but entirely *volatile*.

"In every one of these experiments, acid matter had been produced, and it always presented the character of nitrous acid. Two of the great sources of foreign matter had been detected and removed, viz. the vessels, and the water employed; it still however remained to be explained, how nitrous acid and ammonia could be produced in cases where pure water and pure vessels had been used. In no part of this elaborate enquiry is the penetration of Davy more striking, than in his reasonings upon this problem, and in the beautiful experiments which his sagacity suggested for its solution.

"It occurred to him, that the nascent oxygen and hydrogen of the water might respectively combine with a portion of the nitrogen of the common air, which is constantly dissolved in that fluid; but if this were the case, how did it happen that the production of nitrous acid was progressive, while that of the alkali was limited? The experiments of Dr. Priestly, on the absorption of gases by water, at once suggested themselves to his mind as being capable of solving this last difficulty; for that distinguished philosopher had shown, that hydrogen, during its solution in water, expelled the nitrogen, whereas oxygen and nitrogen were capable of co-existing in a state of solution in that fluid. It was, however, necessary to confirm the truth of this explanation by experiment, and he accordingly introduced the two cones of gold, containing purified water, under the receiver of an air-pump; the exhaustion was effected, and the Voltaic pile brought to act upon the water thus circumstanced; after eighteen hours the result was examined, when the water in the negative cone produced no effect upon prepared litmus, but that in the positive vessel did give it a tinge of red barely perceptible.

"Had his series of experiments terminated here, the truth of his conclusions would have been established by the comparatively small proportion of acid formed in this latter experiment; but he determined to repeat it under circumstances, if possible, still more unexceptionably conclusive. Having, therefore, arranged the apparatus as before, he exhausted the receiver, and then filled it with hydrogen gas from a convenient air-holder; he made even a second exhaustion, to ensure the highest accuracy, and then again introduced carefully prepared hydrogen. The Voltaic process was continued during twenty-four hours, and at the end of that period it was found that neither the water in the positive nor in the negative vessels altered the tint of litmus in the slightest degree.

"Thus did he succeed in exposing the three great sources of fallacy which had so long mis-led chemists, with regard to the generation of acid and alkaline matter in Voltaic experiments, viz.—The impurities of the vessels—the foreign matter contained in the water—and the compounds generated by the combination of the nitrogen of atmospheric air with the elements evolved from water; and thus did he establish, by an unbroken chain of incontrovertible evidence, the important truth, that 'water, chemically pure, is decomposed by electricity into gaseous matter alone—into oxygen and hydrogen.'

"Out of the foregoing train of research very naturally sprang the consideration of the *decomposing agencies of Electricity*. It had been constantly observed, that, in all electrical changes connected with the presence of acid and alkaline matter, the former uniformly collected around the positive, and the latter around the negative surface of the apparatus.

"In one of the earliest experiments, Davy had also noticed that glass underwent decomposition, and that its alkali always passed to the negative surface. He was, therefore, led to enquire whether, through electrical agency, different solid earthy compounds, insoluble, or soluble with difficulty in water, might not be made to undergo a similar decomposition. We shall find that the result of the trials were decisive and satisfactory. For conducting experiments of this description, he hit upon the happy expedient of constructing the cups with the materials which he wished to submit to experiment, and then by introducing water into them, and forming the necessary connexion by means of asbestus, he completed the Voltaic circuit. In this manner he submitted to experiment *sulphate of lime, sulphate of strontia, fluate of lime, sulphate of baryta*, &c. and with analogous results; the acid element in each case passing to the positive, and the earthly base to the negative cup.

"As, in the above experiments, the bodies under examination were presented in considerable masses, and exposed large surfaces to the electric action, it became necessary to enquire whether minute portions of acid and alkaline matter could, by the same agency, be disengaged from solid combinations. This point was very readily elucidated. A piece of fine grained basalt, which, by a previous analysis, had been found to contain 3·5 per cent of soda, nearly ·5 of muriatic acid, and fifteen parts of lime, having been divided into two properly-shaped pieces, and a cavity, capable of containing twelve grains of water, been drilled in each, was submitted, as in former experiments, to the action of the pile. At the end of ten hours, the result was examined with care, when it appeared that the positively electrified water had the strong smell of oxy-muriatic acid, and copiously precipitated nitrate of silver; while that which was negative affected turmeric, and left by evaporation a residium which appeared to consist of lime and soda.

"A part of a specimen of compact zeolite from the Giants' Causeway, and vitreous lava from Ætna, were each treated in a similar manner, and with results equally satisfactory.

"Having thus settled the question with regard to the disengagement of the saline parts of bodies insoluble in water, he proceeded to extend and multiply his experiments on soluble compounds, the decomposition of which, as might have been supposed, always proceeded with greater rapidity, and furnished results more perfectly distinct. In these processes he employed the agate cups, with platina wires, connected by amianthus moistened with pure water; the solutions were introduced into these cups, and the electrifying power applied in the manner already described. In this way, *sulphate of potash, sulphate of soda, nitrate of potash, phosphate of soda*, &c. were respectively examined; and in every case, the acid, after a certain interval, collected in the cup containing the positive wire, and the alkalies and earths in that containing the negative wire.

"When metallic solutions were employed, metallic crystals or depositions were formed on the negative wire, and oxide was likewise deposited around it, while a great excess of acid was found in the opposite cup.

"With respect to the transfer of the constituent Parts of Bodies by Electric Action, several original experiments were instituted, and some important conclusions established.

"Several facts had been stated, which rendered it probable that the saline elements evolved in decompositions by electricity, were capable of being transferred from one electrified surface to another, according to their usual order of arrangement; but to demonstrate this clearly, farther researches were required, and Davy proceeded to supply the necessary evidence. He connected one of the cups of sulphate of lime before mentioned, with a cup of agate, by means of asbestus, and filling them with purified water, connected them with the battery. In about four hours, a strong solution of lime was found in the agate cup, and sulphuric acid in the cup of sulphate of lime. By reversing the order of arrangement, and carrying on the process during a similar period, the sulphuric acid appeared in the agate cup, and the lime in the opposite vessel. In both these experiments (the acid in the one case, and the lime in the other), the elements of the substance must have passed, in an imperceptible form, along the connecting line of asbestus into the opposite vessel.

"Many trials were made with other saline bodies, and with results equally satisfactory; the base always passing into the vessel rendered negative, and the acid into that which was positive.

"The time required for these transmissions appeared to be, *cæteris paribus*, in some proportion to the length of the intermediate volume of water.

"In the farther prosecution of the enquiry, Davy discovered a still more extraordinary series of facts. In the first place, he found that the contact of the saline solution with a metallic surface was not in the least necessary for its decomposition. He introduced purified water into two glass tubes, and connected with them, by means of amianthus, a vessel containing a solution of muriate of potash. In this case, the saline matter was distant from each of the wires at least two-thirds of an inch; and yet alkaline matter soon appeared in one tube, and acid matter in the other; and in sixteen hours moderately strong solutions of potash and muriatic acid had been formed.

"The discovery of this fact became the key to that of others. He very naturally proceeded to enquire into the progress of the transfer, and into the course of the acid and alkaline elements; when, by the use of litmus and turmeric, he arrived at the following conclusion,—that acids and alkalies, during their electrical transference, passed through water containing vegetable colours without effecting in them any change. From which we are led to the consideration of the fourth division of the subject, viz. 'On the Passage of Acids, Alkalies, and other Substances, through various attracting Chemical Menstrua, by Electricity.'

"As soon as it was discovered that a power generated by the Voltaic pile was capable of destroying elective affinity in the vicinity of the metallic points, it seemed reasonable to suppose, that the same power might also destroy it, or at least suspend its operation, throughout the whole of the circuit. The truth of such a supposition was at once placed beyond all doubt by the following very striking experiment.

"Three tubes, the first containing a solution of *sulphate of potash*, the second a weak solution of *ammonia*, and the third, *pure water*, each being connected with the other in the usual manner by amianthus, were arranged in relation to the pile, as follow:—the *sulphate of potash* was placed in contact with the negatively electrified point, the *pure water* with the positively electrified point, while the solution of *ammonia* was made the middle link of the conducting chain; so that no sulphuric acid could pass to the positive point in the distilled water, without passing through the ammoniacal solution.

*(To be continued.)*

## THE OLIVE TREE.

Of this tree as many as eighteen kinds are enumerated; but it appears that the chief distinction lies between the wild and the cultivated, the former of which is dwarfish, useless, and neglected, while the latter is eagerly propagated, valuable, and highly-esteemed. It abounds in the countries of the East, appearing to have been originally found in Asia, and thence transplanted into southern Europe. In the latter, and in Africa, it does not rise spontaneously as in Asia, but requires diligent attention in its cultivation: it is especially abundant in Syria and Palestine, springing up with its ancient freshness in the valleys of the Holy Land, cresting the mountains of Judea, and vindicating its paternal soil on the same spot, at this day which bore the name of Mount Olivet and Mount of Olives eleven centuries before the Christian era; uninterrupted by the succession of Hebrews, Assyrians, Romans, Moslems, and Christians. During the siege of Jerusalem, all the trees growing near were cut down, but of course the roots were left undisturbed. It flourishes well on the shores of the Mediterranean; in several of the islands of that sea it is cultivated with much advantage, the wealth of their inhabitants depending in a great measure on its prosperity. In Greece it flourishes, contributing not a little to the riches of the infant state. In great Britain it grows readily, especially in the south, bringing forth fruit on the wall if protected during frost. In Egypt the great endeavours of Ibrahim Pacha to promote its cultivation, with a view of increasing the revenue, have all but failed, owing to the indolent and sluggish habits of the people.

The tree is an evergreen, and runs up to a height of 20 or 30 feet, its trunk is knotty, its bark smooth and of an ash-colour: its leaves oblong, not unlike those of the willow, dark green above, and whitish beneath. In June its blossoms come forth in bunches, small, white, delicate, and beautiful, slenderly attached to the tree, and falling off in showers by the gentle breeze; the fruit which succeeds is of an oval form, at first green, then pale, and ultimately black. The disparity between the produce of the wild and the cultivated olive has been compared to that between the crab and the choice apple, or the sloe and the plum. The tree, although one of great poetic fame, is nevertheless far from beautiful, its dusky hue giving it the appearance of being covered with dust. It will grow on the driest and most flinty soil; and, if not liable to be pruned, lives to an astonishing age, in almost any country, although mostly confined to those of warm, or at least temperate climates. It is frequently propagated by truncheons, that is, short pieces of the trunk, or of substantial branches, which, being planted, soon take root, and send forth goodly stems; it is also multiplied by grafting. In scripture times it was grown in gardens set apart for it.

The olive was formerly in Palestine contemplated as an emblem of prosperity and excellence; its tender boughs have by numerous tribes been viewed as sacred; by the ancient Greeks they were highly estimated, being on great occasions selected for ornament, brought forward in great profusion at the nuptial feast, adorning the apartments of the bridegroom on the marriage-day, and forming wreaths to crown the successful competitors at the Olympic games; the modern Greeks too, in emulation of the old times, have instituted similar pastimes, at which King Otho confers the chaplet of honour with his own hands. It is a symbol of peace and reconciliation, and was, amongst others, sacred to Apollo.

The olive was one of the principal fruits cultivated by the Jews, who used it for their daily food, and highly valued it for its nutritive qualities; in Canaan it constituted a very considerable proportion of the wealth. It is chiefly valuable on account of the plentiful supply of oil which is obtained from its fruit when ripe, and which, in all the oleaginous class of plants, excepting the present, is obtained from the seed, but in this is yielded by the fleshy part of the fruit. It is very useful in a variety of ways in a hot country; in the Levant and in Greece it is much esteemed as an ingredient in cookery, entering into almost every dish. In the small island of Corfu, in the Gulf of Venice, the produce in 1835 amounted to nearly 100,000 barrels, in value about 2,000,000 of dollars. Of old it was obtained by treading the berries under foot, also by pounding them in mortars; now, however, mills are employed for the purpose, some of which are erected in the vicinity of Athens. Besides its use by the Jew as an article of food, it was highly prized in the way of ornament, to "make his face to shine." Under the ceremonial law, it was an ingredient in a costly perfume, wherewith the sacred orders of the priesthood were anointed. A failure in the olive crop was regarded amongst the Hebrews as a severe calamity, its success materially affecting their temporal condition. It possesses a soothing influence in mitigating pain, and is said to cure the poisonous bite of the viper. Competent judges have asserted that it may be used with benefit to the constitution, especially with vegetables, in preference to artificial sauces, which, while palatable, are pernicious. The use of the fruit with us, during or after drinking much wine, is well known; there are three kinds used—the French, Spanish, and Italian, all differing in appearance and flavour, and which are chosen according to taste. To obtain the juice in the greatest perfection, the fruit should be carefully gathered, and never shaken off, as the bruises occasioned by the latter mode injure the oil; the oil should also be expressed immediately the fruit is gathered. An admixture of beech-oil, which is procured on purpose, is found to preserve it from becoming rancid, to which in its unmixed state it is liable when sent on long voyages. For polishing metals, olive-oil is the best, there being water in all other oils.

Of the application of the wood in modern times, there appear few records; but in sacred writ there is ample testimony to its usefulness, in doors, lintels, side-posts, and carvings. Its texture, however, is solid, its colour is yellowish, and there appears reason to suppose, being a tree of a hardy nature, and which lives to a great age, that it is adapted to superior uses.

## ELECTRO-METALLURGY.

### *On Substances capable of receiving the Metallic Deposit.*

THE voltaic deposit of metal may take place upon any conducting substance, which is capable of acting the part of the negative metal, in the arrangement. The laws which relate to this, are the same which regulate, in a similar manner, the plates of the battery. The deposit may be effected upon most metals, except the earthy and alkaline, and upon any alloy or compound of them. It may likewise take place upon charcoal and plumbago. When the metals are employed, the effect is evident enough, for the arrangement differs in nothing from that of a Daniell's battery.

Where we desire the duplicate to possess a surface and form exactly like those of the original, it is of the utmost importance that the metal on which deposit is to take place, should not of itself decompose the fluid, because, in that case, the duplicate is sure to be more or less impaired. To illustrate this, zinc, lead, tin, or iron, in sulphate of copper, precipitates the copper immediately from its solution, but the former metals are dissolved, exactly in equivalent proportion with the reduction of the latter. The solution of this metal impairs the surface, and renders the duplicate less perfect. This may be prevented, in a great measure, by taking care that the voltaic current is passing at the moment when the metal is plunged into the fluid; and this mode of proceeding is supposed, by many, entirely to supersede the elective affinity, as it is termed, or the spontaneous action of the metal on the fluid. But I can decidedly affirm, that a battery of twelve cells will not entirely prevent the solution of the more oxydable, and the reduction of the less oxydable metals.

The metals which can be employed with advantage to receive a deposit of any other metal, are therefore those which are not acted upon by the particular fluid in which they are immersed; those however, which are but slightly acted upon, may still be employed. Platinum, from its being unaltered by any solution, holds an important place for the reception of every metal; its great value however, must ever be an impediment to its general use.

Gold is equally valuable with platinum, but is still more expensive; yet when extended to that state in which it exists as gold leaf, it may be applied over the surface of any soft substance, and thus a metallic surface is presented. This mode may be employed with other metals, such as silver or tin; but we have other methods, which render all these modes useless.

Silver is only reduced by gold and platinum, and therefore may be employed for the reduction of metals, when we require the deposit to be of very pure metal. Silver leaf of a thickness of about one square foot to the ounce, and made of pure metal, is much used by the forgers. The process they adopt is, to place the coin to be copied on a piece of wood, and upon the coin they place a piece of this thin silver. They beat it gently with a wooden mallet, till a perfect impression is taken on the metal, a result soon obtained. They then copy the opposite side of the coin in the same way. The two impressions are then soldered together, and the manufacturer sallies forth and risks his neck for the illicit shilling, which has cost him this labour. The reader will doubtless have no inclination to practice this fraud, and therefore it is unnecessary to enter into the process farther; but it should be borne in mind, that the same means may be employed, with a better intention by the electro-metallurgist, to obtain a mould.

The alloys of lead which are principally employed, are pewter, the fusible metal, and the type metal. The first is an alloy, consisting of about eighty parts of tin, and twenty of lead, but for many purposes, more lead might be added. There are many varieties of this alloy, containing either copper, antimony, or bismuth, but the first I believe will be found to be the best. The fusible metal has been much used by the electro-metallurgist for small casts, but its manipulation is difficult. It should be melted over a lamp, and the surface skimmed perfectly clean. A portion is then to be poured upon any flat surface, and the medal is to be placed upon it with a jerk, and firmly pressed. The metal should be nearly at the point of congealing before the impress is given, or the surface of the cast is apt to exhibit a crystalline appearance. The fusible metal of Sir Isaac Newton, contains lead, bismuth and tin, but mercury is generally added by the instrument makers to render it more easily fusible; the mercury, however, should always be omitted, when the alloy is to be used for taking casts. The composition of the type metal is stated to be about one part of lead, to sixteen of antimony, with a small porttion of copper. Considerable practice is required to make casts either in the fusible or type metal, and I am informed that even in type foundries, a man rarely excels in the casting of more than a few letters.

The Italians have a method of taking very perfect moulds with pewter. They take a portion of the melted pewter, and place it on a piece of paper; upon this they lay the medal, and under both a piece of carpet; upon the medal they place a log of wood, and then a sharp blow on the wood will ensure the sharpness of the cast. The worth of a cast thus made, is from six pence to half a crown.

An impression may be given to a perfectly clean bright surface of sheet lead, by placing upon it the object to be copied, and then with a steady hand dealing a heavy blow. By this mode even a sealing wax impression may be copied, although this at first sight would appear hardly credible. By pressure alone, it would be difficult to obtain the result, which can be given by the blow.

Rolled lead, first scraped, in order to remove any oxide from the surface, and then flattened by running it through a press upon a polished iron plate, will readily take the impression of the most delicate work of engraving. The object to be copied, is simply to be placed upon the lead, and then the two are to be sent once, and once only, through the printing press, as in the ordinary operation for taking a print. This mode is perfect, and answers well for any case. The pressure in rolling is far greater than can be given by direct pressure, though there are instruments, which are used by embossers, capable of exerting great power.

The metal employed for stereotyping, is applicable to the electrotype. A mould in this metal is taken in a particular way from plaster, but it requires certain apparatus which there is no need to describe, as any article can be easily obtained from the foundry.

Non-conducting substances are of three kinds; substances having no affinity either for the metal or the solution; substances acted upon by the solution; and lastly, substances capable of combining with the metal thrown down. Those of the first class are by far the most valuable, but are not very numerous. The best of these is sealing-wax, a composition of shell-lac, venice turpentine, and colouring matter. Dr. Ure gives, as the proportion in which these are used, four, one, and three. The manufacturers have several varieties, the most expensive of which is the best for making seals. Some of them are extremely hard, as for example, a black wax which is used for filling up the letters in the engraved plates of shop windows, but I do not know how a difference of composition can affect the properties of the wax in this important manner. The use of sealing wax is attended with considerable expense, as good wax cannot be purchased under three and sixpence or four shillings a pound, but it takes impressions of objects of the greatest delicacy with the utmost accuracy. Every one uses this substance, and sealing is one of those operations in which every one thinks that he excels his neighbour in the manner in which he performs it; but however well satisfied he may be with his skill in the small way, yet the management of large seals is attended with great difficulty and uncertainty. Proof seales are made by engravers, by holding a piece of card over a flame, and rubbing gradually a stick of wax, previously softened by heat, upon the heated card, till a sufficiency is obtained, when the coin is to be pressed upon it. Very large seals are made by taking a good sized stick of wax, and holding it in a flame, not only till the point, but even three or four inches of its length are lighted. It is then to be held over a piece of paper or card, when large drops of melted wax will keep falling, and in a short period a considerable quantity will be melted. The flame of the stick is to be blown out, and the fluid mass well stirred round and round, till all the air bubbles are dispersed, and a clear surface of semi-fluid wax is exposed. It is now ready to receive the impression of the object of which we are desirous of obtaining a copy. This is to be laid upon the wax, and pressed with considerable force, and lastly plunged into cold water, so as to cool it suddenly. Much less difficulty attends the use of a metallic die, for that abstracts the heat, and does not adhere.

When we are desirous to obtain an impression in wax, from wood or similar substances, they should be previously brushed over with a little salad oil. In these cases, by plunging the wax into cold water, its surface is apt to sink in places, and thus becomes uneven. Very large seals have been made of sealing wax, by means of placing the medal on the semi-fluid composition and subjecting it to hydrostatic pressure. In this way the late Mr. Bates succeeded in making perfect seals of four or more inches in diameter.

White wax may be used for taking casts, and can be procured with least expense by buying the waste ends of wax candles, which may be readily melted over a lamp. The object to be copied is to be very lightly oiled, and enveloped in a piece of paper, which should be tied round the edge with string. By this proceeding we form a kind of rim to the medal. The fluid wax is then to be poured into the cup thus formed, care being taken that no bubbles of air adhere to the medal. It is then suffered to remain not only until it becomes solid, but even quite cold, which will not take place in less time than two or three hours, on account of the wax being a bad conductor of heat. It may then be taken off by gently pulling the wax cast from the medal.

(*To be continued.*)

## THE COMMON SUNFLOWER.--ITS USES AND CULTURE.

By W. Taylor, F. L. S.

William Taylor, F. L. S, has made various experiments for the last ten years upon a plant commonly known under the name of the sunflower, which he considers might be introduced into field culture with great advantage in several different views.

It is the Helianthus annuus, a native of Mexico, though it appears to be indigenous to many parts of the world. It is found wild in the southern districts of Africa, and very common in the East Indies, where it is called the Soorooge-mookey, or sun-starer.

The plant is an annual belonging to the natural order Compositæ, attaining the height of three to four feet; it agrees with every rotation of crops, and succeeds in all soils, provided here is sufficient depth of mould for the plants to derive proper support and nourishment; and, if the necessary space be given to each plant to spread out its branches, it attains the highest perfection.

In regard to the situation, it should be chosen so open as to expose the plants as much as possible to the warmth of the sun, as the crops in such places not only ripen and fill the seed, but the plants are considerably larger in growth than in those which are close and confined.

In preparing the ground for this crop the land should not be rendered light by too much ploughing, but be in a firm state of mould in the superficial parts, and the plants should always be kept clean, and free from all kinds of weeds, the first month or six weeks after the plants have made their appearance; and the Sunflower should be manured with the ruins of old buildings or walls, for the plants suceed best in earth that is mixed with a material for the production of nitrous gas, and even nitre itself is very abundant in the Helianthus the number of bushels of lime rubbish required for an acre would be about thirty, and the value of the thirty bushels about ten shillings.

The proper season for sowing must in great measure be regulated by circumstances; but the earlier the seed can be got into the ground the better, say the beginning of April, as the crops will be ripe and ready to harvest the latter part of August, which will be of the greatest importance to the grower. and the necessary quantity of seeds required for an acre depends upon the condition of the soil, and varies from 4 lbs. to 5 lbs.; but it is of course advisable to sow a little more than is actually wanted, to provide against any unforeseen accidents which may happen to the seeds before germination.

The seed should be drilled into the ground, the distance from row to row eighteen inches, and the plants should be thinned out to thirty-six inches from plant to plant; the number of plants at this distance would be about 14,500 per acre; at eighteen inches from plant to plant, 25,000 per acre, and at twelve inches from plant to plant, 32,000.

After culture, the land between the plants should be kept quite clean from all sorts of weeds, but especially while the plants are in a young state of growth, and as soon as they have risen sufficiently above the surface of the earth, the work of after culture may be readily accomplished by a single horse-hoe-plough, so as to cut up the weeds and stir the mould well, and lay it up a little to the roots of the plants, and the parts between the plants in the rows may be cleared or cleaned by a small light hand-hoe. Where, from the nature and quality of the land, the plants rise to a great height they may be pruned, and some of the lower branches taken off early with great advantage to the crops in their growth and produce of seed; and he made many experiments on the plants to endeavour to produce them as dwarf as possible, and by so doing he increased the quantity of seed very materially; and by pruning plants three feet high down to twenty-four inches, he succeeded in this way, never attempting to prune or cut a plant till he perceived some small heads, about the size of a common nut, making their appearance out of the sides of each leaf, then he begins to prune the plants down to twenty-four, and in a few weeks they begin to branch out at the sides.

Harvesting the Crop.—In performing this business a number of baskets are provided in proportion to the extent of the crop, and placed in the field, into which all the large heads of the plants are gradually taken off as they become ripe, and the heads of the plants are conveyed to a machine similar to the Indian corn mill, where the seed is readily scratched out, and the refuse burnt for alkali.

Where this method is practised, the depredation of birds and other vermin, is often prevented as well as the shedding and dropping of seeds upon the ground, by which a very great loss may sometimes be sustained; and another great advantage in growing this sort of crop, is it rather serves to improve the soil than to exhaust it, for the Sunflowers receive most of their nourishment from the number of large leaves they have on their stalks, and having no large roots like many other plants, but principally consist of small fibres that do not run deeper into the ground than two inches.

The produce of this kind of grain, like that of most others, varies considerably according to the state of the soil, climate, and cultivation that is employed; but the average quantity of seed is about fifty bushels per acre; fifty bushels of seed produces fifty gallons of oil; and the refuse, after the oil has been extracted, made into oil-cakes, produces 1500 lbs; and the stalks when burnt for alkali give 10 cwt. of potash, besides paper, hemp, and other useful articles.

This plant is not liable to disease, such as blight, mildew, or others of a similar nature, but generally in a blooming healthy state; and although some insects may fix and shelter themselves on the flowers or heads of the plants, they cannot, from the close compact state of the seeds in them, lodge in their interstices, consequently the tom tits, which are perhaps the greatest enimies to these crops may not only seek the insects as their food, but at the same time plunder the seed of the flowers, as it is certain and well known that they not unfrequently work it out of the heads, and even before it gets full ripe. The capability which these birds possess of suspending their bodies in a backward direction upon the flowers, also tends to facilitate their getting out the seeds from the heads. Such birds are not numerous.

The flowers of the Sunflower appear in succession during a considerable period, and produce a rich repast for bees, as the flowers afford considerable supplies of honey and wax; the honey is much superior in point of quality and quantity from the flowers of the Helianthus than from any other flowers, such as the Trifoliums, Polygonums, Heaths, or any of the Labiatæ plants.

He found by various experiments upon the Helianthus annuus, that a plant three feet high transpired in a day 1 lb. 14 oz. avoirdupois, that the quantity of transpiration in the same plant was proportional to the surface of the leaves; and when he cuts the leaves off the stalk the transpiration ceased, and in twenty-four hours the plant withered and died. By these observations he considers that the leaves are the organs of transpiration; and he found that transpiration was nearly confined to the day, very little taking place during the night.

The leaves of the same plant perform very different operations at different times; during the day they are giving out moisture and absorbing carbonic acid gas, and emitting oxygen gas; during night, on the contrary, the leaves are absorbing oxygen gas. The leaves not only absorb carbonic acid gas and oxygen gas, but water also.

The name of the Sunflower originated from the resemblance which its broad golden disc and ray bear to the sun, and is rendered furthur appropriate by its having the power (which, indeed, other syngenesian plants possess) of constantly presenting its flowers to that luminary.

This order of plants is only endued in a very high degree with the same quality that is common to the whole vegetable world, that of presenting themselves to the light; though this property, where it is eminently conspicuous, has been construed into a sort of sympathy or perception in the plant, like the ancient heliotrope.

In the feeding of animals, the seed, being of a farinaceous oily quality, may be giving as a cheap, substantial, and nourishing food for neat cattle, sheep, swine, and all sorts of poultry, and may be used either in the meally state, or that of cake, after it has been expressed or manufactured into oil.

The large roots and naked stems, and some other waste parts, may in many places be converted into fuel. They may be made use of, in the billet or other forms for drying malt; and in some places may be converted into other ways as common fuel, and may be substituted as chips for lighting of fires in the dried state near large towns.

The refuse of the plants may be employed as the foundation in littering of farm-yards, as well as for other purposes about them: such as wattled defences, divisions, screens, and temporary coverings for sheds. It may therefore be concluded, that this plant may now not only be cultivated for the purpose of ornament, but for a variety of economical uses and applications, as well as domestic purposes. It may also be found useful and beneficial with hemp in the cultivation and improvement of land of the fen and marsh kinds. When the Sunflower is grown three feet from plant to plant, in the intervals a crop of potatoes or beetroot may be obtained. Bread was made from the meal by Mr. King, Berners street in 1834.

*Specimens of the productions from the Sunflower.*

No. 1. Hemp, from the stalks of the plant, when bruised with mallets and steeped in water, the same way as flax or hemp, produces a strong fibre in the manufacture of pack-thread and bags.

No. 2. Paper, from the heads of the plant. After the seed is taken out there remains a white, shining, silvery, fibrous substance, which is contained in a large proportion, for manufacturing into whitybrown paper.

No. 3. Syrup, for medicinal purposes.

No. 4. The Dye, from the petals or blossoms of the plant after they are dried upon a hot iron furnace, produces a brilliant yellow material for dyeing woollen goods and silks, as the colours are found to stand the test of acids and alkalis, and for making tinctures in medicine.

No. 5. Oil-Cake.—After the seed has been manufactured into oil, there remains a farinaceous oily cake, which may be made use of in feeding of bullocks, sheep, and swine; and the seed before it is crushed is found very excellent food for foreign and English birds and poultry.

No. 6. The Oil is superior to any other now in use for the following purposes: — In the manufacture of woollen goods; in the manufacture of soap and candles; for lubricating all sorts of machinery; burning in lamps; in the manufacture of blacking, where olive oil is now used; and for watch-makers, not freezing. It is tasteless, and free from scent.

No. 7. Potash, made from the stalks of the Sunflower, is employed in the manufactute of glass and paste, and with oil or fat in the manufacture of soap and also used for a varitey of other useful purposes. The properties of this patash are—silica, magnesia, lime, and alumina.

No 8 Gum, Resin, or Balsam, extracted from the plant when three quaters grown, which will be found a most excellent varnish for carriages, in the arts, and for medicinal purposes.

No. 9. The green leaves of the Sunflower, when dried and bruised into powder, form excellent fodder for all kinds of cattle, particularly milch cows, as it may be given to them with great advantage, by mixing the powder with chaff or bran.

Another authority says: — We presume it is not generally known that this plant, which is so often regarded as worse than a useless cumberer of the ground, is cultivated extensively in some parts of the United States, and turned to a very valuable account in a variety of ways. The *oil* derived from the Sunflower *seed* is pretty well known. Its excellence for fancy painting and druggist use, is said to be confirmed, and we are even told that it is equal, if not superior, to almond or olive-oil for table use. One acre of ground will produce from forty to fifty bushels of seed, sometimes much more. Good seed will produce a gallon of oil to the bushel and the oil has been sold at 1 dol. 50 cents per gallon, when flaxseed-oil stood at ninety cents.

*The refuse*, after the oil is expressed, is said to be a valuable food for cattle.

*The leaf* is manufactured into cigars, of a mild, pleasant flavour, possessing, it is said, powerful pectoral properties, highly commended by physicians in many diseases of the chest. The leaves, properly cured, will bring from five to fifteen cents per pound.

*The stalk*, when stripped of the leaf and seed, may be burnt, and a superior alkali made from the ashes.

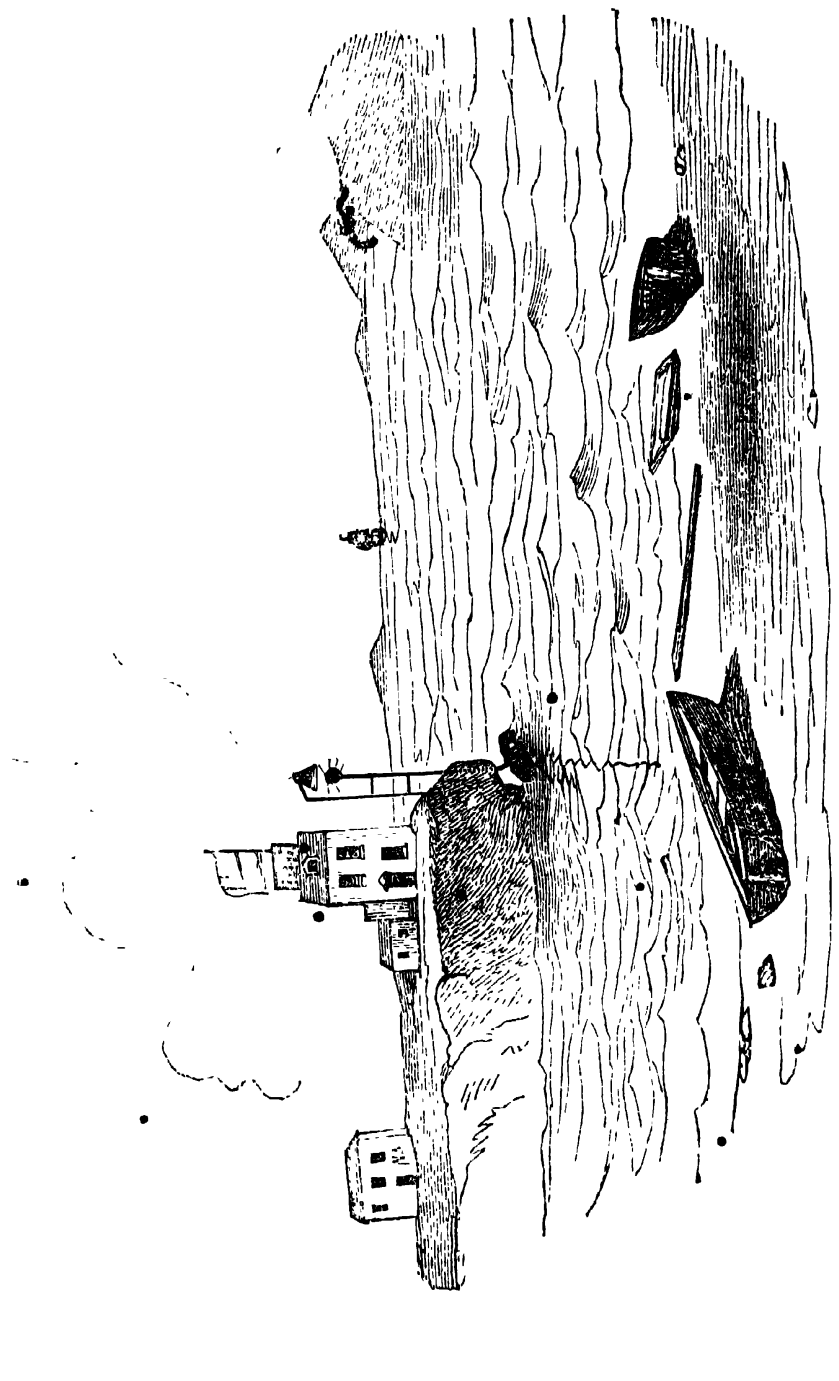
*The comb* of the seed, or properly the filaments of the flower is excellent feed for cattle or hogs.

The Helianthus is cultivated in the vicinity of York, Pa.; and a gentleman in North Carolina, in 1839, cultivated one hundred acres.

## VARIETIES.

*Cochineal dye* is made from an insect. Every pound weight of this valuable drug is said to contain 70,000 insects boiled to death; so that the annual sacrifice of intersectual life to procure our scarlet and crimson dyes amounts to about 49,000 of these minute members of the vast creation. Cochineal insects have been introduced to Spain, where they are said to thrive on the prickly pear. The insect is also encouraged in Malta.

*Electro-Magnetic Carriage.*—Beil, of Frankfort on the Maine, has completed his Electro-Magnetic Carriage. The arrangement appears to be capable of great power; and the machinery producing the motion, with the battery, weighs a ton and a half. The carriage is mounted on ordinary railroad wheels. The battery consists of twenty pairs of copper and zinc plates. The arrangement has sufficient power to propel with the greatest facility the carriage containing from thirty to forty persons. The velocity is not mentioned.



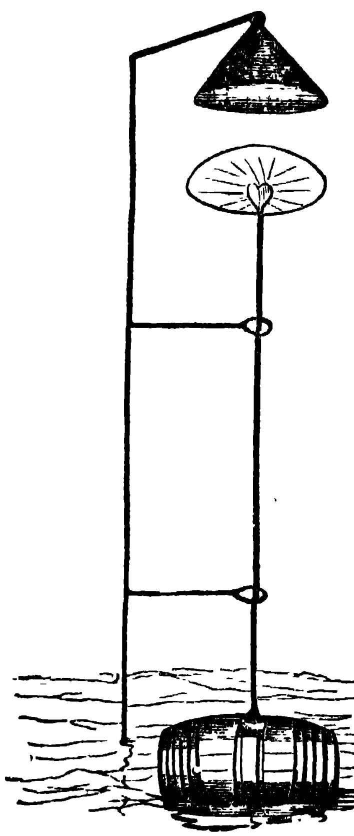
MACHINE FOR SHOWING THE STATE OF THE TIDE.

## MACHINE FOR SHOWING THE STATE OF THE TIDE.

*To the Editor of the Magazine of Science.*

SIR,

It has been a matter of no little consideration with myself, in a few of my travels through the "Coasts of Britain," to determine a question that has often arisen in my mind, viz. has any means been discovered by which a mariner unacquainted with a certain coast, could, on suddenly arriving in the night time, tell in what state the tides were at the time, on that coast. In all my researches I have not as yet found any plan in which the least means has been adopted, by which mariners at night might both distinguish where they were, and in what situation they were placed. A scheme has struck me which I think might be employed with success, that is, that there should be a ball of light placed on the top of long pole, (fixed near any projecting rock at a sufficient distance from the shore) communicating with a buoy which might be floating on the surface of the water. This ball of light might be so contrived, as to rise when the water rose, and to sink when it lowered; when the buoy rose this ball of red light might be made to go into a kind of extinguisher, which would make the light



a deep purple or some other colour, signifying by this that there was no danger on account of the water being high enough to allow the mariners to enter with safety into the harbour or creek which he wished to gain.

As I feel very anxious concerning this means of, perhaps, saving the lives of many of our British mariners, I shall feel obliged by your allowing it to occupy a space in the next number of your excellent work.

I remain, yours, &c.

A SUBSCRIBER.

## ON PERSONAL EXERCISE.

THE sanitary influence of personal exercise, especially if it be included in a scheme of general education, has been pointed out by writers of nearly every nation and period; who have also condemned its neglect, as being a pre-disposing cause of constitutional weakness, and of irregularity in the growth of the human frame.

So much importance was attached to personal exercise by the Athenians, that it was prescribed by them "in lieu of physic, and as an antidote against those pale faces and emaciated frames, too common where intellectual studies are ardently pursued;" * and it has been stated, in evidence of the paramount advantage of exercise, by one of the most eminent physicians and philosophers of *our* time, "that a man of sound constitution, and who remains uninjured by poison or violence, may have uninterrupted health to the full period of human life; there are only four things or conditions which he can ever be required himself to provide or secure; namely, fit AIR, WARMTH, ALIMENT, and EXERCISE of his bodily and mental faculties." †

Various systems of personal exercise have prevailed at different periods; all of which were intended to promote health,—increase the muscular power,—and give symmetry to the figure;—but chiefly to produce a "well poised and vigorous mind."

The ancients had their Gymnasia, when, *unconfined by dress*, the gymnasts practiced "wrestling, running, fencing, dancing, &c., to the measured time of simple music:" but as it was discovered that the *extremes* to which these exercises were carried had a tendency to destroy the equilibrium which ought to exist between the body and the mind, they fell into disrepute, and consequent disuse.

Some four and twenty years ago, gymnastic exercises were introduced in London by Captain Clias, and adopted by other professors, who for a time met with extensive patronage. When kept within certain limits, these exercises were found to be productive of much benefit: but the gradual introduction of feats which required in their execution a degree of activity and muscular power rarely possessed even by the most robust; and the injury sustained by many, who attempted them notwithstanding their deficiency in those physical qualifications;—together with the fact of one of the professors having met with a serious accident while endeavouring to execute a scarcely achievable and useless exploit,—drew the attention of thinking men to the subject, and led to their almost total exclusion from those public establishments where they had been previously held in high estimation.

"Female Gymnastics, or Callisthenics," were subsequently introduced to public notice, and in 1827 a treatise by Signor Voarino, appeared upon the subject, in which the nature of this system of exercise was fully explained, and the benefits attainable through its adoption pointed out. It was shewn that the tendency to strain the figure, which had been strongly urged as an objection to the Gymnastic exercises, was obviated in the Callisthenic; due account having been taken in their arrangement, of the difference, in point of constitution and muscular power, between the sexes.

---

* History of the Manners and Customs of ancient Greece, by J. A. St. John.

† Dr. Arnott On Warming and Ventilating.

We have seen that the gymnastics of the ancients consisted in running, fencing, dancing, &c., to the measured time of simple music; and the subjoined account of those of the moderns is taken from one of the numbers of "The Library of Useful Knowledge," by the late Sir Charles Bell; entitled "Animal Mechanics."

In speaking of the perfect adaptation of the means to the end in the mechanical construction of the human frame, the author makes the following observations.

"The whole apparatus of bones and joints being thus originally constituted by Nature in accurate relation to the muscular powers, we have next to observe, that this apparatus is preserved perfect by exercise. The tendons, the sheaths in which they run, the cross ligaments by which they are restrained, and the *bursæ mucosæ** which are interposed to diminish friction, can be seen in perfection only when the animal machinery has been kept in full activity. In inflammation and pain, and necessary restraint, they become weak; and even confinement and want of exercise, without disease, will produce imperfections. Exercise unfolds the muscular system, producing a full bold outline of the limbs, at the same time that the joints are knit, small and clean. In the loins, thighs, and legs of a dancer we see the muscular system fully developed; and when we turn our attention to his puny and disproportioned arms, we acknowledge the cause—that, in the one instance, exercise produced perfection, and that in the other, the want of it has occasioned deformity. Look to the legs of a poor Irishman travelling to the harvest with bare feet: the thickness and roundness of the calf show that the foot and toes are free to permit the exercise of the muscles of the leg. Look again to the leg of our English peasant, whose foot and ankle are tightly laced in a shoe with a wooden sole, and you will perceive from the manner in which he lifts his legs, that the play of the ankle, foot, and toes are lost, as much as if he went on stilts, and, therefore, are his legs small and shapeless.

"And this brings us naturally to a subject of some interest at present: we mean the new fashion of exercising our youth in a manner which is to supersede dancing, fencing, boxing, rowing and cricket, and the natural impulse of youth to activity.

"By this fashion of training to what are termed *gymnastics*, children at school are to be urged to feats of strength and activity, not restrained by parental authority, nor left to their own sense of pleasurable exertion. They are made to climb, to throw their limbs over a bar, to press their foot close to their stomach; to hang by their arms and raise the body,—to hang by the feet and knees,—to struggle against each other by placing the soles of their feet in opposition, and to pull with their hands. No doubt if such exercises be persevered in, the muscular powers will be strongly developed. But the first question to be considered is the safety of this practice. We have seen a professor of gymnastics, by such training, acquire great strength and prominence of muscles; but by this unnatural increase of muscular power, he became ruptured on both sides. The same accident has happened to boys too suddenly put upon these efforts.

"It is proper to observe, that where the muscular power is thus, we may say, preternaturally increased, whether in the instance of a race horse, an opera dancer, or a pupil of the *Callisthenic* School, it is not merely necessary to put them on their exercises gradually in each successive lesson, but each day's exertion must be preceded by a wearisome preparation," &c., &c.

Now it must be quite evident that the exercises here described cannot be intended for *females*; nor can they come under the denomination of *Callisthenics*; this term having been compounded for the purpose of designating a system of exercise opposed to violent action, and meaning literally, exercises intended to produce beauty or elegance, combined with strength. Gymnastics and Callisthenics should not therefore be used synonymously, as the systems of exercise to which these terms respectively apply, are materially different in their arrangement.

Dr. Arnott states, in his "Elements of Physics," in reference to the effect produced by personal exercise, that, "Facts of this kind, and the known truth that by *gymnastic* exercises and *training*, the form of the body may be changed, shed important light upon the subject at present so near the hearts of many English mothers, viz, the weak and crooked backs of their daughters."

Surely the *gymnastics* described by Sir Charles Bell cannot be here pointed at!—it must be the more gentle system of exercise denominated *callisthenic*, to which Dr. Arnott draws attention.

The mechanical arrangements of a fully appointed modern gymnasium, are numerous, complicated, and expensive. They consist of ropes, poles, ladders, and inclined planes; (for climbing) foot and hand swings; a triangle, horizontal and parallel bars; a bridge, the flying course, the spindle (*or mad horse!*) &c., &c., to each of which peculiar exercises are adapted.

These gymnasia are generally attached to national, or large private, establishments; and are therefore to a certain extent exclusive. They usually occupy some convenient and extensive space out of doors, and are intended for the use of the male sex. Callisthenics on the contrary, are usually practised within doors. and by females; the space required for their performance inconsiderable, and the apparatus both simple and inexpensive.

In planning a *system* of personal exercise, there are many circumstances to be taken into consideration; the first and most important being the *safety* of the practice.

If the exercises are intended to neutralize the ill effects of sedentary occupations,—to strengthen the constitution,—or to correct an habitual bad carriage; they should be so gradually progressive in their arrangement, with regard to the power exerted in their execution, as to prevent a strain upon the parts employed; and so equally diffused or balanced, that one part of the muscular system may not be benefitted to the detriment of another. But should the intention be to correct any irregularity in the growth of the figure, which there is reason to hope may yield to treatment during the plastic period of youth; in such cases the exercise should be so ordered as to take effect, more particularly upon the part intended to be benefitted; and had better be frequently repeated after short intervals of repose, than continued for any considerable length of time. Care should also be taken that the position during the *time of rest*, be in accordance with the *intention* of the exercise.

* These *bursæ murosæ* (mucous purses) are sacs containing a lubricating fluid. They are interposed wherever there is much pressure or friction, and answer all the purposes of friction-wheels in machinery.

It has been stated that personal exercise is one of the four things which those of sound constitution are "require themselves to provide and secure that they may have uninterrupted health to the full period of human life;"—that exercise when well balanced between the superior and inferior extremities, (and not carried to excess) has produced "perfection in the full bold outline of the figure;—and that the want of it has occasioned deformity."* But this is not all, for we find that systematized exercise is adopted with confidence as a *curative* process, in those establishments expressly intended for the treatment of distortion, more particularly in cases of spinal deviation. Even in that stage of the affection when, with a view of relieving the spine from the weight of the body, the patient is required to lie almost constantly either in the prone or in the supine position, exercises are performed in the standing or sitting posture, at stated hours in the course of each day; and when recumbent means are also afforded for employing considerable muscular action and of giving extension to the figure. This mode of treatment embraces two important considerations; the exercise "unfolds the muscular system," and has an *indirect* influence in the curative process, while the extension acts *directly* upon the part affected.†

But while we recommend those who are afflicted with confirmed bodily infirmity to the care of the skilful practitioner of the healing art, it may not be unprofitable to enquire what *system* of personal exercise is best calculated to exert a countervailing influence when much time is devoted to scholastic pursuits, and when the evils attendant upon the want of exercise are manifest in constitutional *delicacy and* THREATENED *deformity*.

There are persons who would exclude daily personal exercise from the routine of general education upon the plea of encroachment on the time required for scholastic advancement; to such the perusal of Mrs. C. Hall's charming tale of "Cleverness," might afford a profitable lesson. Still the economy of time in educational pursuits must not be disregarded. Therefore, that system of exercise which calls forth the greatest quantity of muscular action in a given time, and which has the advantage of being based upon physical laws, must be the best calculated for general adoption.

We have the evidence of many of the most eminent writers on Physical Education, in favour of the practice of dancing, considered as a *system* of personal exercise. It must not however be supposed, that it is the *fashionable* dancing of any particular period which has been recommended; but rather the *study* as well as the *practice* of the art; in reference to the theory of muscular action, and the principles of equilibration.‡

Combe observes that, "before we can dance well, not only must we *know the motions*, but our muscles must be trained to *execute them*." §

The preliminary exercises used in the *study* of dancing, are intended to show, that steps consist in the arrangement of a certain number of simple or elementary movements of the feet; and that each of these movements should be accompanied by a natural and well defined position of the body. Appropriate distinguishing terms are applied to these simple movements, which impress their character upon the mind; and it is only by the *regular practice* of these, that we can reasonably expect to acquire facility in their execution,—a graceful mien,—and an increase of muscular power. This *system* of exercise, may in fact be considered analagous (and equal in its effects) to the practice of the scales in music; by the one we have the *constructions* of steps, and are therefore enabled to adopt without difficulty, any style of dancing which fancy or fashion may dictate; by the other we perceive that musical passages are derived from the scales, and that by practising these with attention, we are enabled to understand and to execute the compositions of popular authors.

If then with certain exercises for the lower extremities, (the beneficial effects of which have already been described) there be others combined for the the superior extremities, which are calculated to *equalize* the muscular development; it may be considered that these conjointly offer a *system* of personal exercise, which if resorted to daily, is well calculated to invigorate the feeble,—to give an easy deportment to the robust,—and to afford reasonable hope of amendment, if not of permanent cure,—in incipient cases of spinal deviation.

The benefit intended to be derived by exercising the superior extremities, is the enlargement of the chest or thorax. To effect this object three sets of muscles are mainly concerned, those which bring the sternum forward,—the *pectoral* muscles,—those which elevate the ribs,—the *serrati* muscles,—and those which are situated in the small of the back, on either side of the vertebral column, immediately above the pelvis,—the *latissimus dorsi* muscles, which assist the other muscles when the arms are raised above the head, in accomplishing this object, and giving the spine a variety of motions. By enlarging the cavity of the chest, respiration is improved; the lungs are more fully distended and the blood more perfectly oxygenated: its circulation consequently receives an impulse which carries it on with vigour to the extremities; and it deposits in its course, in a greater degree, than when the circulation is sluggish,—that earthy matter which is one of the constituents of bone, and upon which constitutional soundness and the solidity of the human superstructure must to a considerable extent depend.

Different mechanical agents have been adopted at different times for the purpose of securing the advantages above stated: amongst these are dumb-bells, clubs, and poles; the two former are objectionable (particularly for young females) on account of their *dead weight*, and the latter on account of their *rigidity*. If we use a dumb-bell or a club of any given weight (say for instance of only two pounds), a power *exceeding* that weight must be exerted upon it merely to give it motion; and if by any muscular effort we accelerate that motion, it (that is to say, the dumb-bell or the club) acquires a momentum, which if suddenly checked, may be productive of much mischief, the greatest care being requisite to keep this increase of power under control; we cannot, in fact, *lessen* the specific weight by any degree of motion we give it, and without motion it becomes absolutely useless as an agent for exercise. The pole again on account of its *unyield-*

* See "The Report of The Verral Charitable Society for the treatment and attendance at their own houses of poor persons afflicted with diseases of the Spine, Chest, Hips, &c." Also "Tuson on Curvature of the Spine and Diseases of the Vertebral Column."

† Chambers's Edinburgh Journal, No. 590.

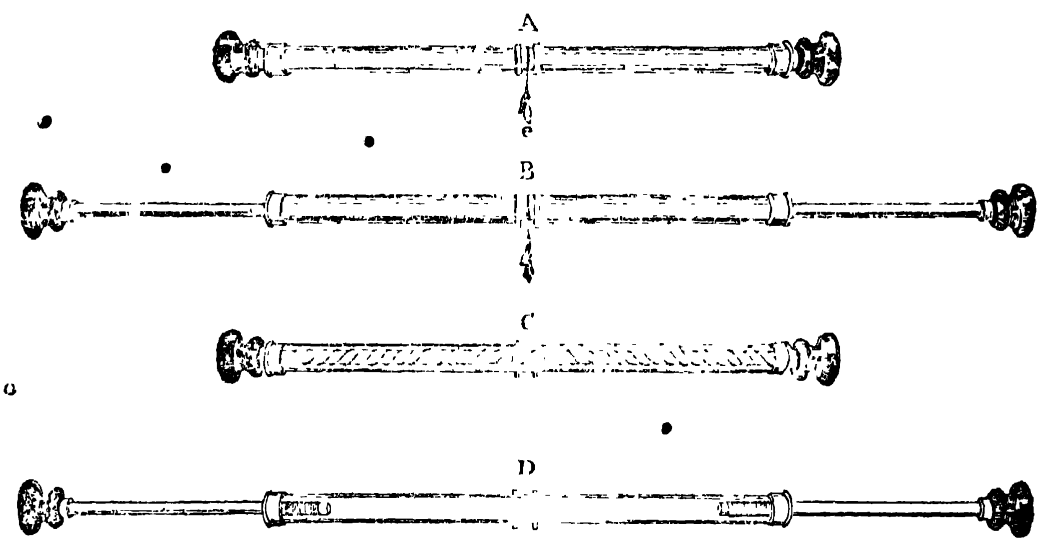
‡ See Arnott's Elements of Physics, p. 120, 122, 123, 126.

§ The Constitution of Man considered in relation to external objects, by George Combe, p. 55.

*ing* nature, occasions a strain upon the muscles of the back and shoulders generally, and upon the wrist in particular, which renders extreme caution in its adoption, for the purpose above stated, absolutely necessary; independently of which, the attitudes it elicits are out of nature; the *rotatory* motion of the wrist, upon which the easy graceful action peculiar to that joint mainly depends, being for a time wholly suspended.

A rope to climb, a hand swing, and the pulley and weight, are also frequently recommended for the purpose of exercise in cases of spinal deviation: but the disinclination on the part of females to climb a rope, together with the inconvenience (trifling though it be) of putting up and taking down apparatus where an apartment cannot be appropriated exclusively to the performance of exercise, are generally advanced in excuse for these agents not being adopted.

The little instrument described by the wood cut has been constructed by Mr. Tenniel, F.S.A. of 22 Glos'ter Place, New Road, for the purpose of furnishing safe and beneficial exercise for the superior extremities of youth of both sexes, but more especially for the young growing female during the period usually devoted to general education. It may be considered, as an index to the advantages which some persons attribute to the before named agents for personal exercise, without any of the disadvantages which have been alleged against them by others. The *modified* Callisthenic Exercises adapted to its use, (which are perfectly easy of execution) have been submitted to the consideration and judgment of several of the most eminent members of the faculty, by whom they have been pronounced to be "exceedingly well calculated to improve the figure, give strength to the body, and promote and preserve health."




*Systolic and Diastolic Exercising Staff.*

*A* is a brass tube having caps of the same metal screwed upon each end, through which brass rods pass. Each of these rods has a wooden knob at one end, to serve as a handle, and at the other end a nut, for the purpose of securing a steel spiral compression spring, which works upon the rod when it is drawn out. *B* shows the instrument when the rods are drawn out. *C* is a section of the instrument showing the state of the spring when there is not any power exerted upon it: and *D* the spring compressed or *contracted*, where the rods are drawn out to their full extent, *e* is a tassel to which the eye is directed for the purpose of equalizing the exercises of the arms, in their relative position to the head.

The instrument has been named the "Systolic and Diastolic Exercising Staff," not (as has been erroneously supposed) because it is presumed to exert any direct influence upon the heart; but in consequence of its action being dependent on the "forcible bending of a spring," and "its flying out again to its natural site;"* and so far resembling the action of two muscles of that organ.

The staff is manufactured of three different sizes, varying in weight, length and power according to the age and physical means of the person using it; the weight of the smallest staff is rather *less* than one pound, that of the largest about one pound and a quarter; the length of the former, one foot five inches when not in action, but it is capable of being elongated, according to the impulse it receives, to any intermediate degree from its original length, up to two feet three inches. The dimensions of the full sized staff range under similar circumstances, between two feet three inches, and three feet three inches and a half. The power exerted in using the instrument is gradually employed from that degree of strength which is sufficient merely to sustain its weight with *both hands*, up to a force (opposed to the resistance *within it* by the *pull of each hand*) of five, ten, or fifteen pounds, according to the length to which the rods are drawn out. It contracts also with an energy equal to the power which is necessary to produce its elongation; both forces can therefore be rendered available for personal exercise, and as the movement consequent upon this action and re-action, is (as nearly as possible) *continuous*, there can be no danger in its appliance, of straining either a muscle, a tendon, or a ligament, by a sudden check or jerk,

* Vide, "Systole," Dr. Johnson's Dictionary

## GALVANISM.

(*Continued from page* 396.)

"In less than five minutes after the electric current had been completed, it was found, by means of litmus paper, that acid was in the act of collecting around the positive point; and in half an hour the result was sufficiently distinct for accurate examination.

"Other experiments were made with a solution of lime, and with weak solutions of potash and soda, and the results were analogous. Muriatic acid, from muriate of soda, and nitric acid, from nitrate of potash, were also transmitted through concentrated alkaline menstrua, under similar circumstances, and with like effects.

"Davy also made several experiments on the transition of alkaline and acid matter, through different neutro-saline solutions, the results of which were exactly such as theory would have anticipated.

"In conducting, however, these experiments of electrical transference, there would appear to be one condition essential to their success, viz. that the solution contained in the intermediate vessel should not be capable of forming an insolute compound with the substance transmitted through it: thus, for example, Davy found that *strontia* and *barytya* passed, like the other alkaline substances, very readily through muriatic and nitric acids: and *vice versa*, that these acids passed with equal facility through aqueous solutions of the earths in question; but when it was attempted to pass *sulphuric* acid through the same earthy solutions, or to pass the earths through the sulphuric acid, and then the results were of a very different character: the sulphuric acid, in its passage through the barytic solution, was arrested in its progress by the earthy body, and falling down as an insoluble compound with it, was carried out of the sphere of the electrical action, by which the power of transfer was destroyed. The same phenomena occurred whenever he attempted to pass muriatic acid through a solution of sulphate of silver. We now come to the next division—viz. 'Some general Observations on these Phenomena, and on the mode of Decomposition and Transition.'

"Davy considers that it will be a general expression of the facts relating to the changes and transitions by electricity, to say, that 'hydrogen, the alkaline substances, the metals, and certain oxides, are attracted by negatively electrified, and repelled by positively electrified metallic surfaces; and on the contrary, that oxygen and acid substances are attracted by positively electrified, and repelled by negatively electrified metallic surfaces.' And moreover, that these 'attractive and repulsive forces are sufficiently energetic to destroy or suspend the usual operation of elective affinity.'

"Amidst all these wonderful phenomena, that perhaps which excites our greatest astonishment is the fact of the transfer of ponderable matter to a considerable distance, through intervening substances, and in a form that escapes the cognizance of our senses! Upon this question, Davy offers the following remarks:—'It is,' says he 'very natural to suppose, that the repellent and attractive energies are communicated from one particle to another particle of the same kind, so as to establish a conducting chain in the fluid; and that the locomotion takes place in consequence: thus, in all the instances in which I examined alkaline solutions through which acids had been transmitted, I always found acids in them, as long as any acid matter remained at the original source. In time, by the attractive power of the positive surface, the decomposition and transfer undoubtedly become complete; but this does not affect the conclusion. In cases of the separation of the constituents of water, and of solutions of neutral salts forming the whole of the chain, there may possibly be a succession of decompositions and recompositions throughout the fluid.'

"We are next brought to a very important point in the enquiry—viz. 'The consideration of the General Principles of the chemical changes produced by Electricity.'

"The experiment of Mr. Bennett, already alluded to, had shown that many bodies, when brought into contact, and afterwards separated from each other, exhibited signs of opposite states of electricity: but it is to the investigations of M. Volta that we are indebted for the clear development of the fact: for he has distinctly proved it in the case of copper and zinc, and other metallic combinations, and he supposed that it might also take place with regard to metals and fluids.

"In a series of experiments, made in the year 1801, on the construction of electrical combinations, by means of alternations of single metallic plates, and different strata of fluids, as explained upon a former occasion, Davy had observed that, when acid and alkaline solutions were employed as the elements of these Voltaic combinations, the alkaline solutions always received the electricity from, and the acid always transmitted it to the metal. These principles seem to bear an immediate relation to those general phenomena of decomposition and transfer, which have been the subject of the preceding details.

In the most simple case of electrical action, the alkali which receives electricity from the metal would necessarily, on being separated from it, appear *positive;* whilst the acid, under similar circumstances, would be *negative;* and these bodies having respectively, with regard to the metal, that which may be called a positive and a negative electrical energy, in their repellent and attractive functions, would seem to be governed by the common laws of electrical attraction and repulsion, the body possessing the positive energy being repelled by positively electrified surfaces, and that possessing the negative influence following the contrary order.

"Davy made a number of experiments with the view of elucidating this idea, and of extending its application; and, in all cases, their results tended, in a most remarkable manner, to confirm the analogy.

"He proceeded, by means of very delicate instruments, to ascertain the electrical states of single insulated acid and alkaline solutions, after their contact with metals; but the sources of errors were so numerous, as to render the results far from being satisfactory; but in experiments on dry and solid bodies, the embarrassment, arising from evaporation, chemical action, &c. did not occur. When perfectly dry oxalic, succinic, benzoic, or boracic acid, either in the form of powder or crystals, were touched upon an extended surface with a plate of copper, insulated by a glass handle, the copper was found positive, the acid negative. When again metallic plates were made to touch dry lime, strontia, or magnesia, they became negative: in these latter experiments the effect was exceedingly satisfactory and distinct: a single contact upon a large surface being sufficient to communicate a considerable charge.

"Numerous other trials were made, and the results confirmed the principle; and moreover proved, as might have been expected, that bodies possessing electrical conditions with regard to one and the same body, possessed them with regard to each other: for instance, a dry piece of lime became positively electrical by repeated contact with crystals of oxalic acid.

"These results led him to reason more fully upon the 'Relations between the Electrical energies of bodies and their Chemical affinities.'

"As the chemical attraction subsisting between two bodies seem to be destroyed by giving to one of them an electrical condition opposite to that which it naturally possesses; and since the substances that combine chemically, as far as can be ascertained, exhibit opposite states of electricity, the relations between this energy and the chemical affinity would appear to be sufficiently evident to warrant the conclusions at which Davy arrived, viz. that 'the combinations and decompositions by electricity were referable to the law of electrical attractions and repulsions; from which he advanced to the still more important step—' that chemical and electrical attractions were produced by the same cause, acting in one case on particles, in the other on masses.'

*(To be continued.)*

## ELECTRO-METALLURGY.

### *On Substances capable of receiving the Metallic Deposit.*

*(Continued from page 398.*

Plaster casts may be even copied in wax, by simply oiling the plaster with a little sweet oil, previously to pouring in the fluid, and thus a perfectly sharp reverse of the plaster will be obtained. A still better method of taking a reverse from plaster, is to let it absorb as much hot water as it will take up without any remaining on the surface. It is then to be enclosed in paper, and melted wax poured upon it whilst it is warm; after which the whole is to be allowed to cool, when the wax will separate from the plaster with the greatest facility. Should the slightest adhesion exist, it shews that the plaster has not absorbed sufficient water, a circumstance which the operator must avoid another time, for with care, the plaster will not be injured in the slightest degree by this proceeding.

A mixture of equal parts of bees wax and rosin may be employed for taking casts, and may be used in a similar manner to wax. This composition is used a great deal by the Italians, but care must be taken not to use the fused mixture too hot. The composition should be melted, and then allowed to remain till the bubbles have dispersed, and till it becomes nearly as thick as treacle, when it is to be poured over the object, in the same way that white wax is used.

Of the second kind of non-conducting substances, there are several varieties; as paper, plaster of paris, &c., which are acted upon by the fluid, Paper rapidly absorbs the fluid of the solution, and becomes rough, and therefore it must be treated with various substances, in order to give it a perfectly uniform surface. It may be brushed over with a little drying oil, such as linseed or nut oil; I give the preference to the former. The oil should be thoroughly boiled, so that it may dry as quickly as possible, after its application to the paper. The substance to which the oil is to be applied, should be clean. It is then to be brushed lightly over with a camel's hair brush till all absorption ceases, and the surface is left shining, owing to the small quantity of oil still remaining on the surface; but great care must be taken that the plaster or paper be just saturated, and no more, as the superfluous oil, by drying on the surface, will fill up the space between the fine lines. The paper must then be left to dry for about twenty-four hours, and if possible be exposed to the sunshine. It is then ready to receive some conducting substance, of which we shall hereafter speak This mode of treating paper appears, for most purposes, to be superior to every other.

Varnishes may be applied for the same purpose, and as some of them dry more quickly than the oils, their use is attended in some cases with advantage. The principal of these is the white hard, copal, mastic, and carriage varnish. The first dries in a few minutes, and should be applied until a small quantity bears up from the surface. It is best adapted for highly-glazed papers, where the quantity of size prevents the absorption of the more viscid varnishes. The mastic fulfils its purpose very well, but no particular advantages attend its application. The carriage varnish may be sometimes used, but great care must be taken that it does not clog up the fine lines, otherwise it is a most valuable varnish for this purpose, and leaves a very smooth surface. It would be in vain to describe all the modes which may be adopted to render paper non-absorbent and smooth,—it is the principle to which I wish to call particular attention. Sometimes a mixture of bees-wax and rosin previously fused, may be applied, particularly to the absorbent papers. The paper should be held over a flame so that it does not burn, and the composition rubbed upon the opposite side to that on which we desire to make the copy, till the paper is thoroughly infiltrated, when it will be found not to pass beyond the surface. The paper is hard in a few minutes, and ready for the solution. This is an excellent process, and one which may be frequently adopted. Sometimes rosin itself may be used, but it is apt to be brittle. Other substances may be employed in a similar manner, as balsam of canada, &c.

The preparation of plaster of paris is of the utmost importance, and the destruction of its absorbent property is to be obtained by means similar to those employed in the preparation of paper. Plaster of paris is sulphate of lime, or gypsum, deprived of its water of crystallization by heat. In this state it has such an affinity for water, and is capable of taking up so much, that when the powder is mixed with water, till it becomes of the consistence of cream, it sets after a few seconds into a hard mass, In the manufacture of plaster casts, we must pay attention to several little niceties, in order to get rid of all the air bubbles. These arise from two causes, either from the adhesion of the air to the plaster, or from the plaster carrying down air with it, when added to the water. The first is to be remedied by using fresh burnt plaster, which is always adopted by the cunning stereotypers, for they state that if it simply stands a fortnight, the casts will not be so good. The workman cannot explain this, but the rationale was well known to Mr. Wyatt, our celebrated sculptor, who told me that he attributed it to the adhesion of the air; and that thus many delicate casts were injured. He places the common plaster in a saucepan over the fire, and heats it, when it heaves from the discharge of the gas, it is then ready for use. Sufficient plaster should be placed in a basin, and water poured upon it till it is completely covered, and all bubbles cease to rise, when it must be thoroughly mixed by rubbing it together. The surface to which it is to be applied, should be slightly brushed over with a very small quantity of salad oil. A little fluid plaster may then be poured on the cast, and with a hog's bristle painting brush, thoroughly rubbed into all the fine parts, which will prevent the adhesion of any air bubbles in the plaster which might prevent a perfect impression. Another portion of plaster, sufficient to give the desired thickness is now to be added, and time must be given for the whole to set, when it should be removed from the mould, and gently heated over a fire to drive off excess of moisture. It is then found to be exceedingly hard, and ready to receive substances to destroy its absorption.

The best mode of treating plaster casts is to place them in a flat dish with either bees wax alone, or with a mixture of equal parts of bees wax and rosin previously fused. The wax and rosin should not exceed half the height of the cast, and the heat employed should be sufficient to render the composition perfectly fluid. After a short time, the whole is to be raised to a considerable temperature, and then some of the fluid may be brushed over the hot plaster, which will absorb it, and upon waiting a little while the whole of the plaster will be filled with the composition; the plaster is then to be removed and drained, after which no wax will be found to remain on its surface, but its texture will be completely filled, and thus a beautiful non-absorbent and smooth surface is procured. This is an excellent method of treating plaster casts, and is attended with but moderate trouble. The more rosin is contained in the above composition, the higher will be the heat required for its perfect fusion, and although rosin will answer by itself, yet it cannot be made to penetrate beyond a very little distance into the texture of the plaster, though a clean, hard, non-absorbent surface can by this means be produced. The solution of rosin in oil of turpentine may be used, but it is difficult to drive off all the turpentine. A mixture of rosin and grease may also be used. White wax, such as that obtained from wax candles, answers very well to prevent the absorption of plaster, and is very easy to apply.

Common tallow succeeds admirably well in filling plaster. It is readily melted, and from its fluidity passes into the numerous pores of its texture. It is as well thoroughly to boil the cast in the tallow, and then drain off the superfluity, and afterwards leave it in a cool place to harden. The hardest tallow should be selected, but good candles answer every purpose.

Stearine is nothing more than common tallow, with the fine fluid parts or elaine removed by pressure; it answers perfectly to fill plaster. The melted stearine is to be employed in a manner similar to tallow.

Spermaceti also renders plaster non-absorbent, and is to be applied in the same way as tallow. Spermaceti, as sold for candles, answers the purpose well.

The application of boiled linseed oil is another mode which may be practised. It should be applied to the cast until a very minute quantity remains unabsorbed on the surface; it is then to be dried, and this is best accomplished by free exposure to sunshine. The mere hardening of the exterior film does not indicate a sufficient dryness for the object to be placed in the solution; for it is necessary that the oil should be somewhat dry throughout. If the object be placed in the solution, previously to its being dry, the oil will separate from the plaster, and the solution will act upon the cast, and both cast and solution will be materially impaired, if not utterly destroyed. Plaster requires a large quantity of oil for its saturation, perhaps as much as half of its bulk. The casts should not be over dried when the oil is applied, as the oil does not then so readily harden.

*(To be continued.)*

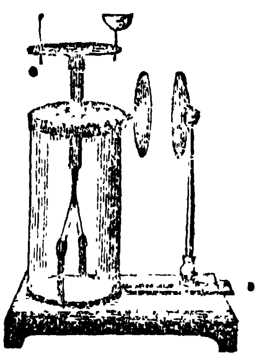
## VARIETIES.

*Patent Fuel.*—Some specimens of patent fuel, lately put on board a steamer proceeding to a warm climate, and which was nicely packed, in cubical guise, concreted, after a little time, into a solid mass, which was as difficult to separate as if it had been as much Indian-rubber. Hammers and picks had scarcely any effect upon it; and much inconvenience was sustained from the want of fuel to sustain the fires, reliance having been placed upon the supply of this treacherous material.

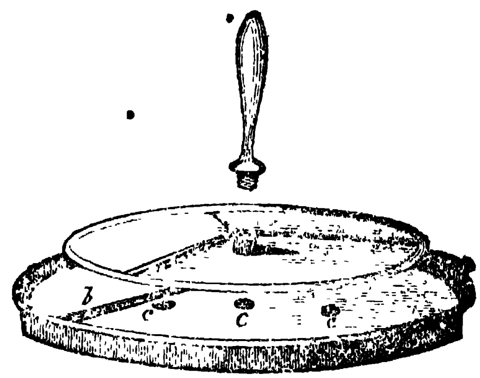
*Crayons.*—Slender, soft, and somewhat friable cylinders, variously coloured for delineating figures upon paper, usually called chalk drawings. Red, green, brown, and other coloured crayons, are made with fine pipe or china clay paste, intimately mixed with earthy or metallic pigments, or in general with body or surface colours, then moulded and dried. The brothers Joel, in Paris, employ as crayon cement the following composition: 6 parts of shellac, 4 parts of spirits of wine, 2 parts of turpentine, 12 parts of a colouring powder, such as Prussian blue, orpiment, whitelead, vermillion, &c., and 12 parts of blue clay. The clay being elutriated, passes through a hair sieve, and dried, is to be well incorporated by trituration with the solution of shell-lac in the spirit of wine, the turpentine, and the pigment; and the doughy mass is to be pressed in proper moulds, so as to acquire the desired shape. They are then dried by a stove heat.

*Fossil Crocodile.*—The fossil remains of an immense crocodile differing from all known species have been found at Bonn.

*Parsnep* (*Pastinaca sativa*, Linn.)—This is a native British plant, being often found growing by the road side; but it has not altered so much as the carrot. It is generally used with salt fish in Lent. It contains still more sugar than the carrot, and some persons dislike it on account of its peculiar sweet taste. Besides its use at the table, a pleasant beverage can be brewed from it with hops, as is practised in the north of Ireland: it will also furnish an ardent spirit and wine. In Scotland parsneps and potatoes are beat up with butter into a dish for children, who are remarkably fond of it. They are excellent fried. The Guernsey parsnep appears to be an improved variety: it grows there to the length of four feet, and three or four inches in diameter. When parsneps are grown in a poor soil, they lose much of the rank taste which they acquire in richer ground; and when they are roasted, as they are in the north, on peat ashes, they become sweet and agreeable, and almost as farinaceous as potatoes.



THE ELECTROSCOPE.



THE ELECTROPHORUS.

## THE ELECTROSCOPE, AND THE ELECTROPHORUS.

Mr. Noad in his admirable lectures on Electricity, tells us "that amongst the earliest manipulations of the phenomena of electricity, effects were rendered apparent which proved that contact between two bodies was not absolutely requisite to cause them to assume the electrical state, but on the contrary it was found that the force or agency operates at definite distances producing distinct mechanical effects. Thus an electrified body or an excited rod of glass or sealing wax when brought near to bits of paper, feathers, or other light substances, causes them to move towards it, and if presented to a small suspended unelectrified ball draws it aside from the vertical position. "Did it happen," he says "that these attractions and repulsions took place between electrified bodies only, the natural inference would be that the forces are exerted on one body and the electric fluid on the other; but since an electrified body exhibits an attraction for bodies not electrified, it would seem that the fluid diffused over an electrified body, excite an attraction on the *matter* of bodies not electrified."

Our author goes on to examine the condition of fixed bodies, and observes that the "results strongly confirm the idea of the existence of two electric fluids uniformly distributed in equal proportions over a body in its natural state," and concludes by stating that the practical demonstration of the facts propounded is best exhibited with the gold leaf electroscope, shown above with the condenser attached. Previous to the application of electrified bodies to this delicate contrivance as a test, we give it a permanent charge, and as great attention is paid to insulation, in the construction of the instrument, it will retain the charge thus given to it for a considerable time, care being taken to have it perfectly free from those great enemies to electrical retention, *damp* and *dust*.

To ascertain the electrical state of any body, we bring it near to the cap or plate of the electroscope; if on doing this the gold leaves increase their divergence, we know that the electricity of the body under examination is *negative*, but if the divergence diminishes, we are certain that the electrical state is *positive*.

A very instructive and useful instrument, depending on inductive action, is the electrophorus. It consists of three parts—a cake of resinous matter, composed of equal parts of shell lac, Venice turpentine, and common resin melted at a gentle heat; a conducting plate or *sole*, which is a circular metallic plate with a rim about a quarter of an inch deep round the edge, into which the composition is poured, and a cover which is of metal, provided with a glass handle. To use it, the resinous plate is excited by holding it in the hand in a slanting direction, and striking it briskly several times with a piece of dry, warm fur or flannel; the cover is then laid on, and on removing it by its insulating handle, it is found to have acquired a feeble charge of *negative* electricity by the contact. Let the metallic plate be replaced, and ***uninsulated*** by touching it with the finger, and on again lifting it by its handle, it will be found to give a strong spark of *positive* electricity. The process may be repeated an unlimited number of times without any fresh excitation of the plate being required, and indeed after being once excited, a spark may be obtained from it during many weeks, since the resin acts solely by its inductive influence on the combined electricities actually present in the plate.

It will not be difficult at once to comprehend this When the metallic plate is placed on the excited resin, it cannot be considered to be *in actual contact with it*, on account of the inequalities on the surface of the latter. It is therefore in a condition analagous to that of a conductor, under the influence of an electrified surface, its lower surface becoming *positive*, and its upper surface ***negative***, by induction. When it is removed from the resin, the separated electricities re-unite; but when the plate is uninsulated, while in contact with the resin, the repelled negative electricity escapes into the earth, and the plate becomes positively charged. It is thus rendered clear that the electricity of the moveable plate is derived not in the way of *charge* from the resin, but is the result of the process of induction.

The figure represents Mr John Phillips's modification of the Electrophorus, the object of which is to avoid the trouble and tediousness of establishing a communication between the insulated cover and the earth, by means of the finger, when electrical accumulation, or sparks in rapid succession, is the object. Three methods are proposed: the first consists in raising from the metallic basis above the edge of the resin, a brass ball and wire, to which the edge of the cover, or a brass ball upon it, may be applied; this method is stated to act very well, especially with small covers, which can with ease and certainty be directed to any particular point of the sole. The second is to fix a narrow slip of tin-foil *b*, quite across the surface of the resinous plate, and unite it at each end with the metallic basis. This construction answers perfectly and instantaneously, and is very convenient with large circles, the cover of which, though uneven, will then be sure to touch some conducting point. The third method is to perforate the resinous plate quite through to the metallic basis at the centre, and any other points, and at all those points to insert brass wire *c*, *c*, *c*, with their tops level with the resin.

## IMPROVEMENTS IN THE MANUFACTURE OF OILS.

A PATENT has lately been granted to Moses Poole, London, for improvements in the manufacture of oils, by using a material not heretofore employed, and in obtaining stearine therefrom, applicable in the making of candles; and also in the manufacture of manure from the residium of such oils, with other matters.

The patentee describes the above invention as consisting in the employment of oyster shells; firstly,—for improving the quality of certain oils, principally those obtained from beech or oak-tree flowers, from poppy seeds and flowers, and from grape seed; secondly,—for improving the quality of candles; and thirdly,—for improving the quality of manure, and effecting a saving in the preparation thereof.

The mode of applying this invention in the manufacture of oil is as follows:—The oyster shells are washed, dried, and ground to powder; then, after the usual preparation of the oleaginous substances, and prior to putting them in the hair or lawn bags, they are powdered with as much oyster shell powder as will be equal to about one-fifth of their bulk; when this is effected, they are put into the bags, and submitted to the action of the hydraulic press. The oil obtained is of two kinds, which are received in different vats; into each vat two pints of sulphuric acid are thrown, and the oil is well stirred, until it assumes a frothy appearance; the operator then throws in as much distilled water as there is oil in the vat, and, after stirring until it is covered with a white lather, allows it to rest for ten hours; the oil will then be at the top, the stearine directly beneath it, and the water and dregs at the bottom.

In concluding the description of this part of his invention, the patentee makes the following remark:—"In the above fabrication, the mixture of the beech and the poppy, in the proportion of two-fifths of the former to three-fifths of the latter, is already an improvement; but a greater one is the mixture of each of these two substances with the grape seed, in the proportion of one-half. The three substances can be mixed together, and the oyster-shell powder will, in each case, be added in the proportion before mentioned. Do not forget that, previous to the said addition, the oleaginous substance, prepared for the extraction of oil, is to be watered with distilled water, in the proportion of half a gallon per 2 cwt. of the oleaginous substance, and reduced into paste by means of a cylinder. Eight hundred-weight of this must produce twenty-five gallons of the best oil, four gallons of lamp oil, and fifty pounds of stearine."

When oyster-shells are employed in the manufacture of candles, they are washed, and reduced to powder, which is converted into a white paste by the action of muriatic acid; this paste is warmed by steam, and introduced by degrees into the boiling tallow, stearine, spermaceti, or wax, in the proportion of forty per cent., being thoroughly incorporated with it by stirring. Candles are made of this composition in the ordinary way. The patentee states, that the introduction of the oyster-shell powder gives to tallow candles the metallic or dry sound of wax, increases their hardness, and improves the colour of the light.

The third part of the invention, viz., improving the quality of manure, is effected in the following manner:—Into the water and dregs, resulting from the manufacture of the oil, (as described in the first part of the invention), a quantity of soot is stirred; then the oil-cakes, remaining after the extraction of the lamp oil, are ground, and thrown in, together with the water and dregs proceeding from the leys of soap manufactories, the residual matters from tallow-melting and soap-making, and a large proportion of oyster-shell powder, which are stirred well together. "Let the whole ferment and dry, and afterwards get it ground, and you shall have produced a manure equal to the best guano."

## THE ATOMIC THEORY.

(FROM LIEBIG'S CHEMISTRY.)

(*Continued from page* 392.)

You will now perceive that, according to this theory of the constitution of bodies, and their mutual substitution in combinations, the numbers denominated equivalents are neither more nor less than the weight of the atoms. The *absolute* weight of the atom of any substance it is not within the reach of our faculties to determine; but how much more or less weight one body brings into a combination than another, that is to say, the *relative* weight of atoms, can readily be ascertained.

If to replace 8 parts by weight of oxygen 16 parts by weight of sulphur are required, that is, double the weight of the oxygen, the atom of sulphur is twice as heavy as that of oxygen.

If substituting hydrogen for oxygen in any compound, only one-eighth part of the weight of the latter substance is required to one part of the former, it is evident that the weight of the atom of hydrogen is eight times lighter than the atom of oxygen. Carbonic acid is a group of *two* atoms, containing one atom of carbon and one atom of oxygen. Carbonic acid is a group of *three* atoms, containing two atoms of oxygen to one of carbon.

The immutability of the combining properties of bodies is fully explained theoretically by thus assuming the existence of indivisible ultimate particles, which are of unequal weights, incapable of penetrating or being diffused through each other when they are united in chemical combination, but being arranged together side by side.

It is, however, in the highest degree expedient that you should discriminate between what is established on the sure ground of experience, and what in this subject is merely hypothetical.

The real experimental import of the equivalent numbers is the expression of the proportional and relative weight of bodies in which they produce analogous effects in chemical combinations; and these effects we represent to our minds, and render intelligible, by ascribing them to indivisible particles, or *atoms*, which occupy a certain space, and possess a certain form, or shape. We possess no means of ascertaining the *number* of atoms, even in the most simple compound, since for this purpose it would be necessary that we should be able to see and to count them, and therefore, notwithstanding our firm conviction of the existence of of physical atoms, the supposition that the equivalent numbers are actually expressive of the absolute weights of the individual atoms, is really nothing better than an hypothesis, for which we have no further proofs.

One atom of cinnabar contains 16 of sulphur to 101 of mercury; now chemists, in assuming that these proportions express the relative weight of *one atom* of mercury and *one atom* of sulphur, pass from experimental certainty into hypothesis; for this mode of representation is merely hypothetical. 101 of mercury may, for aught we know to the contrary, represent the weight of two, three, four, or more *atoms*. Should it represent two atoms, one atom of mercury would be expressed by 50·5; should it represent three atoms, one atom would be expressed by 33·6. In the first case cinnabar would consist of two atoms, twice 50·5, in the latter case of three atoms, thrice 33·6 of mercury, to one atom of sulphur.

Whatever supposition we may entertain in this respect, whether we assume the composition of cinnabar to require two, three, or more atoms of mercury or sulphur, its constitution remains invariably the same. It is only the method by which we represent the composition of a chemical compound to our minds, which would vary with the hypothetical view respecting the number of atoms contained in the compound. It will always be most advisable to banish all that is hypothetical from the symbolic language of chemistry, more especially as the only purpose of this language is to demonstrate to our sense of sight, to render easy of apprehension, and to facilitate the recollection of, the compositions, substitutions, transmutations, and decompositions of chemical combinations. The method of representing the constitution of compound substances ought never to be used for expressing unsettled and mutual notions or speculative theories. The number of the equivalents of the constituents of a chemical compound is invariably, and strictly definable, but the number of atoms necessary to make up an equivalent will never be ascertained. There is not, however, the slightest disadvantage in assuming that the equivalents are the weights of the atoms themselves in cases where theoretical considerations, the mere explanation of ideas, is concerned. In this sense those numbers express merely the difference between the weights of various atoms; that is, by how much the weight of the atom of one body is heavier than that of another.

Every one in the least acquainted with arithmetic will now perceive that the selection of the numbers to represent the equivalents of the simple bodies is a matter of indifference, provided they all bear to each other the true relations,—the *relative* proportions, and not the absolute amount, being the true experimental conclusions. Hence there are several methods employed by various chemists in constructing tables of equivalent numbers. One of the most common, indeed, the one most generally employed, assumes as its starting point the composition of water. The proportional weight of hydrogen and oxygen, as they are combined in the composition of water, is taken as the initial numbers of the series. Water contains eight parts by weight of oxygen, to one part by weight of hydrogen; hence 8 is employed to express the equivalent or atomic weight of oxygen, and hydrogen is assumed to be represented by 1. Upon the supposition, then, that water consists of a single atom of oxygen, combined with a single atom of hydrogen,—and, further, that in every conceivable combination into which these elements may enter, the replacement of one atom of hydrogen, or one atom of oxygen, invariably requires one atom of any other body, and neither more nor less,—then these equivalent weights of all other bodies express their atomic weights, and the numbers by which they are represented all refer to the assumed unit, or one part by weight of hydrogen in nine parts of water.

But if any person chooses to devise any other series of numbers, always maintaining strictly the same exact relative proportions, it may, of course, be done.

One other method which has also been used extensively, and has been supposed to present certain advantages, assumes the equivalent of oxygen to be 100. The numbers of this series are obtained by simply multiplying the former by 12½, which gives us 12·5 for hydrogen and 100 for oxygen, and the other numbers, representing the equivalents of other bodies, express the amount of each which is required to replace 100 of oxygen or 12·5 of hydrogen. The multiplication of the equivalents by one and the same number does not, of course, alter their relative proportions, and it is, therefore, quite immaterial whether we use numbers referring to hydrogen as a unit, or to oxygen as 100.

## CANDLE WICKS.

It is a remarkable circumstance, that the wicks for the best candles are still cotton rovings imported from Turkey, notwithstanding the vast extension and perfection of cotton-spinning in this country. Four or more of these Turkey skeins, according to the intended thickness of the wick, are wound off at once into bottoms or clues and afterwards cut by a simple machine into lengths corresponding to those of the candles to be made. Mr. Colebank obtained a patent, in June, 1822, for a machine for cutting, twisting, and spreading wicks, which, though convenient, does not seem to have come into general use. The operations are performed upon a series of threads at once. The apparatus is placed in a box, in front of which the operator sits. A reel extends across the box, at the hinder part, upon which the cotton threads have been previously wound: from this reel they are drawn off in proper lengths, doubled, and cut by an ingenious mechanism. By dipping the wicks into the melted tallow, rubbing them between the palms of the hands, and allowing the tallow which adheres to harden, they may be arranged with facility upon the broaches for the purpose of dipping. The dipping room is furnished with a boiler for melting the tallow, the dipping mould, or cistern, and a large wheel for supporting the broaches. From the ceiling of the workshop a long balance-shaped beam is suspended, to one end of which a wooden frame is attached for holding the broaches with the wicks arranged at proper distances. The opposite arm is loaded with a weight to counterbalance the wooden frame, and to enable the workman to ascertain the proper size of the candles. The end of the lever which supports the frame is placed immediately above the dipping cistern; and the whole machine is so balanced that, by a gentle pressure of the hand, the wicks are let down into the melted tallow as often as may be required.—*Ure*.

## ELECTRO-METALLURGY.

### *On Substances capable of receiving the Metallic Deposit.*

(*Continued from page* 408.)

The same observations which apply to varnishes, balsam of canada, venice turpentine, &c., with respect to their application to paper, apply also to plaster articles. Of varnishes, the mastic, and white hard are the best, but the formerly described methods are superior to those in which any of the varnishes are used. Experiments have been tried upon every other substance likely to be useful, but these it is needless to describe.

I am tempted to give a table of the substances which may be applied to plaster, as a summary of the results of my experiments, taking into consideration their relative efficiency as well as cheapness.—

Tallow
Stearine
Spermaceti
White wax
Bees wax and rosin
Rosin
Linseed oil
Nut oil
Solution of rosin in turpentine
Balsam of canada
Mastic varnish
White hard varnish
Lac varnish, &c.

The third class of substances, which comprises those which are acted upon by the metal reduced from the fluid, are few in number; yet unfortunately this class contains one substance which takes finer casts than any other, and that is sulphur. The newly precipitated metal no sooner comes in contact with the sulphur than it combines with it, forming a sulphuret, and the cast swelling enormously, is quite disintegrated. The only mode of remedying this is to coat the sulphur mould with a varnish, such as, for instance, white hard and mastic, of which a very thin layer should be applied; however, the sulphur casts have not answered well under any treatment, and as we have so many other modes of taking casts, there appears no inducement to follow the subject farther.

Non-conducting substances may be copied or multiplied by depositing a thin film of any conducting substance upon this; and gold, silver, bronze, or copper powder, might be employed for this purpose.

There is another process by which non-conducting substances, such as animal matter, vegetables or minerals, may be coated with the finely divided metal. The object is to be brushed over with a small quantity of the solution of any salt of gold, silver, or platinum, and in that state is to be exposed to the vapour of phosphorus, from the evaporation of either the alcoholic or etherial solution, when immediately a deposit of finely divided metal will take place on the surface. It has been supposed that this is a phosphuret of the metal, but if a little piece of phosphorus be placed in a solution of gold, silver, platinum, or copper, the phenomena will be explained, as the respective metals will coat the phosphorus. The deposit of copper is particularly be useful.

The substance to be copied may be also brushed over with a solution of any of the metals last mentioned, and exposed either to sunshine or to heat, when reduction will take place; but the process is tedious, and is therefore very rarely employed. Any other mode by which the metals may be reduced, would suffice; as for instance, their reduction by proto-sulphate of iron, or hydrogen gas.

Gilding, silvering, or coppering objects by means of their respective leaves may be employed; yet all these modes are imperfect, and we have no need of any metallic covering whatever, as other means answer the purpose better, and are even more simple and cheaper.

The best method of giving a non-conducting substance a thin conducting layer, is the application of carbon, either charcoal or powdered black lead. It is only necessary to brush these substances over the object till the thinnest film is obtained, and that will be amply sufficient for the purpose for which it is wanted. The black lead is the best on account of its peculiarly unctious nature, which enables its application to be made with the greatest ease, either by a camel's hair, or hog's bristle brush, according to the nature of the substance to be covered; care must however be taken, that the interstices between the fine lines are not blocked up, as this would of course render the duplicate imperfect. Occasionally there is some difficulty to make a thin film adhere to the surface, but if it be an object where perfect sharpness is not indispensable, a small quantity of varnish may be applied, which is suitable to earthenware, Sometimes a little spirit of wine may be used, when a cast is capable of being acted upon by that fluid, as sealing wax, but great care must be taken not to render the surface rough. Upon many substances, the black lead may be made to adhere by simply breathing upon the object. In whatever manner we cause its adhesion, it is important always to bear in mind, that it is of more consequence that a smooth polished surface of black lead be exposed, then a thick rougher coating.

The different opinions which are entertained, as to the applicability of black lead for this purpose, are owing entirely to the fact, that great differences exist between one sample and another, of that article; for if it be not really carbon, it is absolutely a non-conductor, and I have found a number of pieces totally inactive, while others were most excellent conductors. The action or inaction of different pieces, before grinding, is not all dependent on the hardness, for I possessed a piece of that variety, which is called rock by the pencil makers, which completely annihilated the teeth of three of my saws, by which I attempted to cut it. I then sent it, for the purpose of having it sawed, to a celebrated mechanic, and he succeeded no better than myself; in fact, nothing but a diamond would have made any impression upon it, and yet it was one of the best pieces for voltaic purposes which I ever possessed. Sometimes, on the contrary, hard pieces are of no value, whilst soft pieces are excellently adapted. There is no method but direct experiment, by which the conducting quality of any particular sample of black lead can be ascertained. There are not two shops where it can be bought alike, so much is either naturally bad, adultered, or ill prepared. Perhaps the best test of good black lead, is to take a pinch between the finger and thumb, and press it; when, if good, it will cake together and adhere. If charcoal be employed, it should be well burnt, and in the finest possible state of division. The prepared charcoal of the shops exists in the state of an impalpable powder, but it is difficult to apply it.

Of all these various methods, none is, in my opinion, at all comparable to good black lead. The thinness of the coating is such, that it is not sufficient, of itself, to carry the voltaic current (for a layer so thin as only to be visible by reflected light, is sufficient) but this thin layer so favours the extension of the copper laterally, that the whole surface speedily becomes coated. It is very interesting to trace the layer of copper extending itself over any object. For this purpose, a piece of black sealing wax, coated with black lead, answers best, as the difference of colour renders its mode of precipitation very evident. It will be seen that the copper grows, perhaps from some point of the wire, on to the black lead, and gradually extends itself laterally till the whole is inflamed by the metal.

## TURNIP.

Turnips grow wild in England, but these cannot by cultivation be brought to resemble exactly the cultivated vegetable. It is said that they were brought here from Hanover. Turnips contain mucilage, little or no gluten, but a good deal of sugar, though the quantity of the latter varies exceedingly, and is not so considerable as in the carrot. The quantity of nutritious matter, upon the whole, in turnips is small; according to Sir H. Davy only 42 parts in 1000. They are an excellent culinary vegetable, much used all over Europe, and are either eaten alone, mashed, or cooked in soups and stews. A hot climate does not seem to agree with them; and in India they and many of our garden vegetables lose their flavour, and are comparatively tasteless. The Swedish is the largest variety, but too coarse for the table; is excellent for cattle. The green leaves of the turnip, gathered young in the spring, make good greens, well known by the name of *turnip tops.* The leaves for greens are good from any of the varieties, but are less acrid from the Swedish. Turnips grown in the field will be found of a better flavour than those produced in the garden; and the same remark applies to all the brassica tribe, with the exception of the cauliflower and broccoli, as also to potatoes and tuberose roots. The French *navet* is a variety of turnip (*Brassica napus esculenta*), but has more the shape of the carrot. It is of a very fine flavour, and is much esteemed on the Continent for soups and made dishes. Two or three of them will give as much flavour as a dozen common turnips; stewed in gravy it forms an excellent dish. The peculiar flavour resides in the rind; consequently this is not cut off, but only scraped. The *navet* was once grown here; at present it is seldom to be found in our gardens, though very deserving of being cultivated. It is of a yellowish white colour, and resembles the carrot in form. It is often on the Continent served up with them as ornamental on account of the contrast of colour. It is sometimes imported to the London market.

## IMPROVEMENTS IN CAULKING SHIPS, BOATS, AND OTHER VESSELS.

Sarah Coote, of Clifton, near Bristol, has lately patented an invention for improvements in caulking ships, boats, and other vessels.

This invention consists in substituting a different material to that at present in use for caulking ships, boats, and other floating vessels.

Under this invention the patentee entirely discards the use of flax or hemp, which are of a harsh and thready nature, and even when saturated with tar, will not produce a binding effect, for the materials may be entirely separated. The plan now proposed, is to employ fleece wool, shorn without washing, when it can be had in that state. This is to be subjected to a picking operation, which will have the effect of separating the fibres, and may be done expeditiously by woman and children, near whom is to be placed a large shallow tub. Within this tub a strainer, made of netting wire or wood, is to be firmly fixed to a hoop or rim, only about one inch within the tub or cask; there must be bars across, and feet or short legs, about six inches, attached to this straining-frame, to keep it sufficiently high to affix a spigot and faucet into the tub. When a sufficient quantity of wool has been deposited in the tub, it is to be filled with a requisite quantity of thin white-lead paint, and then the wool and paint are to be stirred about with a proper fork, made for the purpose. After all this is properly done, and the superabundant liquor is drawn off by the spigot and faucet, fixed in the tub below the straining frame, the saturated wool may be lifted from the tub by a hooked instrument, and put into buckets for use. A pair of crinkled plyers may be necessary, to take it out of the buckets on its application.

The patentee claims the employment of wool or hair, saturated with paint or pigment, for caulking ships or other vessels.

## GALVANISM.

(*Continued from page* 407.)

"From these views, he is led to propose the electrical powers, or the forces required to disunite the elements of bodies, as a test or measure of the intensity of chemical attraction. An accurate investigation into this connexion, which may be called the *Electro-dynamic* relations of bodies to their combining masses or proportional numbers, would be the first step towards fixing the science of Chemistry on the permanent foundation of the Mathematics.

"If, then, the power of electrical attraction and repulsion be identified with chemical affinity, or rather, if both be dependent upon the same cause, it will follow that two bodies which are naturally in opposite electrical states, may have these states sufficiently exalted to give them an attractive power superior to the cohesive force opposed to their union; when a combination will take place which will be more or less energetic, as the opposed forces are more or less equally balanced. Again, when two bodies, repellent of each other, act upon a third with different degrees of the same electrical energy, the combination will be determined by the degree; or if bodies having different degrees of the same electrical energy with respect to a third, have likewise different energies with respect to each other, there may be such a balance of attracting and repelling forces as to produce a triple compound; and by the extension of this reasoning, complicated chemical union may be easily explained.

"Whenever bodies brought by artificial means into a high state of opposite electricities are made to restore the equilibrium, heat and light are thl common consequences. It is perhaps an additionae circumstance in favour of the theory to state, that heat and light are likewise the results of all intense chemical action. And as in certain forms of the Voltaic battery, where large quantities of electricity of low intensity act, heat without light is produced; so in slow chemical combinations there is an increase of temperature without any luminous appearance.

"The effect of heat in producing combination may be easily explained according to these ideas; it not only gives more freedom of motion to the particles, but in a number of cases it seems to exalt the electrical energies of bodies;—glass, the tourmaline, sulphur, and some others, afford familiar instances of this latter species of energy.

"In general, when the different energies are strong and in perfect equilibrium, the combination ought to be quick, the heat and light intense, and the new compound in a neutral state. This would seem to be the case in the combination of oxygen and hydrogen, which form water, a body apparently neutral in electrical energy to most others; and also in the circumstances of the union of the strong alkalies and acids. But where one energy is feeble, and the other strong, all the effects must be less vivid; and the compound, instead of being neutral, ought to exhibit the excess of the stronger energy.

"The grand principle thus developed may enable us to obtain new and useful indications of the composition of bodies, by ascertaining the character of their electrical energies; and we now find, in most modern works of Chemistry, that bodies are arranged according to their natural electrical relations; and are said to be ELECTRO-POSITIVE, or ELECTRO-NEGATIVE, according to their polarities. The advantage of such an arrangement must be freely acknowledged, for it has been the means of establishing analogies of the utmost importance in chemistry, of which some striking examples are adduced in a subsequent part of the work under review, where a general view is taken of the revolution which chemical science has undergone during the investigations of Davy, and contemporary philosophers.

"After some further enquiries into the theory of the Voltaic pile, to which an illusion has been already made, the author offers additional reasons for supposing the decomposition of the chemical menstrua essential to the continued electro-motion of the pile; and if the fluid medium could be a substance incapable of decomposition, there is every reason to believe the equilibrium would be restored, and the motion of Electricity cease. Having shown the effects of *induction*, in increasing the electricity of the opposite plates, he arrives at the important conclusion, that in a Voltaic arrangement the *intensity of the Electricity increases with the number, but the quantity with the size of the plates.* A theory which was subsequently confirmed by the experements of Mr. Children.

"The paper concludes with 'some general illustrations and applications of the foregoing facts and principles,' and which the author thinks will readily suggest themselves to the philosophical enquirer. They offer, for instance, very easy methods of separating acid and alkaline matter, where they exist in combination in mineral substances: and, in like manner, they suggest the application of electrical powers for effecting the decomposition of animal and vegetable bodies.

"On exposing a piece of muscular fibre to the action of the battery, he found that potash, soda, ammonia, lime, and oxide of iron, were evolved on the negative side, and the three mineral, together with the phosphoric, acids, were given out on the positive side.

"A laurel leaf, similarly treated, yielded to the negative vessel resin, alkali, and lime; while in the positive one there collected a clear fluid, which had the smell of peach-blossoms, and which, when neutralized by potash, gave a blue-green precipitate to a solution of sulphate of iron, so that it must have contained *Prussic Acid.*

"A small plant of mint, in a state of healthy vegetation, on being made the medium of connection in the battery, yielded potash and lime to the water negatively electrified, and acid to that positively electrified. The plant recovered after the process; but a similar one, that had been electrified during a longer period, faded and died.

"These facts would seem to show, that the electrical powers of decomposition even act upon vegetable matter in its living condition; and phenomena are not wanting to show that they operate also on the system of living animals. When the fingers, after having been carefully washed with pure water, are brought in contact with this fluid in the positive part of the circuit, acid matter is rapidly developed, having the character of a mixture of muriatic, phosphoric and sulphuric acids; and if a similar trial be made in the negative part, fixed alkaline matter is as quickly developed.

"Davy thinks that the acid and alkaline taste produced upon the tongue during galvanic experiments, depends upon the decomposition of the saline matter contained in the living animal substance, and perhaps in the saliva; and he farther observes that, as acid and alkaline substances are thus evidently capable of being separated from their combinations in living systems by electrical powers there is reason to believe that, by converse methods, they might also be introduced into the animal economy, or made to pass through the animal organs; and the same thing may be supposed of metallic oxides; and that these ideas ought to lead to some new investigations in Medicine and Physiology.

"He thinks it by no means improbable, that the electrical decomposition of the neutral-salts, in different cases, may admit of economical applications; and that well-burnt charcoal and plumbago, or charcoal and iron, might be made the exciting powers for such a purpose. Such an arrangement, if erected upon a scale sufficiently extensive, with the medium of a neutro-saline solution, would, in his opinion, produce large quantities of acids and alkalies with very little trouble or expense.

"Alterations in chemical equilibrium are constantly taking place in Nature, and he thinks it probable that the electric influence, in its faculties of decomposition and transference, may considerably interfere with the chemical changes occurring in different parts of our system.

"The electrical appearances which precede earthquakes and volcanic eruptions, and which have been described by the greater number of the observers of these awful events, admit also of easy explanation on the principles that have been stated.

"Besides the cases of sudden and violent change, he considers there must be constant and tranquil alterations, of which electricity, produced in the interior strata of the globe, is the active cause: thus, where *pyritous* strata and strata of *coal-blende* occur,—where the pure metals or the sulphuret are found in contact with each other, or with any conducting substances,—and where different strata contain different saline menstrua, he thinks electricity must be continually manifested; and it is probable that many mineral formations have been materially influenced, or even occasioned, by its agencies.

"In an experiment which he performed of electrifying a mixed solution of the muriates of iron, copper, tin, and cobalt, contained in a positive vessel, all the four oxides passed along the connecting asbestus into a positive vessel filled with distilled water, while a yellow metallic crust formed on the wire, and the oxides arranged themselves in a mixed state around the base of it.

"In another experiment, in which carbonate of copper was diffused through water in a state of minute division, and a negative wire was placed in a small perforated cube of zeolite in the water, green crystals collected round the cube; the particles not being capable of penetrating it.

"By a multiplication of such instances, Davy remarks, that the electrical power of transference may be easily conceived to apply to the explanation of some of the principal and most mysterious facts in geology; and by imagining a scale of feeble powers, it would be easy to account for the association of the insoluble metallic and earthy compounds containing acids.

"'Natural electricity,' observes our philosopher, 'has hitherto been little investigated, except in the case of its evident and powerful concentration in the atmosphere. Its slow and silent operations in every part of the surface will probably be found more immediately and importantly connected with the order and economy of nature; and investigations on this subject can hardly fail to enlighten our philosophical systems of the earth, and may possibly place new powers within our reach.'

"Thus concludes one of the most masterly and powerful productions of scientific genius. I may perhaps have been considered prolix in recording the progressive researches by which he arrived at his results; but let it be remembered, that the great fame of Davy, as an experimental philosopher, rests upon this single memoir; and though the secondary results to be hereafter considered, may be more dazzling to ordinary minds, yet in the judgment of every scientific observer, they must appear far less glorious than the discovery of the primitive laws. Let me ask whether Sir Isaac Newton does not deserve greater fame for his invention of fluxions, than for the calculations performed by the application of them? I do not hesitate in comparing these great philosophers, since each has enlightened us by discoveries alike effected by means invented by himself. Not only did both unlock the caskets of Nature, but they had the superior merit of planning and constructing the key.

"I challenge those, who have carefully followed me through the details of the preceding memoir, to show a single instance in which accident, so mainly contributory to former discoveries in electricity, had any share in conducting its author to truth. Step by step did he, with philosophic caution and unwearied perseverance, unfold all the particular phenomena and details of his subject; his genius then took flight, and with an eagle's eye caught the plan of the whole.—A new science has been thus created; and so important and extensive are its application, so boundless and sublime its views, that we may fairly anticipate the fulfilment of those prophetic words of Dr. Priestly, who, in the preface to his History of Electricity, exclaims—'Electricity seem to be giving us an inlet into the internal structure of bodies, on which all their sensible properties depend. By pursuing this new light, therefore the bounds of natural science may possibly be extended beyond what we can now form any idea of. New worlds may open to our view, and the glory of the great Sir Isaac Newton himself, and all his contemporaries, be eclipsed by a new set of philosophers, in quite a new field of speculation. Could that great man revisit the earth, and view the experiments of the present race of electricians, he would be no less amazed than Roger Bacon, or Sir Francis, would have been at his.' In our turn we may ask, what would be the astonishment—what the delight of Dr. Priestly, could he now witness the successful results of Voltaic research? —and what would he say of that mighty genius who has demonstrated the relations of electrical energy to the general laws of chemical action? It was his good fortune to have witnessed the discovery which identified electricity with the lightning of the thunder cloud: what would he have said of that which identified it with the magnetism of the earth! Of this at least we may be certain, that he would have expunged from his history the passage in which he observes—'Electrical discoveries have been made so much by accident, that it is more the powers of nature, than of human genius, that excite our wonders with respect to them.'"

## IMPROVEMENTS IN THE MANUFACTURE OF CORK AND OTHER STOPPERS.

Charles Hancock, of Grosvenor-place, has lately obtained a patent for certain improvements in cork and other stoppers, and a new composition or substance which may be used as a substitute for, and in preference to, cork; and a method or methods of manufacturing the said new composition or substances into bungs, stoppers, and other useful articles.

This invention consists, Firstly, in manufacturing cork and other stoppers, and useful articles, of a composition formed partly of cork, or wood sawdust, and partly of caoutchouc, or a vegetable extract recently introduced from the East Indies, called *gutta percha*, (and sometimes *gutta tuban*), or a mixture of caoutchouc and gutta percha, or a mixture of glue and trecale. Secondly,—in manufacturing cork and other stoppers, and useful articles, by connecting the above composition, when in the state of blocks or sheets, with similar blocks or sheets of caoutchouc, or gutta percha, or caoutchouc and gutta percha combined. Thirdly,—in manufacturing cork and other stoppers, and useful articles, partly of pieces of cork, and partly of pieces of the composition, or of caoutchouc, or caoutchouc and gutta percha combined; or wholly of pieces of cork, connected together by caoutchouc, or gutta percha, or caoutchouc and gutta percha combined, or some other suitable cement. Fourthly, — in manufacturing cork and other stoppers, and useful articles, by making the interior body of the article of cork, and coating it externally, either wholly or partially, with the composition, or with a mixture of ground cork and any suitable oil or varnish, or with caoutchouc, or gutta percha, or caoutchouc and gutta percha combined.

When the composition is made of cork and caoutchouc, the cork is rasped or ground to powder, and added, in suitable proportions, to the caoutchouc, which has been brought to a fluid state; the mixture is then transferred to moulds, of the size of the required articles, and left to solidify: if wood saw-dust is substituted for the cork, the same process is followed.

The gutta percha may be used (either alone, or combined with caoutchouc) in its native liquid state, or a solution of it may be obtained by the ordinary mode of dissolving caoutchouc; or instead of mixing the ground cork or saw-dust with the caoutchouc or gutta percha in a fluid state, the mixture may be effected by mastication, in the machines employed for that purpose by manufacturers of caoutchouc; the combined matters are then placed in large moulds (for the purpose of forming blocks, which are afterwards to be cut into stopperrs or other articles), or in moulds of a proper size and shape for producing the required articles, and left to solidify. When glue and treacle are used, they are melted in a common glue-pot, and the ground cork or saw-dust being then added, the mixture is placed in moulds, as before.

Gutta percha may be made into sheets or blocks by the ordinary mode of treating caoutchouc; and sheets or blocks may also be made, in the same manner, partly of gutta percha, and partly of caoutchouc. The sheets or blocks, thus produced, are placed in a sheet-cutting machine, of the kind generally employed for caoutchouc, and cut into strips, which are again divided into pieces of suitable dimensions for the articles intended to be made.

In making articles partly of cork, and partly of the composition (or of caoutchouc, or gutta percha, or caoutchouc and gutta percha combined), the latter may be attached to the former either at top or bottom, or both; the cement preferred to be used for connecting the pieces together, is a solution of caoutchouc, or gutta percha, or the two combined.

To make stoppers wholly or chiefly of pieces of cork, the pieces are laid one above the other, and cemented together with a solution of caoutchouc, or gutta percha, or other suitable cement.

The patentee claims, Firstly,—the new compound or substance above described; and the employment of the same in any of the states, and according to any of the methods, aforesaid, in the manufacture of cork and other stoppers, and useful articles; confining his claim, as regards caoutchouc, to the use of the same in combination with gutta percha, or when alone combined with ground cork or wood saw-dust, for the purpose of being manufactured into cork and other stoppers. Secondly,—the employment of gutta percha, in any of the states, and according to any of the methods aforesaid, in the manufacture of cork and other stoppers, and useful articles. Thirdly,—the manufacture of cork and other stoppers, and useful articles, of common cork, cased or coated with the said new composition, or with a mixture of ground cork and any suitable oil or varnish, or with caoutchouc alone, or gutta percha alone, or with a mixture of caoutchouc and gutta percha; excepting always, stoppers made of fibrous materials, in so far as regards the application thereto of caoutchouc alone.

## VARIETIES.

*Explosive Harpoon.*—A patent has been taken out at New Bedford, United States, for a harpoon of a new kind. It contains a quantity of fulminating powder in the iron, which explodes from pressure when the harpoon strikes the whale, and is expected to kill the animal by the shock.

*How to make Sugar out of Sawdust.*—Mix the sawdust of hardwood with strong sulphuric acid; and when the mixture has become clear, saturate the acid with chalk, strain off the liquid, and evaporate it to dryness. A substance will thus be obtained very like gum arabic; and if this gummy substance be treated again with sulphuric acid, it will be converted into sugar susceptible of granulation. Sugar may be obtained from rags and from starch by the same process, but for economical uses sawdust is the preferable material.

# INDEX.

END OF THE SIXTH VOLUME.

C. TURNER, PRINTER, CHURCH STREET, HACKNEY.