THE
YEAR-BOOK OF FACTS
IN
Science and Art:

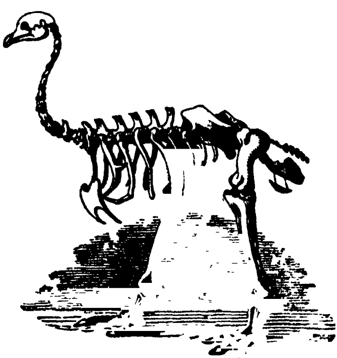
EXHIBITING

THE MOST IMPORTANT DISCOVERIES & IMPROVEMENTS OF THE PAST YEAR;

IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND MINERALOGY; METEOROLOGY AND ASTRONOMY.

By JOHN TIMBS, F.S.A.

AUTHOR OF
"THINGS NOT GENERALLY KNOWN FAMILIARLY EXPLAINED,"
"CURIOSITIES OF HISTORY," ETC.



Skeleton of the Elephant-footed Dinornis (*Dinornis elephantopus*) in the British Museum.—(See page 268.)

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PROFESSOR GRAHAM, M.A., F.R.S., THE NEW MASTER OF HER MAJESTY'S MINT.

(*With a Portrait.*)

THE appointment of Professor Graham as the successor of Sir John Herschel in the Mastership of the Royal Mint has afforded universal satisfaction, and is an additional evidence of the recognition of the claims and qualifications of men of science to fill high offices of trust and responsibility in the public service. The appointment of Sir John Herschel to the post once filled by the illustrious Newton* was a topic of congratulation in scientific circles; and the nomination of Herschel's successor denotes that the Government intend to adhere to the only just and fair system, in this department, at least,—namely, the rule of selecting such men as are by their antecedents pre-eminently qualified for the situations they are chosen to fill.†

Professor Thomas Graham was born in 1805 at Glasgow, where his father was a merchant and manufacturer. He received his early education at the City Grammar School, and was entered as a student at the Glasgow University in 1819, and in 1824 took the degree of M.A. At that time, Dr. Thomas Thomson was Professor of Chemistry in the University, and by opening his laboratory to the students greatly aided the study of chemistry at that seat of learning. Mr. Graham remained two years more at the University, chiefly devoting himself to the study of mathematics and physical science: he then removed to Edinburgh, where he was the especial friend of the eminent heat philosopher, Sir John Leslie. Mr. Graham returned to Glasgow in 1828, and there established a public laboratory for the study and practice of chemistry; and succeeded Dr. Clark as Lecturer to the Mechanics' Institute. In 1830, he was appointed Andersonian Professor of Chemistry in the University, which professorship he filled until his removal to London, on his appointment to the Chair of Chemistry in University College, vacant by the death of Dr. Edward Turner. For ten years Mr. Graham was Chemical Examiner in Arts in the University of London. He remained at University College until his appointment to his present office at the Mint, upon the retirement of Sir John F. W. Herschel, Bart., in April, 1855.

Professor Graham, during the past twenty years has received several honorary distinctions from scientific bodies for his researches in Chemical Philosophy, more especially into the nature of salts and gases. In 1834, he received from the Royal Society of Edinburgh their Keith Prize for his discovery of the law of the diffusion of gases. In 1840, he received from the Royal Society of London their Gold Medal for his discovery of the polybasic character of phosphoric acid; and his researches into the nature of double-salts, sub-salts, and into the mode of combination of water with salts. In 1849, Professor Graham was adjudged the Royal Society's Gold Medal for his Bakerian lecture "On the Diffusion of Gases," in which it was observed, that it is the diffusion of the molecules of the salts which are concerned in solubility, and not the Daltonian atoms, or equivalents, of chemical combination; and the application was indicated of the knowledge of the diffusibilities of different substances to a proper study of endosmose. And, in

* "In the new and responsible situation to which Newton was elevated, his chemical knowledge was of great use to the country; and in effecting the re-coinage which was completed towards the close of 1699, his services were so highly appreciated, that the Chancellor of the Exchequer declared that he could not have carried it on without his assistance."—*Sir David Brewster's Life of Sir Isaac Newton*, vol. ii. p. 192.

† Professor Graham had previously filled the office of Assayer, whose duty it is to submit all bullion presented for coinage at the Mint to an uniform scientific control. To his elevation to the Mastership, Dr. Daubeny, President of the British Association at their last year's meeting at Cheltenham, referred as a proof of a greater appreciation of the claims of science, in the Government "having departed from the practice which had prevailed ever since the death of Sir Isaac Newton, of regarding the Mastership of Her Majesty's Mint as a purely political appointment, and in conferring it, as they have done, on the two last occasions, as a reward for scientific eminence."

1854, Professor Graham received from the same learned body a like honour for his Bakerian lecture on "Osmotic Force,"—the name applied to the power by which liquids are impelled through moist membranes, and other porous septa, in experiments of endosmose and exosmose. This valuable paper was reported at length in the *Year-Book of Facts*, 1855, p. 199. One of its results is the hope to find in the osmotic injection fluid the deficient link which certainly intervenes between muscular movement and chemical decomposition.

Two important associations for the promotion of chemistry owe much to the exertions of Professor Graham, who took a leading part in their establishment: these are—the Chemical Society, instituted in 1841, of which Professor Graham was the first president—and with the proceedings of which the readers of the *Year-Book of Facts* are acquainted, through the abstracts which have appeared year by year in its pages. The second institution referred to is the Cavendish Society, established in 1846, for the promotion of chemical science by the translation and publication of valuable works and papers on chemistry, not likely to be undertaken by ordinary publishers. Of this important "printing club," Professor Graham has been president since its formation; and in 1848, he edited for the Society a volume of Chemical Reports and Memoirs.

Mr. Graham's high scientific attainments have contributed to the efficiency of various branches of the public service of late years. Thus, he acted as vice-president and reporter to the Jury on Chemical and Pharmaceutical Products at the Great Exhibition of 1851. In 1846, he was a member of the Commission appointed to report to the House of Commons on the Ventilation of the New Houses of Parliament; in 1847, he was commissioned by the Board of Ordnance, in conjunction with other *savans*, to inquire into the various methods of casting guns. In 1851, he was appointed by the Government, with Professors Miller and Hofmann, to report on the chemical nature of the water supplied by the various companies to the metropolis. The services of Professor Graham to the Government in various Reports to the Board of Inland Revenue have been of great value in a fiscal point of view, as well as indirectly in connexion with various sanitary reforms, and the increased attention devoted to the health of the people.

Mr. Graham has been for twenty years a Fellow of the Royal Society; for six years a member of the Council, and has twice held the office of Vice-President. He is also a corresponding member of the Institute of France; and is connected with the Academies of Sciences of Berlin, Munich, Turin, Washington, &c.

Professor Graham is most extensively known by his excellent *Elements of Chemistry*, of which two editions have appeared. It has been translated and greatly enlarged by Dr. Otto, of Brunswick.

We are indebted for the Portrait prefixed to the present volume to "the Photographic Portraits of Living Celebrities," executed by Maull and Polyblank; and for some of the facts in the above Memoir, our acknowledgment is due to the very neatly written Biographical Notice, by E. Walford, M.A., accompanying the admirable Photograph.

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THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

MANUFACTURE OF IRON AND STEEL WITHOUT FUEL.

THIS important discovery was communicated by its originator, Mr. Henry Bessemer, to the British Association, at their meeting at Cheltenham in August last, in the following paper:—

Mr. Bessemer commenced by asserting that crude iron contains about 10 per cent. of carbon; that carbon cannot exist at white heat in the presence of oxygen, without uniting therewith and producing combustion; that such combustion would proceed with a rapidity dependent on the amount of surface of carbon exposed; lastly, that the temperature which the metal would acquire, would be also dependent on the rapidity with which the oxygen and carbon were made to combine; consequently, that it was only necessary to bring the oxygen and carbon together in such a manner that a vast surface should be exposed to their mutual action in order to produce a temperature hitherto unattainable in our largest furnaces. With a view of testing practically this theory, he had constructed a cylindrical vessel of three feet in height, somewhat like an ordinary cupola furnace, the interior of which was lined with fire-bricks; and at about two inches from the bottom of it inserted five tuyere pipes, the nozzles of which were framed of well-burnt fire-clay, the orifice of each tuyere pipe being about three-eighths of an inch in diameter. These were so put into the brick lining (from the outer side) as to admit of their removal and renewal in a few minutes when they were worn out. At one side of the vessel, about half-way up from the bottom, there was a hole made for running in the crude metal; and on the opposite side there was a tap-hole stopped with loam, by means of which the iron was run out at the end of the process. The vessel should be placed so near to the discharge-hole of the blast-furnace as to allow the iron to flow along a gutter into it. A small blast cylinder would be required, capable of compressing air to about 8lb. or 10lb. to the square inch. A communication having been made between it and the tuyeres before named, the converting vessel would be in a condition to commence work. It would, however, on the occasion of its being first used after re-lining with fire-bricks, be necessary to make a fire in the interior with a few baskets of coke, so as to dry the brickwork and heat up the vessel for the first operation, after which the fire would have to be all carefully raked out at the tapping-hole, which would again be made good with loam.

The vessel would then be in readiness to commence work, and might be so continued without any use of fuel, until the brick lining in the course of time became worn away and a new lining was required. The tuyeres are situated nearly close to the bottom of the vessel; the fluid metal will therefore rise some eighteen inches or two feet above them. It is necessary, in order to prevent the metal from entering the tuyere holes, to turn on the blast before allowing the fluid crude iron to run into the vessel from the blast furnace. This having been done, and the fluid iron run in, a rapid boiling up of the metal will be heard going on within the vessel, the metal being tossed violently about, and dashed from side to side, shaking the vessel by the force with which it moves from the throat of the converting vessel. Flame will then immediately issue, accompanied by a few bright sparks. This state of things will continue for about 15 or 20 minutes, during which time the oxygen in the atmospheric air combines with the carbon contained in the iron, producing carbonic acid gas, and at the same time evolving a powerful heat. Now, as this heat is generated in the interior of, and is diffused in innumerable fiery bubbles through, the whole fluid mass, the metal absorbs the greater part of it, and its temperature becomes immensely increased; and by the expiration of the 15 or 20 minutes before named, that part of the carbon which appears mechanically mixed and diffused through the crude iron has been entirely consumed. The temperature, however, is so high that the chemically-combined carbon now begins to separate from the metal, as is at once indicated by an immense increase in the volume of flame rushing out of the throat of the vessel. The metal in the vessel now rises several inches above its natural level, and a light frothy slag makes its appearance, and is thrown out in large foam-like masses. This violent eruption of cinder generally lasts five or six minutes, when all further appearance of it ceases—a steady and powerful flame replacing the shower of sparks and cinder which always accompanies the boil.

The rapid union of carbon and oxygen which thus takes place adds still further to the temperature of the metal, while the diminished quantity of carbon present allows a part of the oxygen to combine with the iron, which undergoes combustion, and is converted into an oxide. At the excessive temperature that the metal has now acquired, the oxide, as soon as formed, undergoes fusion, and forms a powerful solvent of those earthy bases that are associated with the iron. The violent ebullition which is going on mixes most intimately with scoriæ and metal, every part of which is thus brought into contact with the fluid, which will thus wash and cleanse the metal most thoroughly from the silica, and other earthy bases which are combined with the crude iron, while the sulphur and other volatile matters which cling so tenaciously to iron at ordinary temperatures are drawn off, the sulphur combining with the oxygen, and forming sulphurous acid gas. The loss in weight of crude iron during its conversion into an ingot of malleable iron, was found, on a mean of four experiments, to be 12½ per cent., to which will have to be added the loss of metal in the finishing rolls. This will make the entire loss probably not less than 18 per cent., instead of about 28 per cent., which is the loss on the present system. A large portion of this metal is, however, recoverable, by treating with carbonaceous gases the rich oxides thrown out of the furnace during the boil. These slags are found to contain innumerable small grains of metallic iron, which are mechanically held in suspension in the slags, and may be easily recovered by opening the tap-hole of the converting vessel, and allowing the fluid malleable iron to flow into the iron ingot moulds placed there to receive it.

The masses of iron thus formed will be perfectly free from any admixture of cinder, oxide, or other extraneous matters, and will be far more pure and in a sounder state of manufacture than a pile formed of ordinary puddle bars. And thus it will be seen that by a single process, requiring no manipulation or particular skill, and with only one workman, from three to five tons of crude iron passes into the condition of several piles of malleable iron in from thirty to thirty-five minutes, with the expenditure of about one-third part the blast now used in a fiery furnace with an equal charge of iron, and with the consumption of no other fuel than is contained in the crude iron.

To persons conversant with the manufacture of iron (said Mr. Bessemer), it will be at once apparent that the ingots of malleable metal which I have described will have no hard or steely parts, such as are found in puddled iron, requiring a great amount of rolling to blend them with the general mass; nor will such ingots require an excess of rolling to expel cinder from the interior of the mass, since none can exist in the ingot, which is pure and perfectly homogeneous throughout, and hence requires only as much rolling as is necessary for the development of fibre; it therefore follows that, instead of forming a merchant bar or rail by the union of a number of separate pieces welded together, it will be far more simple, and less expensive, to make several bars or rails from a single ingot. Doubtless this would have been done long ago had not the whole process been limited by the size of the ball which the puddler could make.

I wish to call the attention of the meeting to some of the peculiarities which distinguish cast steel from all other forms of iron—namely, the perfect homogeneous character of the metal, the entire absence of sand-cracks or flaws, and its greater cohesive force and elasticity, as compared with the blister steel from which it is made—qualities which it derives solely from its fusion and formation into ingots, all of which properties malleable iron acquires in a like manner by its fusion and formation into ingots in the new process; nor must it be forgotten that no amount of rolling will give to blister steel (although formed of rolled bars) the same homogeneous character that cast steel acquires by a mere extension of the ingot to some ten or twelve times its original length. One of the most important facts connected with the new system of manufacturing malleable iron is, that all the iron so produced will be of that quality known as charcoal iron; not that any charcoal is used in its manufacture, but because the whole of the processes following the smelting of it are conducted entirely without contact with, or the use of any mineral fuel; the iron resulting therefrom will in consequence be perfectly free from those injurious properties which that description of fuel never fails to impart to iron that is brought under its influence. At the same time this system of manufacturing malleable irons offers extraordinary facility for making large shafts, cranks, and other heavy masses. It will be obvious that any weight of metal that can be founded in ordinary cast iron by the means at present at our disposal may also be founded in molten malleable iron, to be wrought into the forms and shapes required, provided that we increase the size and power of our machinery to the extent necessary to deal with such large masses of metal.

A few minutes' reflection will show the great anomaly presented by the scale on which the consecutive processes of iron making are at present carried on. The little furnaces originally used for smelting ore have been from time to time increased in size until they have assumed colossal proportions, and are made to operate on two or three hundred tons of materials at a time, giving out ten tons of fluid metal at a single run. The manufacturer has thus gone on increasing the size of his smelting furnaces, and adapting to their use the blast apparatus of the requisite proportions, and has by this means lessened the cost of production in every way. His large furnaces require a great deal less labour to produce a given weight of iron than would have been required to produce it with a dozen furnaces; and in like manner he diminishes his cost of fuel blast and repairs, while he insures a uniformity in the result that never could have been arrived at by the use of a multiplicity of small furnaces. While the manufacturer has shown himself fully alive to these advantages, he has still been under the necessity of leaving the succeeding operations to be carried out on a scale wholly at variance with the principles he has found so advantageous in the smelting department. It is true that hitherto no better method was known than the puddling process, in which from 400 lb. to 500 lb. weight of iron is all that can be operated upon at a time; and even this small quantity is divided into homœopathic doses of some 70 lb. or 80 lb., each of which is moulded and fashioned by human labour, and carefully watched and tended in the furnace, and removed therefrom one at a time, to be carefully manipulated and squeezed into form. When we consider the vast extent of the manufacture, and the gigantic scale on which the early stages of the process is conducted, it is astonishing that no effort should have been made to raise the after-processes somewhat nearer to a level commensurate with the preceding ones, and thus rescue the trade from the trammels which have so long surrounded it.

Before concluding these remarks, I beg to call your attention to an important fact connected with the new process, which affords peculiar facilities for the manufacture of cast steel. At that stage of the process immediately following the boil, the whole of the crude iron has passed into the condition of cast steel of ordinary quality.

By the continuation of the process the steel so produced gradually loses its small remaining portion of carbon, and passes successively from hard to soft steel, and from soft steel to steely iron, and eventually to very soft iron; hence, at a certain period of the process any quality of metal may be obtained. There is one in particular, which, by way of distinction, I call semi-steel, being in hardness about midway between ordinary cast steel and soft malleable iron. This metal possesses the advantage of much greater tensile strength than soft iron. It is also more elastic, and does not readily take a permanent set, while it is much harder and is not worn or indented so easily as soft iron. At the same time it is not so brittle or hard to work as ordinary cast steel. These qualities render it eminently well adapted to purposes where lightness and strength are specially required, or where there is much wear, as in the case of railway cars, which from their softness of texture soon become destroyed. The cost of semi-steel will be a fraction less than iron, because the loss of metal that takes place by oxidation in the converting vessel is about two and a-half per cent. less than it is with iron; but as it is a little more difficult to roll, its cost per ton may be fairly considered to be the same as iron. But as its tensible strength is some thirty or forty per cent. greater than bar iron, it follows that for most purposes a much less weight of metal may be used; so that taken in that way the semi-steel will form a much cheaper metal than any that we are at presented acquainted with.

The facts which I have brought before the meeting are not mere laboratory experiments, but the result of working on a scale nearly twice as great as is pursued in our largest ironworks—the experimental apparatus doing 7cwt. in thirty minutes, while the ordinary puddling furnace makes only 4½cwt. in two hours, which is made into six separate balls, while the ingots or blooms are smooth, even prisms, ten inches square by thirty inches in length, weighing about equal to ten ordinary puddle balls.

Mr. Bessemer's invention has been patented by him; and he is stated to have patented several methods ere he discovered the true process. There are four patents immediately bearing on the question of Mr. Bessemer's originality, but which we have not space to examine.

Among those who questioned the soundness of Mr. Bessemer's views was a writer in the *Birmingham Journal*, who thus expressed his misgivings:—

"Especially important is it that accurate chemical analysis should be resorted to, to show the composition of this iron, and to prove that the new process will truly purge it of sulphur and phosphorus, as we understand Mr. Bessemer to say it will, elements the presence of one per cent. of which is fatal to the quality of the iron."

With the view of settling this question, the above writer has experimented upon a specimen of Mr. Bessemer's iron, upon which he reports:—

The iron consists of an agglutinated mass of large brilliant crystalline grains, possessed of a very imperfect malleability, flattening under the blow of a hammer, but almost invariably cracking at the edges. It is wholly destitute of a fibrous structure, and only after having been repeatedly heated and drawn out in a smith's forge, exhibits the properties of an inferior wrought iron. On analysis it was found to have the following composition:—

Iron	96·9	Carbon	0·05
Phosphorus	1·08	Silicon	trace
Sulphur	0·16		
Total			100·19

This composition is so accordant with the physical properties of the iron that, the composition being given, the chemist would have had no difficulty in predicating its more marked characteristics. Its crystalline structure and fusibility are very satisfactorily accounted for. In order more exactly to illustrate the nature of the change effected by Mr. Bessemer's treatment, we append an analysis of refined iron produced at a large establishment in the neighbourhood of Birmingham. It was made by the courtesy of Dr. Percy, in his laboratory by one of his assistants, Mr. Dick; the iron may be regarded as representing the average composition of refined iron as made at the present moment in the neighbourhood of Birmingham:—

Iron	95·14
Carbon (combined)	3·07
Phosphorus	0·734
Silicon	0·63
Sulphur	0·157
Manganese	trace
Residue, insoluble in hydrochloric acid	0·53
Total	100·261

The residue insoluble in hydrochloric acid, yielded—

Silica	0·3
Alumina, with a little peroxide of iron	0·14
Total	0·44

In contrasting the change effected by Mr. Bessemer's treatment with that of the refinery, the following particulars force themselves strongly upon our notice. Mr. Bessemer's method removes most effectually the carbon and the silicon, while in the refinery these are but little diminished. The carbon is eliminated with a perfection which we should scarcely have thought possible, but we are without information as to the sacrifice at which this has been effected; the amount of iron oxydized by the vivid combustion which Mr. Bessemer induces we are unable to ascertain The point which most prominently strikes the chemist in Mr. Bessemer's iron is, the large amount of phosphorus which it contains—an amount utterly fatal, we fear, to the value of Mr. Bessemer's method. His treatment, we suspect, does not sensibly diminish the amount of this element; but this, too, is a point on which we must be dependent on Mr. Bessemer. We have had no opportunity of examining the slag produced in the treatment, but we learn from an eminent chemist that at least one sample of it contains no sensible amount of phosphoric acid. We have previously explained that it is by the puddling process that the phosphorus and sulphur are mainly removed, the chemical examination of the tap-cinder of the puddling furnace disclosing an abundance of phosphoric acid. As yet, so far as we can learn, Mr. Bessemer has done nothing toward the removal of this pernicious element, phosphorus, and in this important respect his process must be regarded as a failure.

INSTITUTION OF CIVIL ENGINEERS.

At the annual general meeting of the Institution, held Dec. 16th, G. P. Bidder, Esq., Vice-President, in the chair, the Report of the Council for the past Session, which was read, stated, that since the corresponding period of the last year, though political tranquillity had been restored, the monetary crisis consequent upon the large public expenditure occasioned by a state of warfare had retarded the resumption of works of public and private enterprise.

Some few of the foreign works in progress were then noticed;

mentioning particularly the successful opening and the extension of the East Indian Railway, under Mr. Rendel, the late distinguished Past-President of the Institution. In connexion with this subject, it was stated that the honour of knighthood had been conferred upon Mr. Macdonald Stephenson, Assoc. Inst. C.E., who originally proposed and had carried out the first portions of the vast network of railways which was destined to work such a revolution in the Indian Empire. A similar distinction was, at the same time, conferred upon Dr. O'Shaughnessy, the energetic projector and constructor of a system of Electric Telegraphs extending over nearly 4000 miles, through dense jungle, or over the vast plains, rivers, and mountains of India. The Indian Peninsular Railway, constructing by Mr. James Berkley, M. Inst. C.E., under the direction of Mr. R. Stephenson, M.P., President, had now about 100 miles opened, and the great work of extension up to Sholapoor, and through the Bhore Ghaut was now fast progressing; whilst the execution of the North Eastern extension, across the Thull Ghaut towards Nagpore and Jubbulpore, and the Berar cotton-fields, would soon be commenced. The Madras, the Bombay and Baroda, and the Scinde Railways were being vigorously prosecuted, and several other lines were projected, among which was that from Seleucia, on the Mediterranean, to Jabr Castle, on the Euphrates, which river it was proposed to navigate by means of steam-vessels, of shallow draught of water. This recent project had been intrusted to Sir John Macneil, M. Inst. C.E. Since the kingdom of Oude had become a part of the British possessions, arrangements had been made for affording it the benefit of participation in the railway system, which would be commenced by the construction of a line of 50 miles in length, between Cawnpore and Lucknow, whence branches would extend to the most important districts, and be connected with the East Indian Railway. Other lines were also proposed for Gorruckpore, Tirhoot, and Purneah, all contributing to the completion of the internal communications of India.

The Pernambuco railway, in the prosecution of which the late Mr. M. A. Borthwick, M. Inst. C. E., lost his life, had been placed in the charge of Mr. W. M. Peniston, M. Inst. C.E., and was making satisfactory progress.

The Dom Pedro the Second railway, starting from Rio di Janeiro, and passing up the "Serra," into the valley of the Parahiba, and through the principal coffee-producing districts, would be about 200 miles in length. The first section of 40 miles was commenced in 1855, and would be completed by about the middle of next year. The survey was made amidst a dense primeval forest, and in many places through water 5 or 6 feet deep, and great difficulty was encountered in executing the earthworks with slave labour and inadequate tools. By degrees, however, European methods were introduced by Mr. E. Price, Assoc. Inst. C.E., the contractor; and under the superintendence of Mr. C. B. Lane, M. Inst. C.E., the Engineer-in-chief to the Home Department of the Brazilian Government, the railway promised to become a fine enterprise. Mr. Charles

Neate, Assoc. Inst. C.E., was also engaged under the Brazilian Government, in constructing important hydraulic works at Rio de Janeiro. They consisted of quay-walls along the sea-front of the city, with piers and jetties, formed of granite masonry, set in lias mortar, for which the limestone was sent from England.

In Canada, the railway undertaken by Messrs. Peto, Brassey, Betts, and Jackson, might be said to be complete, with the exception of the link to be formed by the Victoria Tubular Bridge across the River St. Lawrence, which was now in progress.*

On the Continent, gradual extensions of all the main lines were being made. The Lombardo-Venetian system had been transferred to a powerful Company, now preparing to act with great energy in the prosecution of their plans. The "Victor-Emmanuel" line, under the direction of Mr. Bartlett, M. Inst. C.E., acting for Mr. Brassey, Assoc. Inst. C.E., the contractor, was approaching the chain of the Alps, for the traversing of which preparations were being made, and experiments upon the machinery for the work of tunnelling on a large scale were being tried. That portion of the line from Aix-les-Bains, passing through Chambery to St. Jean de Maurienne, upwards of 55 miles in length, was opened for public traffic last October. The works were originally laid out by, and to a great extent executed under the direction of Mr. Nieumann, who was succeeded, last year, by Mr. Ricceo, under whose supervision they are now carried on.

In Turkey, and in Russia, extensive projects both for railways and steam navigation were being agitated; whilst in Egypt, H. H., the energetic Said Pacha, was completing the railway communication between Cairo and Suez, spanning the Nile by a vast iron bridge at Kaffre Azzayat, and had confided to Mougel Bey the construction of the preliminary works for the canal across the Isthmus of Suez, advocated by M. Ferdinand de Lesseps; whilst he had authorized the establishment, upon the Nile and the Mahmoudieh Canal, of a complete system of steam towing vessels and barges, now in course of construction in this country.

One of the most important, as well as most interesting, projects of the period was the Submarine Electric Telegraph Cable proposed to be laid from Valentia, on the west coast of Ireland, to St. John's, Newfoundland, a distance of sixteen hundred miles, along the bank,

* The Victoria Bridge, by which the road is to cross the St. Lawrence at Montreal, will more than rival the Britannia Bridge at home; for, constructed on the same principle, it will be within fifty yards of two English miles in length. A large fraction of the whole cost of the line will be expended on this work, for which the estimate is 1,250,000*l*. It was commenced in 1844, and by the contract, ought to be completed in 1860. The abutment of the bridge on the Montreal bank is nearly finished. It is an immense structure, of almost Egyptian massiveness and solidity; the side that faces up the St. Lawrence slopes gradually like a breakwater, to receive and resist the drifts of ice that float down the river every spring, sometimes mounting above the quays, and crushing the houses upon them. The iron superstructure will be carried across the river from the two abutments on twenty-four piers, of which nine are finished, standing like islands in the stream; no part of the roadway has yet been constructed. The centre span of the iron tube will be 350 feet; the spaces between the other piers, twelve on each side of the centre, will be 242 feet each.

or plateau, discovered by Lieutenant Maury, over which the greatest depth of the ocean did not exceed 2070 fathoms. By a new method of enclosing the insulated conducting wires within a covering of ropes, composed of small wires laid in an opposite direction to that of the general "lay" of the cable, a light and flexible cable was formed, which was stated to be capable of bearing the strain of depositing in extreme depths, and having no tendency to twist or "kink" during the process. This ingenious modification of the usual construction of cable, was devised by Mr. Brunel, V. P., whose co-operation was sought by Mr. Cyrus Field and Mr. J. W. Brett, the projectors, under the advice of Professor Morse. The successful result of this daring project for connecting the Old with the New World would be more effectual than any efforts of diplomacy, in cementing that intimate union, so desirable for the true interests of the two countries.

The vital questions of the Metropolitan Sewerage, the New Streets, and the Bridges, remained as undecided as at the period of the last Report.

The principal papers read during the session were then noticed, mention being particularly made of the oral addresses by Mr. Bidder, V. P. Inst. C. E., "on Mental Calculation," the object of which was to demonstrate that the system could be taught to children, and be acquired with less irksomeness and greater facility than ordinary arithmetic. Special notice was also taken of the paper by Mr. John Murray, M. Inst. C. E., "on the Sunderland Docks," which, as an example of dock engineering, stood almost unrivalled in this country.

It was mentioned, that at the last Annual Meeting, Mr. Charles Manby (M. Inst. C. E.), who had held the post of Secretary for upwards of seventeen years, tendered his resignation; he had continued, however, to hold the position until the present time, but in the month of June, 1856, Mr. James Forrest (Assoc. Inst. C. E.), who was well known to the majority of the members, from his almost constant connexion with the Institution during the last fourteen years, having, in fact, been partly brought up within its walls, entered on the post of Assistant Secretary, with the salary formerly devoted to Mr. Manby, who had expressed his willingness to continue to act as Secretary, gratuitously, as long as his services were considered useful to the Institution.

After the reading of the Report, Telford Medals were presented to Messrs. J. Murray, J. M. Heppel, H. Robinson, C. R. Drysdale, and F. M. Kelley; and Council Premiums of Books to Messrs. J. Murray, G. Herbert, Evan Hopkins, J. W. Heinke, J. Baillie, and W. K. Hall.

The thanks of the Institution were unanimously voted to the President, for his attention to the duties of his office; to the Vice-Presidents and other Members and Associates of Council, for their co-operation with the President, and constant attendance at the meetings; as also to the Auditors of the Accounts and the Scrutineers of the Ballot, for their services. Special votes of thanks were accorded to Mr. Bidder, for his addresses on "Mental Calculation," and to Mr. C. Manby, Secretary, for the manner in which he had performed the duties of his office, and his constant attention to the individual wishes of the members.

THE UNITED STATES WAR-FRIGATE "MERRIMAC."

The principal dimensions of this noble ship-of-war are:—

	Feet	In.
Length on keel	250	0
Length on load water line	280	0
Length over all	300	0
Breadth extreme	51	4
Breadth moulded	50	2
Depth of hold (to gun deck)	26	4
Draught of water, forward	23	6
Draught of water aft	24	0

When the vessel is at her load line, the heights of the gun deck ports above the water are amidships 9 feet, and forward and aft 12 feet, or thereabouts. The height from her gun deck to the lower sides of her spar deck beams is 6 feet. The height of her bulwarks is such that, when the hammocks are stowed they reach 8 feet 8 inches above the upper deck. Her gun deck ports are 3 feet 8 inches long, and nearly 8 feet 6 inches apart. Her load displacement is estimated at 4000 tons.

The *Merrimac* was designed by Mr. Lenthall, who is at the head of the Bureau at Washington, and was built by Mr. Delano, the master shipwright of the Navy Yard at Boston. Her frame is of live oak, crossed on the inside with two sets of diagonal iron plates which are inclined in opposite directions. She is also strengthened by similar plates on the outside at bow and stern. Her plank is also of oak, and, like our own ships of war, she is copper-fastened up to a few feet above the load water line. Her decks are of fir. On a careful inspection, she seems to have been built with very great skill and care, and is a very tight strong ship. The large wooden knees (common in American ships because more approved of, and more readily obtained than iron) to some extent interfere with the beauty of her appearance inboard. But she is a very roomy and handsome ship, and the appearance of her main deck is unsurpassed.

With all her sails set, she spreads 56,629 square feet of canvas. Her engines are auxiliary only. Her rig is in all respects like that of the largest American sailing frigates, but from her great length she seems capable of carrying masts, spars, and sails even larger than those she has. The mode in which the mainmast steps is worthy of attention. The shaft of the propeller coming immediately beneath it (since the engines are before the mainmast), a step is formed to receive it above the shaft. This step consists of a large thwartship beam of live oak, supported near the middle by two 12-inch solid iron columns which rest upon suitable keelsons. This arrangement is perhaps as good as any other, although the strength attending it must certainly be much less than that in which the mast steps in a wooden step supported immediately by the keelsons themselves, as is the case where no screw shaft interferes. The modes adopted in our own navy are various. In some cases tall iron forked steps, which stride across the shaft are employed, and in others the heel of the mast itself is enlarged, and the shaft allowed to pass through it, the lower piece of the mast being separable from the upper, and connected with it by clasped jointed hoops.

The *Merrimac* is pierced for 60 guns, but if she were actually to carry that number they would have to be of a lighter character than those now on board of her. Her present armament is as follows:—On her upper deck there are two large pivot guns, each weighing nearly 5½ tons, and of 10 inches bore, and fourteen 8-inch guns, each weighing rather more than 3 tons; on her gun deck there are twenty-four 9-inch guns, each weighing nearly 4½ tons. The whole of these guns, forty in all, though strong enough to discharge solid shot, if desired, are primarily intended to be served with hollow shot, or with shell,—for it is now a practice with the Americans to supply their navy with a quantity of empty hollow shot, which may be either plugged and used as such, or charged, fitted with fuzes, and used as shells. We must not, however, omit to mention that she might carry a few additional 9-inch guns on the main deck with perfect convenience. Her gun carriages on the main deck are similar to those used in the French navy. They have, however, but two wheels or trucks each, at the ship's side end of the carriage.

The whole of the 9in. guns, or main-deck guns, as well as the two 10-in. pivot guns, are formed upon Commander Dahlgren's system, which consists in giving to the gun, at each point of its length, a thickness proportioned to the direct pressure of the powder in the chase at that point, supposing the gun to be fired with an ordinary service charge. They are of greatly reduced thickness along the chase, and suddenly increase their thickness near the breech, where the great bulk of the metal of the gun is collected. Each gun is furnished with two lock-lugs, or lugs for the gun-lock—one for use, and one to supply its place if it should be knocked away.

There are a few other novel features in connexion with the guns of the *Merrimac*. One is that her guns are fitted with elevating screws, which supply the place of the *coin*, &c., in our own service. This arrangement tends greatly to facilitate the sighting, and is certainly an improvement, provided that it is not attended with any defect in strength, and we were assured that none had been observed during considerable practice. Another new feature is the employment of bristles, instead of sheepskin, in all the sponges and rammers for the guns; and a further one is the employment, for boat guns, of light and elegant wrought-iron carriages, of which she has three—one for a 9-pounder, a second for a 12-pounder, and a third for a 24-pounder.

The engines of the *Merrimac* are by Mr. Parrott, of the Cold Springs Foundry, New York. She has two cylinders 72 inches in diameter, and 3 feet stroke. These are placed close to the shaft, on opposite sides of it, leaving room only for the crank. Each piston has two piston-rods, one above and one below the shaft; these carry a cross-head from which the connecting-rod reaches back to the crank, as is well understood by engineers. Each cylinder has its condenser at the side of it, and its air-pump opposite to it. The air-pump rods go through the cylinder ends direct to the piston. She is fitted with four of the vertical tubular boilers patented by Mr. D. B. Martin, Engineer-in-chief of the U.S. Navy, similar to those fitted previously in the *Susquehanna*, by Merrick and Son, of Philadelphia. The boilers are of iron, with brass tubes, and have the following general dimensions:

Length of each boiler, athwartships, 11 ft.; breadth, fore and aft, 14·8 ft.; length of vessel occupied by four boilers, 31 ft. 8 in.; breadth of ditto, and fire-room, 31 ft. The fire-room is between the two pair of boilers, the furnaces firing athwartships, and the flues delivering into one chimney. Height of boilers, 13 ft. 6 in.; cubical space occupied by all the boilers and fire-room, being the content of a parallelopipedon included within the above circumscribing lines, 13,240 cubic feet; number of furnaces in all boilers, sixteen; breadth of ditto each, 2 feet 10½ inches; length of ditto each, 7 feet; grate surface area in all, 338 square feet; number of tubes in all boilers, 5480; length (or height) 37¼ inches; diameter (outside) of the tubes, 2 inches; heating surface in furnaces and back connexions up to tubes, 1614 square feet; heating surface in tubes, 8508 square feet; heating surface in tube-boxes and connexions to smoke chimney, 1581 square feet; total heating surface in all boilers, 11,703 square feet; proportion of the same to grate area, 34·6 to 1·00; flue area or calorimeter between tubes in all boilers, 42 square feet; proportion of the same to grate area, 1 to 8 square feet; diameter of smoke chimney, 8 feet.

The propelling arrangements (Griffith's screw) on board the *Merrimac* are very complete. The forward thrust is taken by a series of collars, and the backward thrust by a brass disk dropped down between the end of the propeller bearing and the after sternpost. This disk may be readily renewed when worn. The shaft is supported between the engines and the dead wood by bearings and intermediate spring supports, and a cooling pipe is led from the outside of the ship over each. The after propeller bearings are of wood, upon Penn's principle. The propeller is raised by a cable and pulleys, the cable leading to the capstan. A long wooden stay, tightened by a screw, is used for keeping the propeller down in its place, and suitable means are also provided for steadying the propeller during the raising of it, for slinging it when raised, or partially raised, &c.

The greatest speed ever attained by the *Merrimac* under steam alone was seven knots per hour, and this was made under very favourable circumstances.

We quote these details from the *Mechanics' Magazine*, No. 1730, wherein are described five other United States' steam ships of war, of nearly similar dimensions to those of the *Merrimac*: namely, the *Wabash*, the *Minnesota*, the *Roanoke*, the *Colorado*, and the *Niagara*.

ROCHESTER NEW BRIDGES.

Two new Bridges have been completed at Rochester: one in place of the ancient town bridge; the other at a short distance from it, to convey the North Kent Railway across the river Medway. The new town bridge and the railway bridge each consists of three openings, besides the swing bridge which there is to each. It is in the swing bridges and the method adopted in the foundations that the chief interest and merit of these works is to be observed. In that part of the town bridge which opens, the most elaborate system of contrivances is resorted to, to relieve the work from all strain in its ordinary position fixed for land traffic, and to attain the utmost durability in the working parts. Each of the swing bridges is formed of wrought-iron riveted girders, strutted,—the centre, or pivot of the swing, in the case of the town bridge, being on the pier, so that the swing turns in direction up the stream,—whilst the centre in the case of the railway bridge is on the abutment, so that the swing turns down the stream. In the town bridge, the moveable portion has six of the riveted plate girders in the direction of the length,—the outside girders of the six being 7 feet 11½ inches deep, at one end, and 6 feet 0¼ inches at the other end,—the four intermediate girders being somewhat less. For the strutting, the girders are intersected by boiler plate—a row of plate passing by each side the centre pivot, for extra strength thereat—and elsewhere by cast-iron pipe strutting, which gives the requisite strength with lightness. The footpath of this part of the bridge projects on cantilevers. The bearing-points are the pivot, formed with properly prepared iron and brass, and thirty wheels, or rollers, running on a circle, or roller path, 30 feet in diameter, which is accurately planed to a slight and even inclination,—the rollers being themselves fixed on the edge of what may be called a large horizontal wheel, which keeps them in their places. The motion is given to the bridge by an endless chain, stretched round the circle over the roller path, and also round a small toothed wheel, which last is turned by two men, standing upon and carried with the bridge. The weight to be moved is over 300 tons. By a most ingenious contrivance, when the bridge is not open for river traffic, the weight can be taken off the central pivot. At the outer end of the radius, there is, of course, a stop, to prevent forcing the bridge too far laterally in re-closing it,—and at the same end there are a number of "setting-up screws," to which motion is given by a windlass, for the purpose of taking off the weight which would otherwise exert great leverage upon the machinery; and there is here an horizontal stop, to prevent these screws from themselves forcing up the bridge too far. At the shorter end of the moving girders a considerable weight of stone is filled in the hollow parts under the level of the causeway, so as to get the proper counterbalance. Great nicety was of course required in the planing and arrangement of these swing bridges.

In the main portion of each bridge,—that is to say, town bridge and railway bridge—it has been shown that there are three openings and two piers. The railway bridge consists merely of wrought-iron riveted girders, three in the width of the bridge and continuous for the whole length of the piers and openings together. The centre girder is the deepest; and the three girders are fixed to one pier, whilst their other supports are by rollers, to allow of expansion and contraction. The timbers of the roadway are suspended from the bottom flange by two screw-bolts at each end,—this plan of course being adopted to ensure regular bearing, instead of the other alternative of straining one-half of the flange and outer girders. But it should be observed that the great dependence which in this now usual system is placed on the bolt-holes and heads of the bolts, would lead to the inference that further consideration of the subject might be desirable. This bridge carries the continuation of the North Kent line on to Canterbury. Mr. Joseph Cubitt was the engineer of the railway bridge; Mr. Wm. Mills was the resident engineer; and Messrs. Fox and Henderson were the contractors.

The town bridge has three segmental arches of cast iron, and stone piers and abutments. The stone piers extend only down to the level of low-water,—the pier, if it may be so called, below, being formed of a cluster of cylinder piles, filled with concrete,—there being fourteen piles to each pier, viz., six on each side and one to each of the cutwaters. These piles it was originally intended to sink on Dr. Potts's principle, or by exhausting the air, and allowing the pile to descend by its own weight. It was however found, in commencing at the Strood side, that the cylinder would not penetrate the bottom; therefore a new contrivance, a modification of the diving-bell, was adopted for each cylinder, the air being compressed by an engine, so as to keep out the water, the pile descending by a weight placed at the top, and the men and materials passing in and out through valved chambers, according to an ingenious contrivance by Mr. Hughes, for which he obtained a patent. As in the instance of most valuable inventions, the priority of claim was disputed; and Mr. Bush, who commenced the sinking of a caisson or cylinder, some years since on the Godwin Sands, in last session of Parliament, only just terminated his case,—which was decided against him, in the House of Lords, mainly, as it would seem, because the real priority of claim would have been on the score of an invention by Lord Dundonald.

The strata at Rochester consisted of Kentish ragstone, gravel, soft chalk, and, lastly, in order of descent, hard chalk; and the cylinders were sunk in 9 feet lengths,—having to descend in some instances a total of 40 feet. The details of the work manifested great ingenuity.

Bed-plates were fixed on the top of the cylinders, and on these plates the masonry was laid. A portion of the pier corresponding with two courses of masonry, was formed by an iron curtain enclosing the piles, round the whole pier. After the foundations were completed, the works stood for some time before the superstructure was commenced. The total length of roadway, inclusive of the swing bridge and abutments, is about 700 feet; but with the two approaches, and the land arches at the Strood end, the length would be somewhat greater. The girder framing of the swing-bridge measures about 99 feet along its sides, and 109 feet taking in the segments at each end. The length of the main portion of the bridge, or space of the three openings, is 482 feet, made up by the centre arch spanning 170 feet, two side arches, 140 feet each; and two piers, 16 feet each: and if the pier of the Rochester abutment, 40 feet, and the upper part of the pier only, next the swing-bridge, 34 feet, be added, we have a length of 556 feet for that part of the bridge. On the plan, the breadth between the parapets is 40 feet. The rise of the centre arch is 17 feet, and that of the side arches 14 feet, or in each case, one-tenth.

There are six castings to the sweep of the centre arch and five to that of the side arches, and these castings are nutted and screwed together by flanges, the butting ends being carefully planed to get even bearing. On the plan there are eight of these arches in the breadth of the bridge, strutted by diagonal bracing-frames. The outside arches of the eight, in the 170 feet span, have the I form of section, 4 feet 6 inches in depth, with top and bottom flanges 14 inches by 2½ inches, and a "web" of 2-inch metal. The inside arches are somewhat less in scantling. The decorative castings are screwed on; and, with the cornice and spandrils all in metal, and the iron parapet railing, are well designed for effect. At the upper angle of each spandril one inch is left for the expansion of the arch, which operates at that point, moving in direction towards the pier, in which a sinking is left to allow of such expansion. The arches spring from iron skewbacks, which pass through the pier,—that is, each arch where the piers occur butts against its neighbour.

The roadway and footpaths are carried by cast-iron plates fitted to the tops of the spandril castings. The roadway of the swing-bridge is of timber, where lightness is required.

Sir Wm. Cubitt was the engineer. The foundations were put in by Messrs. Fox and Henderson, and the superstructure was contracted for by Messrs. Cochrane and Co.

At the landing-place on the Rochester side of the river, Mr. Wright has put up a well-contrived landing-stage, which is simply a hollow caisson, formed of riveted plate-iron, and rising and falling in the direction of an inclined plane with the rise and fall of the tide,—being guided by wheels which run in chases in the masonry. Thus, descending a few steps, persons embarking can step immediately to a boat from a flat surface at all states of the tide. —*Abridged from the Builder*, No. 704.

THE SUBMARINE NAUTILUS.

THE *New York Herald* of Nov. 15, 1856, reports the trial of this new apparatus for submarine work. The Nautilus, in external form, is almost round. It is about 10 feet in diameter by 7 feet deep, and weighs 10 tons. A peculiarity, as compared with the old-fashioned diving-bell, is that the entrance is from the top; a species of iron trap door screws down when all are in, and when the machine is at the bottom, another and larger door opens in the base, so as to proceed with the works required. Condensed air is produced on board a vessel or on land, and is communicated to the Nautilus by an immensely powerful hose formed of thick India-rubber, strong enough to withstand a pressure of 200 lbs. to the square inch; this is affixed to the top of the machine, and communicated by valves inside to the working and water chambers. After entering and closing the top of the machine, water valves are opened, which cause the Nautilus to sink; air is taken into the working chamber until its density is equal to that of the water without; the door of the bottom is then raised in order to move upon the ground. The operators step upon the bottom and carry the machine with them, or in current way cables passing from windlasses inside, effect the desired movement. To lift stone, a hook placed on the bottom is affixed to the stone, condensed air is then thrown into the water chambers, and the water is expelled until the weight of the stone is overcome. It is then moved in any direction, and, by the readmission of water, is again deposited. In one of the experiments, a stone weighing five tons was lifted, moved horizontally between twenty and thirty feet, and then deposited. The time occupied in going under water, bringing the stone to the surface (twenty-two feet), then moving, going down and depositing, returning again to the surface, was only nine and a half minutes. The Nautilus will lay 3500 cubic feet of stone per diem, at a cost of thirty-five dollars, being less, according to the opinion of engineers, than the cost of the same work on *terra firma*. The average cost of submarine constructions is 16½ cents the cubic foot, whilst with the Nautilus, as demonstrated, it is but one cent.

NOVEL APPLICATION OF TIDAL POWER.

THERE has been read to the Academy of Sciences, at Paris, a description of an invention of the Abbé Giovanni Basiaco for applying the force of Tidal Streams to Motive purposes by means of—what he terms—an hydraulic chain, which consists of a series of wooden pyramids with rectangular bases united together, so as to form an endless articulated band or chain, intended to float on the surface of the water, and give to the inflexions of the currents. The bases of the pyramids are placed vertically, in such a manner as to be subjected to the action of the water, and are provided with hinged flaps on the lower parts, which descend into the stream beneath the following portion of the course of the chain, and which lifts up and becomes nearly horizontal when moving upwards. The chain passes round drums, which it thus causes to rotate, and whence motion is derived. The inventor proposed principally to apply his system to tugging boats and barges up streams, and with this view made several experiments on the Tiber, which were stated to have given satisfactory results. However, M. Morin, who was charged by the Academy to examine a model of the invention, which was at work in the Seine near the Pont Marie, and report upon it, was of opinion that it might be better applied to furnish motive power to workshops on shore than to tractive purposes, which, even if successful, would necessitate the employment of certain arrangements that would encumber navigable streams; and he thought the invention, on account of its simplicity and cheapness, susceptible of useful application. M. Morin estimated the resulting force of the Abbé's chain at 22 per cent. of the force of the current, and also that it might be advantageously applied to communicate motion to dredging-machines.—*Building News.*

SHIP CANAL THROUGH THE ISTHMUS OF DARIEN.

THERE have been read to the British Association, 'Explorations through the Valley of the Atrato to the Pacific in search of a Route for a Ship-canal,' by Mr. F. M. Kelley, of New York. Several surveying expeditions have been sent by Mr. Kelley into this region, and much valuable information has resulted. But the chief result is a conviction of the feasibility of a ship canal through the isthmus. The most recent of Mr. Kelley's explorers, Mr. Kennish, proposes to enter the Atrato by the Caño Coquīto. The greatest depth on the bar is about 4 ft. at low water; the soundings gradually deepen, and become 30 ft. within 2 miles, when the depth increases to 47 ft., and is nowhere less up to the Truando. The width varies from a quarter of a mile to 2 miles, and the removal of the bar would allow of the transit of the largest steamers. The confluence of the Truando is about 63 miles from the Gulf, and that river forms the channel of the proposed line for 36 miles. The line then follows the valley of the Nerqua through rock-cutting, and passes the summit by a tunnel of 3¼ miles. It reaches the Pacific through the valley of a small stream, and debouches at Kelley's Inlet. In the valley of the Atrato, 300 miles long and 75 broad, and lying between the Antiochian mountains on the east and the Cordillera of the Andes on the west, rain falls almost daily; which accounts for the immense supply of water in that region. On the Pacific side of the Cordillera there is scarcely any rain for eight months of the year. The greater portion of the rain falling in the Atrato valley is caught above the confluence of the Truando. Fifteen large tributaries and numerous smaller streams fall into the Atrato and contribute to the immense lagoons, which form natural reservoirs and a superabundant store of water throughout the year. There are various cogent reasons for selecting the confluence of the Truando as the best point from whence the passage from the Atrato to the Pacific may be effected. In the first place there is no point of junction with the Atrato by western tributaries so near the level of high water on the Pacific as that of the Truando. It happens to be 9 ft. above the Pacific at high water, and it is therefore of sufficient elevation to prevent the Pacific at high water from flowing through the proposed cut into the Atrato; while it is not so high as to cause the current from the Atrato to the Pacific at *low* water to pass through the cut too rapidly. In fact, the elevation of the Truando confluence just preserves a preponderating balance on the side of the Atrato. The Atrato, at the junction of the Salaqui, is only one foot above the level of the Pacific at high water; but the dividing ridge is 1063 feet high and 30 miles wide, according to a survey of that route by Mr. Kennish and Mr.

Nelson. Should any of the rivers at the mouth of the Atrato be selected, without reference to the height and width of the dividing ridge, it may be observed that the maximum tidal wave in the Pacific being 25 feet and that on the Atlantic only 2 feet, the Pacific at high tide would flow into the Atlantic with a current equal to a head of 11½ feet; and at low water in the Pacific the Atlantic would flow into it with a similar current. In the inlet of the Gulf of Micuel, recently called Darien Harbour, the action of the tide is so strong that H.B.M. steamship *Virago*, commanded by Captain Prevost, dragged both anchors ahead, and was only brought up by paying out nearly all her cable. The heights of the tides and the levels of the two oceans have been well established by the recent observations of Colonel Tolten in Navy Bay on the Atlantic and in a deep bend of the Bay of Panama on the Pacific. On the Atlantic a consecutive series of thirty-two observations were taken in the months of August and September during the season of calms. On the Pacific two sets of observations were made. The first, during May and June, when fifty-four consecutive tides were observed in a season of calms; and the second in November and December, when fifty-two consecutive tides were observed in a season of light winds. The results do not exactly correspond, and are given in the following table:—

	Pacific.		Atlantic.
	May and June.	Nov. and Dec.	Aug. and Sept.
Greatest rise of tide . . .	17·72	21·30	1·60
Least	7·94	9·70	0·63
Average	12·08	14·10	1·16
Mean tide of Pacific above mean tide of Atlantic . .	0·759	0·148	
High spring tide of Pacific above high spring tide of Atlantic	9·40	10·12	
Low spring tide of Pacific *below* low spring tide of Atlantic	6·55	9·10	
Mean high tide of Pacific above mean high tide of Atlantic	6·25	6·73	
Mean low tide of Pacific *below* mean low tide of Atlantic	4·73	5·26	
Average rise of spring tides .	14·08	17·30	
Average rise of neap tides .	9·60	12·40	

These observations make the mean level of the Pacific from 0·14 to 0·75 higher than the mean level of the Atlantic; but this is probably owing only to local circumstances, and it may be assumed that there is no difference in the mean levels of the two oceans. The conclusions arrived at by the successive independent surveys carried out at the expense of Mr. Kelley may be summed up as follows:— First, That the oceans can be united through the Atrato and Truando by a canal without a lock or any other impediment. Second, That while the distance between the oceans by this route is only 131 miles, half that distance is provided by nature with a passage for the largest ships. Third, The remaining distance requires the removal of bars, excavations, and cuttings, presenting no unusual difficulties. Fourth, Harbours requiring but little improvement to render them excellent, exist at the termini.—*Athenæum*, No. 1504.

CANAL AT THE ISTHMUS OF SUEZ.

THE French Company which some time ago projected joining the Red Sea and the Mediterranean by a canal, seems still to persist in taking measures to realize the scheme, in spite of the exposure of its absurdity in a late number of the *Edinburgh Review*. At the meeting of the Academy of Sciences in June last, several specimens of the rocks and soil obtained by numerous borings across the Isthmus were exhibited. They were sent by M. Renaud, a member of the Company's Commission. A few of the results of the survey are perhaps worth quoting. The greatest height of the land of the Isthmus above the Mediterranean is only 16 metres, or 52½ English feet, and this holds only for a few miles, all the rest being lower. From the head of the Gulf of Suez to the Mediterranean at Tineh (the ancient Pelusium), the direct distance is 113 kilometres, or 70 miles, of which the hollow called the Bitter Lakes occupies 40 kilometres. The land northward from the Bitter Lakes to the small lake Timsah is 36 feet above the Mediterranean, and the neck of land from the head of the Red Sea to the Bitter Lakes has an elevation of 29 feet—above the Red Sea is of course meant. The Red Sea and the Mediterranean, according to Mr. Robert Stephenson, are very nearly on the same level, though the French Survey of 1800 made the difference of elevation between them about 30 feet.

THE FOUNTAINS AND WATER-TOWERS AT THE CRYSTAL PALACE.

THESE magnificent works were opened on June 18, 1856, in the presence of the Queen and the Court. The works are well described in the *Builder*, No. 698, whence we abridge the following:

In the ornamental basins on the terrace and below it, there are two distinct series of fountains, the upper series comprising the nine basins adjacent to the main building, and terminating with the large circular basin on the central walk through the gardens; the second series including the first series, and in addition to them the more extensive fountains in the temples, cascades, and two large basins in the lower grounds, which terminate the water supply. The upper series, or ordinary display, can be worked independently of the others; but when the lower fountains are shown, the whole display is brought into action, and to effect this, very elaborate arrangements have been found necessary. In order that these may be understood, let us first describe the arrangement in connexion with the fountains of the tanks and upper reservoir, containing the supply of water for the jets, and of the lower reservoirs, where it is collected after being displayed.

The water for supplying the fountains is maintained at three different elevations;—first, in the two high tower-tanks which supply the 250-feet jets in the centres of the lower great basins, and concerning which towers we will speak more at length presently; secondly, in two lower tanks, which contain water for fountains, and for ordinary use in the building, and are situated near its northern extremity. These tanks supply also the high central jets in the upper series, as well as four secondary jets, round each 250 feet jet in the lower grand basins. The supply at the third elevation is contained in the large upper reservoir at the northern end of the building. This reservoir contains about six and a half millions of gallons, and from it the great body of the water displayed in the fountains is drawn.

To raise water from the upper reservoir into the high and low tanks above described, two 30 horse-power pumping-engines are placed near it.

For collecting the water after its display in the fountains there are two reservoirs, namely, one for the upper and one for the second series of fountains. That for the upper series (usually called the intermediate reservoir), is situated at some distance to the north of the central circular basin, and a little below it in elevation. This collects the waste water from the ordinary display of the upper fountains, which is first received into the circular basin, and flows thence into this reservoir.

Four forty-horse-power engines are placed adjoining the intermediate reservoir, which raise or return the waste water from it to the upper reservoir, so as to render it again available for display.

The receiving reservoir for the second series of fountains (which is called the lower reservoir), is situated below the south grand basin, and is of still larger capacity than the upper reservoir, as it would be required to receive all the water contained in the latter and in the high and low tanks, in the event of its being all displayed. The lower reservoir is constructed in the form of an ornamental lake, and the well-known representations of the various extinct animals, and strata illustrative of the science of geology, are placed on its eastern banks. The lower reservoir collects the waste water from the entire system of fountains when in full operation,—the waste being first received into the grand basins, and flowing thence into this reservoir; while to raise or return this waste water from the lower to the upper reservoir, so as to be again available for display, two forty-horse-power engines are provided. The water, it will be seen, is thus made to play its part again and again.

An artesian well is sunk in the lower part of the grounds for a water supply, and a small engine is provided for raising the water from this to the lower reservoir. The well consists of a brick shaft 8½ feet in diameter, and 247 feet in depth, whence a boring is sunk to the additional depth of 328 feet; giving a total depth of 575 feet. The strata, we may mention, consist of clay and sand for 360 feet from the surface, and of chalk for the remainder. And now a few words as to the fountains themselves.

The water displayed in the upper terrace fountains is conveyed through pipes to the large circular basin, where it plays a second time in the low network jets round the margin, and in the other low jets through the basin. When the lower great fountains are displayed, all the waste water from the circular basin is similarly conveyed to them to play their jets of low elevation. Thus the water from the terrace fountains is displayed thrice, and that from the circular basin twice, throughout the entire operation.

In the water-temple, at the head of the cascade, the water issues from a ring round a ball, upon which stands the figure of Mercury, and from the Cupids' mouths thence flowing over the steps of the dome, where it is collected in a cistern formed by the cornice; the bottom of this is perforated, and lets the water fall below in the form of a curtain to the openings.

The magnitude of this system of fountains may be conceived from the circumstance that, when the great waters are in full operation, there are 11,788 jets playing, and that the quantity of water displayed simultaneously in them is about 120,000 gallons per minute.

The whole of these works we must here mention were designed by Sir Joseph Paxton; and six contractors were employed under him in their execution, viz.—Messrs. Cochrane and Co.; Simpson and Co.; Easton and Ames; Aird; Cox and Wilson; and Roe. The engineering operations were executed under the superintendence of Mr. Sheilds, the company's resident engineer, and all the architectural portions were designed and superintended by Mr. Stokes.

The Water Towers, which now form most prominent features in any view of the Crystal Palace, play an important part in the arrangement, serving various purposes. By their means, in the first place, a supply of water can be raised to such an elevation as to play jets of the enormous height of 250 feet in the large ornamental basins in the lower part of the grounds already referred to. The supply water thus elevated is contained in a tank placed on the top of the towers, and is also available for extinguishing fires in the main building itself. Pipes communicating with the water-tanks are carried through the building with a number of fire hydrants placed upon them, so that in the event of fire every part of the edifice may be reached by streams of water of immense force.

The foundation of each tower is composed of a ring of Portland cement concrete, the dimensions of which are,—outside diameter, 58 feet; width of the ring, 11 feet; depth, 3 feet.

On this foundation are erected 780 cubic yards of brickwork, also in Portland cement. This cylinder of brickwork is 18 feet in height, with an average thickness of 7 feet, carrying the entire structure of outer base plates, columns, face-panels, tanks, balcony floors, and roof. The diameter of each tower, from centre to centre of the columns, is 46 feet.

In the interior of the ring of brickwork, there is another foundation of Portland cement concrete, 28 feet in diameter and 5 feet thick, carrying the chimney-shaft and six water-columns. The water-column base-plates are placed equidistant on this foundation, and branch into a circular pipe, through which the water passes both into the tank and out of the tank to the fountain. Of these six columns (communicating with the bottom of the tank), five are for the supply of the fountain, and one for the escape of surplus water.

The chimney is in the centre, and takes the smoke from the heating apparatus and boilers within the building. The height is 276 feet, the diameter 9 feet 3 inches; thickness, up to the height of 60 feet, 14 inches, after which it is reduced to 9 inches. On the top is an ornamental cap of cast-iron 14 feet in height by 16 feet in diameter.

There are eleven stories in each tower, the height between the floors being 20 feet. Winding round the chimney-shaft is a spiral staircase of iron and wood, containing 404 steps. As a means of additional stability, each tower contains ten diaphragms of wrought-iron, 5 feet wide, weighing about 6 tons. These diaphragms are all fixed between the columns and connecting pieces, and are tied together by iron rods 1¾ inch in diameter, and 32 feet in length. The total height of the towers from the first-floor to the top of the tank is 238 feet. There are ten tiers, each tier 20 feet high, making the height of the balcony-floor round the outside of the tank from the first-floor 200 feet. The tanks are 38 feet deep and 47 feet in diameter. Each tank, when full of water, contains 448,000 imperial gallons, or about 2000 tons. The chimney-shafts go through the centre of the tanks. The total weight on the foundation when the tank is full of water will be—

Water	2000	tons.
Wrought-iron	240	,,
Cast-iron	638	,,
Glass, timber, lead, &c.	200	,,
	3078	,,

Say 3000 tons.

The pressure on the square inch at the mouth of the jet is 262lbs. Each tower furnishes but one jet of water, which, on a calm day, will reach the altitude of from 220 to 240 feet. Mains connected with the water-towers are laid in the Palace itself, which, in case of fire, could throw a jet of water to the top of the centre transept.

When finished, the towers will be decorated similar to the Palace.

Mr. I. K. Brunel was the engineer: and Mr. J. P. Ashton, of the firm of Fox, Henderson, and Co., the contractors, superintended the erection of the towers.

STEAM PILE-DRIVING MACHINERY.

Mr. Robert Morrison, of Newcastle-upon-Tyne, has patented a machine or apparatus for Driving Piles by the direct action of

Steam, by which two or more rows of piles may be driven simultaneously without the necessity for any lateral or transverse movement being imparted to the pile-driving mechanism, and consequently the expense of driving temporary piles and erecting platforms for the machine to traverse laterally upon from one row of piles to another is obviated. According to this invention one, two, or more steam cylinders and driving rams are employed, according to the number of rows of piles to be driven at one time, the distance between such cylinders and rams corresponding to the width between the centres of the rows of piles. The cylinders and valve gearing are carried in suitable supports on one end of a travelling carriage running on wheels, and a vertical tubular boiler and small steam engine for hoisting the piles and raising the cylinders when they have each driven a pile, are carried at the other end of the carriage. The boiler is fitted with a conical or tapered fire-box, the contracted end being uppermost. As fast as each pile in a row is driven the machine is traversed forward between the rows to the next piles, and so on until the whole of the piles in each row are driven. The driving rams are made solid, and the pistons are forged or cast in one piece therewith. A stuffing box is fitted on to each end of the cylinders, and the driving rams work through both the stuffing boxes, which thus serve as guides without the necessity for any other means of steadying them during working. The lower end of the ram, or that part which works through the lower stuffing-box is made cylindrical, whilst the upper portion working through the top stuffing-box is made square, to prevent the ram from turning round. Or in place of making it square it may be first turned cylindrical, and then have one side planed off, or it may be simply fitted with a feather on one side: any other form, however, would answer, other than cylindrical. The valves of the steam cylinders are so arranged that the steam may either be admitted on the underside only of the pistons for raising the rams, and then allowing such rams to fall by their own gravity to drive the piles, or the steam may be admitted on each side of the pistons, so that the force of the blow may be increased in proportion to the pressure of the steam. In the former case the upper stuffing-box will not, of course, require packing, but will merely serve as a guide to the ram. The small steam engine which it is proposed to employ for raising the cylinders after they have done their work, and hoisting fresh piles to deposit under the rams, is an inverted trunk engine, the lower end of the trunk being flattened to such an extent as will balance the weight of the piston trunks and connecting rod.—*Mechanics' Magazine,* No. 1735.

SAFETY-APPARATUS FOR BOILERS.

An American invention for indicating and regulating the height of water in Steam-Boilers has been patented in this country. It consists in adapting inside a boiler, or in suitable connexion therewith, a hollow vessel in communication at the bottom with the water, and at top with the steam in the boiler. The vessel is also placed in communication with external signals, or with signals and apparatus whereby pumps may be set going and stopped. The vessel must be fixed in such manner that the level of the water therein when full shall be in a line with or below that in the boiler, and when such is the case no action takes place; but as soon as the water in the boiler sinks below the level of that in the vessel, steam is generated or flows therein, and affords a power for working any suitable external signals, and, if desired, for putting pumps in gear to supply the deficiency in the boiler, and for stopping them on the proper level being attained. It is important that the supplementary vessel or apparatus be so placed, with respect to the boiler, that steam may be generated or admitted, and condensed therein or expelled therefrom, by the action of the steam and water in the boiler.

APPARATUS FOR THE PREVENTION OF STEAM-BOILER EXPLOSIONS.

MR. W. KEMBLE HALL (United States, America) has read to the Institution of Civil Engineers, a paper, in which he observes:—

All the contrivances hitherto adopted for the purpose of providing against explosions, were designed to supply water when that in the boiler had fallen to too low a level, or to open the safety-valve by the pressure of steam, independent of other circumstances. As had been illustrated by the examples alluded to, either of these plans would induce, in many instances, the very accident designed to be avoided. For there seemed every reason to believe that the great majority of explosions were occasioned by the negligence of the attendant, in permitting the level of the water to fall below the flues, exposing the plates to a high temperature, and surcharging the steam with caloric far exceeding that due to its pressure. In injecting an additional supply of water into the boiler, when in this dangerous condition, it was thrown over the heated plates and into the super-heated steam, and suddenly converted into steam of too high a tension for the boiler; and so instantaneously, moreover, that it operated with all the momentum of a blow. And as the water necessary to produce this disastrous result might be supplied to the surcharged steam, from that already in the boiler, by the agitation incident to the opening of the, so-called, safety-valve, the alarming fact was presented, that the very instrument provided for insuring against explosions might become the cause of producing one.

These considerations naturally led to the conclusion, that safety was alone to be attained, by opening a water blow-off valve, when the surface of the water had fallen to a perilous extent, for the purpose of first discharging from the boiler the water, which was the more dangerous element, and then the steam; operating, in fact, as a safety-valve, in a more useful but less objectionable position than the present steam-valve situated on the dome. The arrangement consists of a valve communicating with the water, and kept in position by a rod which serves for its stem, and terminates in a button cemented with tin, or other readily fusible metal, into a copper cup, riveted to the crown of the furnace. There are no working joints, or stuffing-boxes, to become disordered, and the fusible metal is protected by the cup, composed of a material which is a rapid conductor of heat. If the furnace should be unduly heated, the button will be released, and the valve permitted to open and discharge the water and steam from the boiler. The boiler may be injured, and the flues destroyed by the fire, but no explosion can occur. This system has been subjected to trial under heavy pressure, and has been found very successful.

In the discussion which followed the reading of Mr. Hall's paper, it was argued that this system, if properly carried out, would be extremely useful, and almost prevent the possibility of danger from explosion, but that it would be of use only when an explosion was almost inevitable; and that as prevention was better than cure, the utmost should be first done to prevent boilers reaching that state, still retaining Mr. Hall's valuable apparatus, in case of all other means of prevention proving ineffectual. For the discussion, see the Proceedings of the Institution, on March 4 and 11. In conclusion, it was agreed: "With all boilers, Mr. Hall's apparatus would be a valuable adjunct, and in no case would it be prejudicial; but it would be more useful if, as an invariable adjunct, it could take with it a careful, intelligent fire-man, without which no boiler could be considered safe."—*Proceedings of the Institution of Civil Engineers.*

Mr. William Routledge, Newbridge Brass Foundry, has patented an apparatus consisting of an elbow pipe connecting the furnace with the side flue, and fixed just below the water level in the boiler, but may be fixed at any elevation or in any position requisite, and can be applied to any kind of boiler, as an opening into a side or centre flue is all that is required. The pipe is perforated with a number of holes, about half an inch diameter, so placed as to be subject to the immediate action of the furnace fire. In these holes are metal plugs, more or less fusible, according to the working pressure of the boiler. The moment the water in the boiler, from neglect or otherwise, is below the level, and leaves this pipe bare, the heat from the furnace acts upon the plugs, which melt, and the steam, escaping through the holes, immediately relieves the pressure in the boiler, and in a short time extinguishes the furnace fire, thus preventing at once the possibility of the bursting of the boiler from want of water, or injury to the boiler from the action of the fire upon the plates bare of water, which latter cause so frequently results in ultimate accidents and loss of life; for, though no immediate explosion takes place, the plates are so weakened and injured as to cause some future accident, for which no reason can, at the time, be assigned. The present patent entirely obviates this danger, as any neglect on the part of those in charge of the boiler must be attended with immediate discovery.

TOPHAM'S APPARATUS FOR PREVENTING STEAM-BOILER INCRUSTATIONS.

MR. E. TOPHAM, of Nottingham, has patented an apparatus for clearing out the Sediment from the water in Steam-boilers, and preventing incrustations from forming in them. This invention consists in adapting to the interior of the boilers, and at or near the bottom and angles thereof, certain apparatus designed for the purpose of agitating and drawing off the water in the boiler occasionally, so as to prevent incrustation occasioned by the adhesion of the sediment contained in the water to the boiler. The apparatus consists of a shallow scraper, fitting loosely within the boiler, and having one, two, or more rods attached thereto for actuating the same from the outside of the boiler, these rods passing through glands or stuffing-boxes of the ordinary kind, by which they are kept water-tight whilst in action. At the back end of the bottom of the boiler there is an opening, beneath which is affixed a pipe for carrying off the sediment which has been precipitated from the water in the boiler during the day, the discharge of the sediment being effected by the attendant moving the before-mentioned scraper to and fro, by means of a suitable handle or wheels affixed to the outer ends of the rods to which the scraper is attached; or, if necessary, the scrapers may be actuated at stated intervals of time by a steam-engine.

THE DUPLICATE RETORT STEAM-BOILER.

RECENT explosions have led Messrs. Dunn and Co. to bring into notice their Patent Duplicate Retort Steam-boiler. The main advantages that have been sought by the patentees are to render an explosion more difficult, or if it does take place, to diminish the mischievous effects, by giving it only a partial character. These results are proposed to be obtained by the substitution for the present steam-boiler, of a number of cylinders or retorts about 10 feet long, and 19 inches diameter, composed of $\frac{1}{4}$-inch best wrought-iron Staffordshire plates, with strong cast-iron ends, forming the pipe junctions. These cylinders or retorts are placed in parallel lines, and the water supply-pipe is connected with one end of each by a short pipe or neck, through which the water is pumped into all the cylinders, which are generally kept about half full. The water is converted into steam in the cylinders, and the steam passes from the cylinders (on the opposite side from whence the water supply is obtained) through a tube into the steam-chest, and from thence the steam becomes a motive power, and its action is intelligently directed. The fire plays underneath and over the cylinders in a sinuous manner. One great economical advantage is claimed; that in the event of explosion only one cylinder may be affected, and not, as in ordinary cases, the entire boiler.—*Mechanics' Magazine*, No. 710.

MESSENGER'S PATENT TRIANGULAR TUBULAR BOILER.

THIS invention consists in surrounding the fire with tubes, which form water-spaces, extending from front to back, and secured at each end to sockets cast on inner plates, with sides, and ends, and flanges, to which are secured front and back plates. A water space is thus formed between inner and outer plates, which communicate with the tubes. Water admitted at the lower tubes becomes heated, circulates through all the tubes and water spaces, and rises to an outlet at the upper part of the boiler, from whence it is conveyed to whatever place is required to be heated. The patentee describes its advantages thus :—1st. The amount of surface which is by this arrangement exposed to the fire, reduces the quantity of fuel required very considerably ; 2nd. Tubes being used for fire-bars, all burning of the iron is prevented ; 3rd. Should any tube become injured, it can be replaced without in the least disturbing the rest part of the boiler. To convert it into a steam-boiler, the patentee proposes to add a steam-chest, communicating with the water spaces.—*Builder*, No. 723.

WETHERHED'S METHOD OF SUPERHEATING STEAM.

THIS method, invented and introduced by Mr. Wetherhed, (late member of the United States' Congress,) of Superheating Steam, has been submitted to various trials in the Royal Dockyard at Woolwich, and has at length assumed a practical form. During the series of experiments to which the system has been subjected, various improvements were suggested from time to time, and it was, therefore, considered advisable to prolong the trials, and if possible to render the system complete. The method was first tried in the *Black Eagle*, Admiralty yacht, and was attended with a considerable saving of fuel; and before the late voyage of the *Dee* to the western coast of England, the machinery was fitted up with the appurtenances necessary for a further test of the system. The apparatus was at work on alternate days during the voyage, which was specially extended for the purpose, and the results obtained exceeded what was anticipated. The economy realized in fuel amounted to no less than thirty per cent. as compared with the ordinary system of using steam. The apparatus consists of iron pipes carried from the steam-pipe along the front of the tube-plate, and extending into the uptake or chimney, in which they are coiled to increase the surface. These pipes rejoin the steam-pipe at or near the cylinders. Part of the steam passes through these pipes, and becomes considerably heated—superheated, as engineers say—and, combining with the ordinary steam before entering the cylinders, brings the mixed steam to about 340° Fah. It is in this method of passing part of the steam used through coiled pipes in the uptake, and combining it with the common steam, before entering the cylinder, that Mr. Wetherhed's invention consists. The system of simply superheating without mixing the steam has been known for some time past, and has been attempted on many occasions, but without much success. In the first course of the experiments at Woolwich a difficulty existed, namely, the burning and consumption of the wadding. This difficulty, has, however, been got over.

NAPIER AND MILLER'S IMPROVEMENTS IN DRIVING SCREW-PROPELLERS.

MESSRS. G. NAPIER and J. MILLER, engineers, of Glasgow, have patented a method of Fitting Screw Propellers, so that they may be lowered below or raised above the level of the keel while in action.

They place the propeller on a short shaft mounted in a sliding frame, by preference in the dead wood, in which it has bearings down to the keel; a portion of the dead wood and rudder, or stern post, supports the sliding frame in the rear, while it is similarly supported by the dead wood and stern post in front. This propeller frame slides in a vertical direction, and comes up through the deck. A vertical driving shaft is fitted to this sliding frame, and moves up and down therewith, the propeller shaft being actuated by bevel gear. The vertical shaft in the sliding frame receives motion through bevel wheels, one of which is fitted to the shaft, which slides through it freely to permit of the rising or lowering motion of the propeller frame, while at the same time transmitting the rotary motion; the other wheel is fitted to the shaft communicating with the engine or other driving power. The sliding propeller frame may be fitted with rack and pinion gear for elevation and depression; and to render that more easy to be accomplished, the whole weight may be suitably counterbalanced.

HIGH-PRESSURE STEAM FOR MARINE PURPOSES.

An interesting trial lately took place at the railway foundry, Leeds, in the presence of the Government inspector, and other scientific persons, of a novel application of Locomotive High-pressure machinery to Marine purposes. The machinery, which had been arranged and completed from designs of the engineer of the works, was intended, we understand, for a screw steamer recently launched at Hull. Nothing could apparently be more admirable than the smoothness and facility with which the machinery worked, a speed of 120 revolutions of the screw shaft per minute being obtained from the direct action of the engines, without the intervention of multiplying gear. This quickness of piston motion, which is not attainable at low pressure, is one of the main advantages of the application. Another is the great saving of space and weight, amounting to more than one-half. But what seemed to excite admiration most was the ease and quickness with which the motion was reversed, which was repeatedly effected under unfavourable circumstances, and against the full steam pressure of 140 lbs. on the inch, seven and eight times within thirty seconds.—*Leeds Mercury.*

NEW FLOATING STEAM FIRE-ENGINE.

In Mr. Braidwood's Report to the Committee of Managers of the London Fire Establishment, he states that the speed of this New Floating Engine, with the jet propeller, was, at the second trial in Long Reach, above eight miles per hour; and he has no doubt that when the machinery gets more into use (and it is better known how to work the new principle of propulsion), that her speed will be considerably increased. "The fire-engines work beautifully; their estimated power was 1428 gallons of water per minute. At a late trial, they threw 1938 gallons per minute, through four 1½-inch jets, to a height of 116 feet, with a fresh breeze blowing at the time; and there was power to spare, which would have been put on, but for fear of bursting the hose. The steam-engines, also, work well. The nominal power is 80-horse, but they have been worked up to 180-horse, per indicator, with only 90 lbs. pressure of steam. They can be, however, worked safely to 120 lbs., the boilers having been proved to upwards of 200 lbs. pressure."

PLOUGHING BY STEAM.

THE most interesting feature of the machinery exhibited at the meeting of the Royal Agricultural Society at Chelmsford, in July, was the apparatus for Ploughing Land by Steam. The first of the steam ploughing machines exhibited at Chelmsford, which we shall notice, is Mr. Boydell's. This is an improvement upon his previous year's engine, and consists of a common portable eight-horse boiler, with two 6½ inch cylinders, a fly-wheel on one side to drive any machinery by band in place of a stationary engine, and pinions on the other side gearing with a spur-wheel attached to one of the large wheels of the carriage upon which the engine is mounted. These wheels are fitted with the endless railway, described in the *Year Book of Facts*, 1856, p. 54 ; and with which the whole machine is enabled to cross the roughest land, to stalk up steep inclines, to move immense weights, and to overcome great resistances, in the most remarkable manner. It is steered by means of a tiller and steering-wheel, like those of a ship, and weighs in all (including water) nine tons. It will be observed that with this machine the whole of the work is done by itself. There is no need of horse power to drag it from place to place, as with some other arrangements, and for this reason it approximates to what we should be disposed to look for in a good agricultural apparatus. It may be remarked, that in ploughing hill sides the machine will go up light, and work downwards, by which means very considerable inclines will be operated upon with facility. "The inventor considers his engine sufficiently powerful to draw, say ten ploughs in light land, at six inches depth, with a speed of two miles per hour. It has dragged some implements of very heavy draught during the trials, and was not unable to pull forward Coleman's ploughing machine. In an attempt with the dynameter attached to Biddell's cultivator, the instrument broke at forty cwt., the draught of the cultivator as used being much greater still."

The next Steam Ploughing Machine is Fowler's. Mr. Fowler is already known to agriculturists by his steam draining-plough, which was to be seen at work during the Chelmsford meeting on the Crown lands, Hainault Forest, where also an improved double-screw brick machine of his was at the same time at work. For his steam ploughing apparatus he received a gold medal at the late Agricultural Exhibition at Paris. In this apparatus two capstans or barrels on upright or other axes are combined on the same base plate or frame, and they receive motion from a steam-engine in such manner that, when one of the barrels is being driven to wind on the wire rope, the other barrel is allowed to run free and to unwind the wire rope. The wire rope is either attached at either end to upright or other barrels or capstans; and is passed through two guide-pulleys anchored or fixed to the land, opposite to, yet distant from each other, and also distant from the two barrels. A plough or ploughs are attached to the wire rope, at that part which is between the two guide-pulleys, so that when the wire rope is being wound on to one of the barrels and off the other, the plough or ploughs or other implements will be moved in a direction from one guide pulley towards the other, to the distance desired, and then, when the action of the barrel is reversed, the plough or ploughs will be moved in the opposite direction, and by varying the position of the two guide pulleys from time to time the whole surface of a field may be ploughed or otherwise. The anchors consist of low trucks or wagons laden with earth, and furnished with sharp disks for wheels; these disks cut down into the land in a direction at right angles, or nearly so, to that in which the ploughs move, so that while they can be readily traversed, as may be necessary, along the headlands, they at the same time present great lateral resistance to the tension of the rope. Eight ploughs are connected to the apparatus for common ploughing —four for one trip, and the other four for the return. For ploughing trenches from ten to fourteen inches in depth, an implement two furrows' width and two deep is used.

In noticing Fowler's apparatus, and its operations, the *Times* says, "The ploughing is one-way work, but lands or stetches can be readily ploughed by simply turning the implement end for end for each half-land, and by shifting the anchorages accordingly. The work of common ploughing was exceedingly well done, and the trenching implement was drawn with great steadiness in ground through which ten horses were required to pull it. The amount of ploughing on land where three horses are commonly yoked in a plough capable of being done by a ten-horse engine is about eight acres per day of ten hours; and the expense of working, including four men and a boy, fetching water and coal, shifting the engine and tackle to the field, wear and tear, and interest of first cost (which is 495*l.*, including the engine) is apparently not more than 5*s.* or 5*s.* 6*d.* per acre. Trenching costs about double this sum. Should further experiments and calculations prove this estimate to be correct, there can no longer be a doubt that 'an economical substitute' has at last been perfected for the long venerated horse-plough."

The other Steam Ploughing Machine was that of Mr. Smith, of Little Woolstone, Fenny Stratford, Bucks, whose combined sub-soil and trenching plough was described and illustrated at page 481 of the *Mechanics' Magazine*, No. 1685. He works his ploughs with a common 7-horse portable engine and a stationary windlass. Two ¾-inch wire ropes lead from two drums on the windlass round four pulleys, anchored by means of large toothed anchors, two of which are fixed and two shifted as the ploughing proceeds.*—*Mechanics' Magazine*, No. 1719.

SMOKE-CONSUMING APPARATUS.

MR. GUFFROY has patented this invention, consisting in the construction of an apparatus, in which, after the fuel has been once lighted, the fresh fuel is placed on the incandescent mass, and the gaseous products from such fresh supply are made to pass through the burning mass; the combustion is supported and assisted by jets of air introduced through apertures or nozzles. Grate or fire bars are dispensed with, and an aperture is provided in the "tail" or bottom of the apparatus from whence cinders, clinkers, &c., may be removed. A partition plate is added in the upper part of the apparatus to prevent the smoke and gases emitted from the fresh fuel passing off into the heat flue without first traversing the incandescent mass. This partition may, in certain cases, be provided with apertures for the admission of air to support combustion.

SMOKE-BURNING.

A VERY simple and effectual plan for consuming Smoke is now in operation at the works of Mr. William Tristram, manufacturer, and Mr. John Stones, cotton-spinner, at Astley-bridge, near Bolton. The mode adopted is the admission of atmospheric air through the furnace door, and cutting it off as soon as the smoke is consumed, which is effected by an apparatus which acts independently of the fireman. The air is equally dispersed over the surface of the fire by being passed through a perforated chamber, or box, attached to the door on the inside. The experiments were tried in consequence of what was stated by Mr. C. Wye Williams, in an essay on Smoke-burning, which appeared in *The Engineer* newspaper, and the result has been the consumption of the smoke together with a saving of fuel. The cause of the failure in the first instance appears to have been the want of a proper proportion between the amount of air admitted and the size of the fire. The manager of the adjoining mill, Mr. Robert Riley, watched the experiments carefully, and on witnessing the successful result, obtained the permission of Mr. Stones to alter their furnaces on the same plan; and he improved it by making the door to close the apertures in proper time, independent of the firemen.—*Engineer.*

ERICSSON'S CALORIC ENGINE.

AN eminent engine manufacturer of New York has communicated to the *Mechanics' Magazine* the following paper:—

This last modification of the Caloric Engine presents very remarkable features. In common with the engines of the Caloric Ship,* which excited such lively interest in the commercial world, this engine retains the heat of the air

wire rope that hauls the plough up and down the field, and this is supported upon friction rollers, mounted on light frames so as to lighten friction and reduce the draught. For turn-wrest, or one-way work, it is now proved that the steam-plough can operate more cheaply than horse-ploughs; while there are other practical advantages which completely establish its superiority.

* An interesting account of "the Caloric Ship," fitted with the above Engine, appeared in the *Year-Book of Facts*, 1853, p. 5.

passing off from the working cylinder to the cold air entering the heaters This transfer of the caloric from the air that has performed its duty, to the air which enters the machine, Captain Ericsson accomplishes, in this instance, by the same means adopted in his original engines, in 1833, the escaping hot current sweeping the exterior of a series of tubes, whilst the cold current traverses their inside on its way to the heaters. By this method the engine is rendered chiefly dependent on the heat which in the steam-engine is wasted.

The apparatus which effects this great object has been termed by the inventor a regenerator, and the entire machine a caloric engine—very appropriate terms certainly, for although the steam engine is also a caloric engine, the application of the heat in it is not direct. The new motor, on the contrary, applies the heat directly to the acting medium, besides returning it, and is therefore emphatically a caloric engine.

The utility of the regenerator has been questioned by many, but approved by high authorities, such as Regnault. Others, again, have contended that the inventor claims for it properties akin to the chimera of perpetual motion—a most inconsistent assertion, as the fall of temperature by expansion proved to be very considerable in the trial engine of 1833, the question of returning the heat by the regenerator being then fully discussed by Ure, Faraday, and Lardner, who all examined the engine and admitted what the inventor claimed for the regenerator. Professor Faraday, at that time, lectured before the Royal Institution on a model regenerator, furnished by Captain Ericsson. Faraday is not a man to propagate ideas involving perpetual motion.

The modified caloric engine recently patented by Captain Ericsson, exhibits the following mode of operation.

Charge the vessel connecting the cylinder with the heater, with air of 15lbs. pressure to the square inch, and load the regulator according to that pressure; set the valve, and then move both pistons, the result of which will be the expulsion of the air, and the charging the space between the two pistons with fresh air entering through the valve. The valve being thus set, the heated compressed air will force the piston until an equilibrium of pressure is established. The movement being then continued by auxiliary means, the cold compressed air will pass from the cylinder through the valve into the vessel, whilst the space vacated will be filled with hot air of equal tension. The valve being then closed, and the working piston liberated, both pistons will move together by the expansive force of the confined hot air towards the open end of the cylinder. It will be readily conceded that no other force can be expended in this operation than that incidental to friction, since each piston either moves in equilibrium *or exerts useful force*. The remarkable object then obtained by Captain Ericsson's new invention is the compression of the cold air, and the charging the heated against a pressure of 15lbs., without expending any force apart from overcoming friction. The inventor, however, accomplishes still more; he sustains a working pressure of 30lbs. in the engines he has built, by making the supply piston perform the full inward stroke during the period occupied by the working piston in making half stroke, thereby causing a greater amount of air to be drawn in between the two pistons, and at the same time a compression is in the cylinder of 7½lbs. This compression, of course equal to an absolute tension of 22½lbs., will, under an elevation of temperature of 500°, maintain in the heater a working pressure of 30lbs. above the atmospheric pressure. The force exerted by the working pistons under this arrangement, it will be seen, continues during the entire stroke, commencing with 30lbs., and ending with an effective pressure fully as great as in expansive steam engines. The resistance encountered on the return of the working piston is confined to half of its stroke, the counterforce being at the end only half atmospheric pressure, and the mean resistance for the entire return stroke less than 2lbs. to the square inch. The force exerted by the supply piston during its return movement, acts during a space nearly equal to half the stroke of the working piston, commencing at 22lbs., and diminishing according to the law of expansion.

The advantage resulting from the mere proportion thus exhibited of force imparted to the machine, and force expended in compressing the cold air, is by no means apparent to those who merely theorize in the matter. Indeed, Captain Ericsson's disappointed expectation, in relation to the Caloric Ship, is solely to be attributed to his disregarding the size of the supply cylinders, on the strength of his theoretical deduction that, however great the force expended in compressing the air, it would be returned by the working cylinders independently of heat. The differential force of the gigantic pistons, considered by itself, certainly appeared most satisfactory, but proved too precarious in practice. The resisting force within the machine was too great in proportion to its entire motive energy—there was not margin enough to meet the unavoidable losses in practice. Already six engines have been built under the recent patent, with cylinders varying from 15 to 40 inches diameter, all of which are now under trial. One of these, an engine with cylinders of 30 inches diameter, finely executed, and working with peculiar regularity and smoothness, is intended for Europe.

Altogether, Captain Ericsson has built twenty-seven engines, in New Town, actuated by heated air, *twenty-five* of which the writer has seen in operation. The vast labour expendid in planning, independently of execution, can only be appreciated by those who are acquainted with the wide range of Captain Ericsson's experiments, and the diversity of form and combination of these engines, destined shortly to supersede steam as a mechanical motor.

MINING INDUSTRIES OF THE UNITED KINGDOM.

MR. ROBERT HUNT, F.R.S., has communicated to the Statistical Society, a paper "On the Present State of the Mining Industries of the United Kingdom." No new discoveries of tin in this country have been made for a considerable period of time, and the mines are being worked at a continually increasing cost; while, at the same time, the demand for tin for white-metal manufactures is on the increase. Fortunately this metal is known to exist in Australia and Tasmania. It was formerly found that the separation of silver from lead ore was not profitable if the lead contained less than 6 oz. to the ton, and in Wales, ore containing under 12 oz. to the ton was left unanalysed; but, by a process discovered by Mr. Hugh Lee Pattinson, silver may be profitably separated from the lead when 3oz. of it only are found in a ton of ore. By this means an annual saving of not less than 60,000*l*. is effected. The gold-seeking operations in the county of Wicklow in 1795 cost more than the gold produced was worth; and in the lead hills in the county of Lanark, 20,000*l*. were expended to obtain less than 5000*l*. of gold. There is every reason to believe that a new era for our zinc mines is approaching, as the supply from Belgium is not likely to bear the drain upon it, whilst new and economical processes for smelting zinc are being introduced. Scarcely a ton a-year of antimony is raised in England, and of nickel and cobalt also the amount raised is very small, our supplies of these minerals being derived from Norway and Germany. It is also found cheaper to import Sicilian sulphur than to procure it at home; but a small quantity is still brought from Ireland. The estimated value of the metals and coal, at the pit's mouth, and of pig-iron at the furnace, independent of any additions, which must be made before these substances can reach the public, is, for the year 1855, as follows:—Tin, 559,808*l*.; copper, 1,263,739*l*.; lead, 1,400,000*l*.; silver, 147,500*l*.; iron, 9,500,000*l*.; coal, 15,000,000*l*.; zinc, 16,500*l*.; nickel, arsenic, sulphur, &c., 750,000*l*.,—making a total of 28,637,547*l*.; and the number of persons employed in the mines is 303,977—viz., coal, 219,955; iron, 26,106; copper, 21,169; tin, 14,761; lead, 21,749; zinc, &c., 174. The author also mentioned, that of 5,000,000*l*. which had been subscribed ostensibly for the purpose of working the mines of the United

Kingdom, considerably less than a million had been spent for the purposes of exploration, the remaining four millions having been spent in the mysterious operations of the share market. It was to be hoped that a careful study of mineralogy and geology would render mining undertakings of a more safe and satisfactory character than they have hithertò been.—*Literary Gazette*, No. 1856.

SANDERSON'S IMPROVEMENTS IN THE MANUFACTURE OF IRON.

MR. CHARLES SANDERSON, of Sheffield, has patented this invention, which consists in the decarbonization of raw or crude pig-iron melted on the bed of a reverberatory furnace, or obtained in a molten or fluid state direct from the blast furnace, by adding to such melted metal any chemical re-agent; this, by its decomposition, will evolve elements capable of combining with the carbon, and re-acting upon silicon, aluminium, sulphur, phosphorus, arsenic, or other deleterious substance or impurity contained in the iron, and will, by the generation of carbonic oxide or carbonic acid gases (which will not combine with the iron, and will necessarily fly off or enter into combination with the scoria and earthy matters), cause them to separate from the iron; the impurities contained in the metal being thus got rid of, either by volatilization, or by reason of the difference in the specific gravity of the various substances. Also, in the use of sulphate of iron, or its chemical equivalent, for the required purpose, by adding it to cast-iron when it is being melted, for the purpose of producing castings of beams, shafts, and other articles requiring a particularly good iron, and thereby purifying such metal by discharging the earthy and other deleterious matter contained therein, and adding greatly to the strength of such castings.—*Mechanics' Magazine*, No. 1719.

EXPERIMENTS WITH CAST-IRON.

THE interesting fact is developed by experiments of the United States Ordnance Department, that iron, by repeated fusion, up to a certain number of times, is thereby greatly improved in strength. Guns cast solidly, and those cast hollow, through which latter water was made to circulate after casting, showed an astonishing difference in their relative strength, the difference being in favour of the hollow-cast gun, which is attributed to the method of cooling, the solid gun, contracting from the outside, exerting a strain upon the arrangement of the particles of the metal in the same direction as the strain of the discharges. The experiments also showed that old castings are a great deal stronger than new: 8-inch guns, proved 30 days after being cast solid, stood but 72 charges; 34 days, 84 charges; 100 days, 731 charges; and 6 years, 2582 charges. This phenomenon is accounted for by supposing that the particles strained in the cooling re-adjust themselves in the course of time to their new position, and become free, or nearly so.—*New York Paper*.

THE GRANULATION OF IRON IN WATER.

CAPTAIN UCHATIUS has invented a process by which molten iron is granulated and prepared for the manufacture of cast steel. It is stated that the cast steel thus produced has now been used for a year and a half in the Vienna Arsenal, for every description of tools required, where, previously, only the finest quality of English tool steel (Huntsman's) was used. Also that, early in the past year, a commission of scientific officers was instituted in Paris, by command of the Emperor Napoleon, to inquire into the merits of the Uchatius' process of making cast steel, and a very favourable report of the results of the inquiries was issued by the Commission, and published in all the French and most German scientific journals in May last. Shortly following these experiments a French company was formed for the purpose of manufacturing steel after M. Uchatius' plan, and the French patent was purchased for a very large sum.

In alluding to this process, Mr. David Mushet, in the *Mining Journal,* says: "It is a singular instance of the frequency with which matters as old as the hills are re-patented, that the process of granulation in water, for which M. Uchatius, in your last Journal, claims priority over Mr. Bessemer,* was one of the varieties of treatment used at Cyfarthfa (many years since) for this cupola finers' metal. But it was no part of the patent, *such granulation being notoriously old.* This process of refining was also introduced at Mr. Attwood's works at Congreaves, and very profitably carried on for some time. I presume there was some extra trouble incurred, which led to its discontinuance."

Mr. Mushet, and probably many others, will consider it a curious fact that Mr. William Clay, of Liverpool, filed, in September last, a specification of a patent, from which the following is an extract:— In this invention "the granulation of the iron is effected by causing the metal, when in a molten state, to run into water, after which the iron may be collected in a granular form, and be subsequently worked up by the ordinary processes into bars or other forms of wrought iron.

"Instead of simply granulating the iron, and obtaining cast iron or refined metal in the granular form, as above mentioned, the metal may also at the same time be decarbonized, or be deprived of a portion of its carbon, by causing the cast iron, when in a melted state, to fall from a height through the air before reaching the water."—*Mechanics' Magazine,* No. 1730.

NEW ORNAMENTAL CASTINGS.

Works for the prosecution of an entirely new branch of industry have been opened by Mr. Chance, about five miles from Birmingham—the manufacture of architectural decorations and adjuncts in basalt. The rag-stone of the neighbourhood is melted and cast in hot moulds, and cornices, doorheads, and other architectural enrichments are produced, of very lasting quality. When cast in cold moulds, a glassy lava, known as obsidian, is produced—an interesting fact in a geological point of view.—*Builder.*

* Mr. Bessemer's invention is described in the present volume.

In support of the probability of an extension of this new branch of industry, we may mention that operations are now going on at Ordnance Wharf, Rotherhithe (the works of the Colonial Gold Company), where furnaces have been erected for the reduction of gold quartz by direct fusion, under the patent of Mr. Charles Low, late of Swansea. The quartz thus treated is first crushed moderately small, then calcined or roasted, and afterwards fused with a mixture of fluorspar, lime, and oxide of iron, which liquefying agents combine with the silica, and render the matrix perfectly fluid. The primary object is to liberate the gold found by analysis to exist in the quartz, the particles depositing in a bed, or bath, of molten lead at the bottom of the furnace; but the fluid mass runs off as metal, may be cast into moulds, and will form ornamental bricks of lasting quality and great beauty; which practical use of the refuse will materially lessen the cost of the manipulation. The metallic alloy at the bottom of the furnace is to be subjected to direct cupellation for the gold produce.—*Mechanics' Magazine.*

AMERICAN MANUFACTURE OF FIRE-ARMS.

THE machinery now employed by the United States Government for the manufacture of Fire Arms is of the most perfect description, and it executes its work with wonderful celerity and precision. One complete musket can be turned out every eighty minutes of the working day, from the raw material. To produce the musket entire, two hundred and ninety-four machines and nearly five hundred distinct mechanical processes are involved. The barrel is made from iron costing two hundred dollars per ton, mostly procured from Norway, though a very excellent quality is received from Salisbury, Ct. The iron is cut up from bars into pieces of ten pounds weight and fourteen inches in length. After being drawn out to forty inches under a high heat, the bar is curved and welded on steel rods. The barrel is then bored out, and reduced in weight from ten pounds to four and a half, after which it is polished with emery on revolving wheels, and the quality of the workmanship is not exceeded by any in the world.

WHITWORTH'S RIFLE CANNON.

A NUMBER of experiments have lately been made in Manchester with Mr. Whitworth's Rifle Cannon, which was described in the *Year-Book of Facts*, 1856, page 38; the gun employed was what would otherwise have been an ordinary 24-pound howitzer. It was cast at Woolwich, solid, and sent to Mr. Whitworth, who bored and rifled it with the machinery specially prepared for the purpose. It weighs 13 cwt. The bore is polygonal and spiral; but instead of being of a calibre sufficient to take in a 24-pound spherical ball, it is only of the capacity of about a 9-pound ball. The bore measures from side to side 4 inches, and is 54½ inches in depth. It is entirely finished by machinery, and the balls are accurately fitted, the spiral in both cases being beautifully formed. Although, as we have said, the gun is only the size of a 24-pounder howitzer, the balls Mr. Whitworth uses are 24lbs., 32lbs., and 48lbs., these weights, in a bore of the small calibre mentioned, being obtained by an increase in the length of the balls. It will thus be seen that a gun, which, under the present system of construction, is only capable of supporting the strain of a 24lb. ball, will, by Mr. Whitworth's plan, throw a 48lb. shot—a sufficient thickness of metal being left on account of the reduced calibre. The experiments were with 32lb. and 48lb. balls, the lengths of which were respectively 11¾ and 16½ inches. The balls are pointed, the end which goes first being shaped and rounded like the small end of an egg. The base is flat, and slightly concave in the centre. The cannon was mounted on an ordinary artillery carriage, and placed on the north-west side of the grounds, with the muzzle towards the south-east.

The following Table represents the nature and results of the first series of experiments:—

No. of Experiment.	Weight of Ball.	Charge of Powder.	Elevation.	Range.
				Yards.
1	32 lbs.	2½ oz.	45°	423
2	,,	3 ,,	,,	621
3	,,	,,	,,	617
4	48 lbs.	,,	,,	420
5	,,	5 oz.	,,	735
6	,,	6 ,,	20°	600
7	,,	7 ,,	,,	687

Another class of experiments was next commenced, with the gun at a very small elevation, by which the balls grazed the ground at comparatively short distances, and, rebounding, pursued their course, grazing again and again, till their momentum was expended. The first shot was with a 32lb. ball and a 3 oz. charge, the gun being placed at an elevation of only two degrees. The projectile first grazed the earth at a distance of 92 yards, leaving a deep impression about 6 feet in length, and distinct indications of its spiral form and rotatory motion. It bounded from this, reaching an elevation of about 6 feet, and grazing the ground again at 64 yards. The next grazing (probably owing to the earth being hard at the latter point of contact) was at a distance of 70 yards further, whence it entered a ploughed field, grazing the ground several times, and came to rest at a total distance of 492 yards.

The next shot was with another 32lb. ball; the same charge (3 oz.), but with the gun at an elevation of three degrees. The ball, in this instance, first grazed the ground at a distance of 108 yards; and, rebounding, grazed again, 126 yards further on; but having touched the lower bar of an iron fence, which seemed to trip it in its course, it came to a stand in the ploughed field at the same distance as the former (490 yards). The three last experiments were with 48lb. balls.

It should be observed that the smallness of the charges used necessitated the employment of oak waddings to fill up the space in the powder cavity, which was very much to the detriment of the power of the gun.

Mr. Whitworth's new brass cannon, with hexagonal bore, was tried on the north shore, Liverpool, on May 7. Several shots were fired, ranging from 24 to 48 pounders. The first shot was with a 24lb. ball, with 11lbs. of powder, and the extreme distance obtained was 2800 yards, the elevation of the cannon being eight degrees. The experiments were not carried to a test of the *maximum* capacity of the gun, owing to the rapid rising of the tide. The average distance to which a 48lb. shot was fired was 3000 yards, but a much greater distance is expected to be obtained.—*Mechanics' Magazine*, No 1710.

A NEW PISTOL.

A NEWLY-INVENTED American Pistol bids fair to surpass in effectiveness all previous inventions of this class. This pistol will receive nine charges at once, which can be delivered successively in twelve seconds. Carbines on the same principle will contain twenty-five charges. The pistol consists of two barrels, one above the other. The lower tube contains the charges, which consist each of a conical bullet containing its own powder, hermetically enclosed by a copper capsule, filled with detonating ingredients. One pull of the trigger lifts a bullet into the upper tube, or barrel, and instantaneously discharges it. The piece rarely requires cleaning—can be discharged many hundreds of times without detriment—and if the spiral spring, which forces the bullets downwards, becomes injured, it can be replaced in a minute or two by an armourer. The original inventors of the pistol are Messrs. Smith and Wesson, of Hertford, Connecticut, and the patentee for England is Mr. W. R. Palmer, of Connecticut.—*Standard.*

COLONEL JACOB'S RIFLE.

THIS improved Rifle is the result of a long series of experiments made by Lieutenant-Colonel Jacob, C.B., of the Bombay Artillery, detailed by him in a pamphlet, of which the third edition is before us.* Col. Jacob has for twenty-five years past paid much attention to the improvement of Rifled Fire-Arms ; he has, from time to time, communicated the fruits of these experiments freely to Government, without thought of honour or reward; and, in truth (says the Colonel), *I have* received *but little encouragement from authority.* This is the old story of ungrateful return on the part of those to whom the vital interests of the country are intrusted, but to whom the love of pelf and place are paramount considerations.

We select and abridge the following from Col. Jacob's pamphlet:—

Colonel Jacob has prepared a pattern rifle for the Army, lighter, far more handy and convenient in every way, than the rifles hitherto in use, of 24-gauge bore only (that is, the spherical ball of which weighs twenty-four to the pound), with which a tolerably good shot can certainly strike an object the size of a man once out of three times, at a thousand yards distance, and of which the full effective range is above 2000 yards; the ball, at that range, still flying with deadly velocity. These rifles, proposed for the Army, have been only sighted up to 1800 yards, but the sights could easily be adjusted for longer ranges if necessary.

The charge of powder used has been small, two drachms only, for a ball weighing one and three-quarter ounces; but this is sufficient. Further experiments have shown that the 32-gauge bore is better than the 24—the ball not being reduced in weight, but made somewhat longer.

* *Rifle Practice.* By Lieut.-Col. Jacob, C.B. Smith, Elder, and Co.

The description of the proposed pattern rifle for the Army is as follows:— Single barrel, 30 inches long, very stout near the breach, 24-gauge, 4-grooved; grooves to take one complete turn in 48 inches of length, patent breech, good locks, mainspring connected with tumbler by link, half-cock little above nipple, trap in butt; full-stock barrel attached to stock by bands secured with spring catches; steel ramrod with deep hollow head, so as not to press on the shell tubes in loading; sword-bayonet 24 inches long, of the best cast steel; case-hardened iron mountings, and no brass or bright metal anywhere about the piece; folding sight six inches long, with slide, both the sight itself and its slide to be made with springs to prevent their working loose. Weight of the whole, with sword included, about ten and a half pounds.

The above makes a very beautiful and wonderfully effective weapon.

Other pieces of the same calibre (24-gauge), but made a little heavier, make excellent practice at a range of 2000 yards: the balls at that distance penetrating about four inches into very hard dry sunburnt brick: that is, having sufficient force to go through two or more men. Colonel Jacob is convinced that with the balls which he is using, a moderately light and perfectly handy rifle may be made to possess as much effectual power at a distance of 3000 yards as the old two-grooved rifle with the round ball at 300.

A double 24-gauge rifle of Colonel Jacob's, by Manton, 24 inches long, with iron-pointed balls $2\frac{1}{2}$ diameters long, and with $2\frac{1}{2}$ drachms of powder, requires a sight $4\frac{1}{2}$ inches high for 2000 yards; the distance of sight from muzzle being 19 inches. The other elevations may be judged of from this.

Colonel Jacob has some fifty or more rifles made, of all sorts and descriptions, a large proportion of them by the celebrated John Manton and Son; while the cost of target walls alone, used in the course of these experiments, amounts to several hundred pounds, and powder and lead have been expended by the ton.

Colonel Jacob, very early in his trials, discovered that the two-grooved rifle has defects which render it quite unfit for the Army.

If its ball be made to fit loosely, it is at liberty to roll in the direction of its two grooves, and thus the advantage of rifling the piece is, in some measure, thrown away.

If the ball be made to fit tightly, the difficulty of loading becomes a most serious evil. The two-grooved rifle was therefore, after trial, rejected.

The four-grooved rifle with the ball with two bands round it was then tried, and found to be wholly free from the defects of the two-grooved and poly-grooved rifles.

But the proposed four-grooved rifle was rejected by authority, for the reason that the two-grooved rifle, which was thought good enough for the Royal Army, was good enough for the soldiers in India.

All manner of forms were tried, until, after a series of experiments carried on diligently for many years, the Conical ball proved *very greatly* superior to all other shapes thought of up to that time. The round ball was found of little use after 300 yards. This conical ball, though heavier than the round ball of the same calibre in the proportion of three to two, required a charge of powder in the inverse proportion of these weights; that is to say, the charge of the round ball being three drachms, that for the conical ball, with the same range and elevation, was but two drachms.

All manner of rifles were tried, both breech and muzzle loading, of every length, weight, &c., of various twists to the grooves, and of various calibres from 32 to 8-gauge.

The conical ball for a long time held its ground against all others; its advantages were overpowering, and excellent practice was made with it at 600 and even 800 yards.

The experiments had reached this point long before the Minié ball appeared; but immediately that invention was known, great things were expected of it, and it was tried in the fairest manner, and on a large scale.

After long and patient trials, for months together, it was found to *fail completely*.

Under the most favourable circumstances it never equalled, or even approached to, the excellence of the Conical ball, and it was liable to the enormous defect of having the iron cup blown through the ball, the resulting tube of lead not unfrequently remaining firmly and most immovably fixed in the barrel.

The ball had another great defect: it was cast from the foremost end, so that the roughness left by the ingate of the mould, defects of air-holes, &c., must occur *where the form of the ball was required to be most perfect.*

Another ball has apparently some small advantage over the conical ball. It will be observed, that a perfect and very firm hold on the screw formed by the rifle grooves is given by the projections on the ball, quite independently of the action of the expansion principle; while the conical hollow at the back part of the ball gives sufficient expansion to close all windage when the piece is fired, however loose the ball may be when inserted in loading.

The hold on the grooves of the gun being so great, even with the ball quite loose, it was found that the *twist of the rifles could be increased to any extent* required, without the least danger of what is technically termed "stripping;" that is, of the ball being driven through the barrel without following the sweep of the grooves. The rifles were therefore made with the grooves taking one whole turn in thirty-six inches of length; and this twist was found to answer admirably.

The shape of the ball being found to have such great influence on the resistance of the air to its flight, and the twist of the rifles being found of full power to keep the point of the ball foremost with unerring certainty, even in the longest ranges, the form of the ball was still further studied, and in the next adopted. This ball is perfectly and accurately effective up to 1200 yards, and probably to much greater distances. The effect of its shape in overcoming the resistance of the air is so great, that its progressive velocity, after a flight of 1200 yards, is but very little reduced; and even at 1400 yards distance, or further, the percussion shells of this shape burst well.

The shells are formed as follows:—A copper tube of proper size and shape, filled with percussion powder in the usual way, is thrust into a deep opening cast in the fore-end of the ball. The tube is first dipped in melted resin, "kitt," or such like cement, so that it cannot ever become loose; the ramrod end is hollow, so as to press wholly on the lead in loading; all other particulars will be apparent from the figure.

The bead form of the hinder end is not required, the simple flat end being quite sufficient. The solid lead gives way under the pressure of the fired gunpowder quite sufficiently to cause the shell or ball to fit the barrel perfectly air tight.

The Army which should first adopt these weapons would thereby obtain an advantage equal to that of the exclusive possession of fire-arms a century ago. One effect of these would be that the whole of our Field Artillery must become *totally useless.*

The guns must be rifled also! In this case Shrapnell shells would be fully effective at distances of 5000 yards or more.

Nay, from subsequent experiments with Colonel Jacob's pointed balls, it seems that three times this range may be accomplished with cannon. Good practice has been made at Jacobabad with 8-gauge shells, and with iron-pointed balls of like size, at ranges of 2000 and 2400 yards. Flat ended shells, 3 diameters in length, are now found to answer admirably for the smaller calibres. The 32-gauge is large enough for anything, and with the shells above-mentioned, and a charge of 2 drachms of powder, a correct range of a mile and more is readily obtainable. The 32-gauge shells may carry the same bursting charge as has been used with the 16-gauge, so that the destructive power of the explosion is as great with the smaller as with the larger shell.

For cannon-shot the hold on the rifle grooves could be given by a wooden bottom, formed with proper projections to fit the grooves, and fixed to the shot by a square tenon cast on the latter, and a mortice through the wood. The twist of the grooves might be one whole turn in 45 diameters.

In the *Bombay Gazette* it is stated:—The marvellous effects exhibited in the practice at Jacobabad, and more recently at Bombay and Kurrachee, however, are attributable rather to the missile employed than to the engine used in projecting it. This ball, or shell, as it may be, derives its singular excellence mainly from its being of the form best adapted for flight through the air: it requires only one-half the powder that is needed to send one of half its weight, but of less perfect figure, to the same distance! The head of this projectile, which it has been found necessary to form of zinc or iron for the protection of its figure, presents in sectional outline the form of a very acute arch, standing on a cylindrical base of lead of about its own height, partially hollowed at the bottom to take advantage of the expansion principle, and with four vertical bands on its circumference to fit the grooves of the rifle. It must give even a savage respectful notions of science to learn that 3 drachms of powder may be made to send 56 drachms, or nearly twenty times its own weight, of metal from a little tube two feet long to a distance of a mile and a half! Colonel Jacob now makes the points of his missiles—balls we cannot properly call them—of compressed rod iron, and he finds that a 32-gauge shot of this kind, of three diameters in length—that is, of the girth of a spherical leaden bullet 32 to the pound, but three times as long as it is broad—is perfectly effective up to 2500 yards or more.

Wonderful as these facts are, Colonel Jacob contemplates a gigantic step in their extension—by a 4-grooved rifle-cannon, carrying a shot of four inches diameter to a distance of ten miles and more, with force and accuracy.

Among many other instances of practice, Colonel Jacob states:—An ammunition-wagon was exploded at a range of 1200 yards, and next morning at the immense distance of 1800 yards, or 40 yards more than a statute English mile. This last experiment far excels anything that has ever yet been done by any other description of fire-arms.

NEW PROJECTILE.

MR. G. SKELTON has patented an improved Projectile, consisting of an elongated cast-iron case or shell, with a convex base, and the smaller end made tapering, so as to decrease in size one-third of its entire length, upon the periphery of which is formed a spiral groove. Within the smaller end of the projectile is secured a brass tubular box or bush, and in the lower portion of this are formed three conical cavities or vent holes, the opening of each being within the body of the projectile, and next to the powder. Upon the inner surface of the lower portion of the box or bush the percussion cap or detonating powder is placed; a plug or bolt is then screwed into the tubular cavity of the box or bush, the upper portion of the latter being tapped for receiving a corresponding thread upon the plug or bolt to prevent accident. The inventor next inserts a pin in the head of the bolt or plug, so as to rest upon the shoulder of the box or bush, and retain it until the shell is required for use, when the pin must be withdrawn. To exclude moisture, a cast-iron cap is fitted over and screwed to the box or bush, so as to enclose the parts immediately in connexion with the explosive compounds, but which may be removed before the projectile is placed within the gun.

LARGE WROUGHT-IRON GUNS.

MR. W. CLAY has read to the British Association a paper "On the Manufacture of large Wrought-Iron Guns made at the Mersey Iron Works, Liverpool, and on other large masses of Wrought

Iron." The first consideration necessary for the manufacture of wrought iron was, to decide the description of iron of which the gun was to be made, and he selected for his experiment a strong clear iron, puddled from the strongest pigs he could obtain, taking care that the iron should be worked as little as possible before it came to be put into the gun. A core was first prepared the full length of the gun, and of a certain diameter. This core was intended to be bored out. A series of bars was then packed round the core. and again heated and forged to the proper shape ; another series of bars was packed then, and heated and worked perfectly round ; still another and larger series of bars was required, placed longitudinally, and even these were far from the size required. The forging, although larger than any ever previously made, required to be augmented in its diameter at the breech by twelve inches, which was accomplished by two layers of iron placed in such a manner as to resemble hoops. This being all welded round, the forging of the gun was accomplished. The boring was effected in an ordinary powerful lathe, the first bore being eleven inches in diameter, consisting of a drill of seven inches, and a face-cutter of two inches. The second cut three-quarters of an inch on each side, making the bore twelve and a half inches ; and the third, or finishing cut, of a quarter of an inch, completed the bore. He might remark, that the boring was not a work of very great expense or labour ; on the contrary, the process went on so rapidly that he was unable to prepare the fresh boring heads fast enough. The trunnion hoops were made in separate rings, and were shrunk upon the body of the metal.—*Athenæum*, No. 1505.

Some idea of the vastness of this Gun may be gathered from the following particulars of its dimensions :—The barrel is 15 feet long ; it is 27 inches in diameter at the muzzle, or 84¾ inches in circumference ; and 44 inches in diameter at the breech, or 138¼ inches in circumference. The bore is 13 feet 6 inches long, and 13 inches in diameter. It has cost the company 3000*l*. in material and labour alone. The experience of the second day's experiments at Formby was anything but confirmatory of the impregnability of the floating batteries. We were present when a 282lb. ball was fired 120 yards, with a small charge (25lb.), at an iron plate 3 feet 9 inches by 2 feet 9 inches, 4⅜ inches thick, and weighing 17 cwt. The plate was similar to those on the floating batteries, and it was supported against nine balks of timber, imbedded in the sand. It was shattered into a thousand splinters. No floating battery in the world could resist the power of that gun fired at a long range with the proper charge. Our fleet of gunboats and batteries would be useless against it. An artillery officer, of considerable experience, and who has seen much service, was present at the trial to which we refer. On witnessing the effect of the shot, he expressed a belief that such a shot, from such a gun, at a moderate distance, would be sufficient to destroy any floating battery in the service, and that, even if the battery did not sink in consequence of the breach, the splinters, flying in all directions, would prove terribly destructive to the crew.

Trials have been made with this Gun at Shoeburyness. A set of experiments was conducted under the direction of Colonel Mitchell, in the presence of the select committee of artillery officers from Woolwich. They were eminently successful. The practice consisted of about 27 rounds, with solid shot and heavy charges of powder, the range, with 18° of elevation, and a charge of 50lb. of powder, exceeding at first graze 5000 yards. The line of fire was also most admirable, the shot following each other with surprising accuracy. Mr. W. J. Horsfall and Mr. W. Clay witnessed the experiments, as representing the Mersey Company. Since it had been last tried a new and beautiful carriage had been made for the gun, combining the recent excellent appliances introduced by the Woolwich authorities, and which rendered the working of this immense weapon of destruction as easy as that of an ordinary 68-pounder.

At another trial at Shoeburyness, in the presence of the Duke of Cambridge, Lord Panmure, and the Ordnance Select Committee, so confident was the constructor of the gun of its strength and soundness, that, although every one else present retired under the splinter-proof, he stood close beside the gun when the first shot was fired. At an elevation of 10°, and with a charge of 40lb. of powder and *a solid shot*, the enormous range of 4500 yards was reached. The whole of the proof charges were fired, and the gun was considered by all the officers present to be perfectly fit for service.

PATENT MARESFIELD GUNPOWDER.

THIS Gunpowder, which is of perfectly novel introduction, is the result of a course of successful experiments made by a gentleman formerly connected with the Royal Gunpowder Works at Waltham Abbey. Hitherto the manufacture of gunpowder has been almost exclusively confined to two firms, unless we consider the government as another. The three components—charcoal, sulphur, and saltpetre, are the same to-day as they were about the period that Roger Bacon existed. Nor does any change appear to have waited upon the present patent, the whole secret consisting apparently in the more intimate amalgamation of the ingredients. In the ordinary gunpowder, when let off, these three substances did not start fairly, one or other of the three being slower than the others, and consequently left behind. This want of rapidity in the one retarded likewise to a certain extent the other two; but in the present mode of admixture a fair and simultaneous start is made, and the three disappear with a greater detonation, little or no residue remaining upon the spot from which they take their departure. This gunpowder, in consequence of this atrribute, is called "Electric," and truly deserves the title. The manufactory where it was first made is already at work at Maresfield, Sussex, whence its name.—*Mechanics' Magazine*, No. 1738.

HALL'S IMPROVEMENTS IN THE MANUFACTURE OF GUNPOWDER.

AT present the charges of a powder-mill are moistened with water at the commencement of the milling operation, which milling is continued for several hours: as often as the charges become partially dry, they are again damped by sprinkling water over them by hand with a small watering-pot while the mill is in motion; but the distribution of the water is not always uniform, or limited precisely to the quantity required. Mr. E. Hall, of Dartford, has therefore introduced into this part of the gunpowder manufacture certain improvements, which consist in arranging apparatus by which the exact quantity of water can be sprinkled over the charges in a given time, and continued with little variation for an indefinite period; by which means the charges are better worked, the loss from dust is diminished, and less risk of accident is attained.

To provide water for the apparatus, a small pump, with slow motion, is used, to raise a supply to a cistern sufficiently elevated for the distribution of the water by means of small pipes to all the mills which are contiguous, each of the mills being provided with a smaller cistern fixed to the stone shafts, and revolving with them. Each of the shaft cisterns in the mills is provided with a float-valve for admitting a regular supply of water to them, so that the head of water of the sprinkling pipes is maintained in each case at an uniform elevation, which facilitates the adjustment of the quantity of water to be expended on the charges. From the shaft cisterns the water is conducted through small pipes down to near the surface of the mill beds, where a perforated pipe attached to the stone shaft revolves and distributes the requisite quantity of water over the charges. To regulate with precision the quantity of water to be expended on the charges, a cock is provided, with a small aperture, and also an index, so as to be capable of nice adjustment; and below this regulating cock, a stop-cock is provided for shutting off the supply of water from the sprinkling pipes during the time the charges are taken off and others laid on the mill beds. A steam pipe from a boiler is conducted into the water of the shaft cisterns when it is required to be heated for the mill charges, and the steam supply is regulated by a cock, as required.—*Mechanics' Magazine*, No. 1699.

FLOATING BATTERIES.

Mr. T. Grahame has made certain improvements in the construction of Floating Batteries or Vessels, in order to render them ball and shot proof. The battery or vessel is to be constructed of iron, and in order to render the deck and the sides and parts from just below the water line to the deck, ball and shot proof, the inventor employs a considerable thickness of cork, and externally sheathes the vessel with comparatively thin sheet iron, so as to offer small resistance to the passage of ball or shot; and in order to prevent water following the balls which penetrate the outer skin of iron, he uses sheet India-rubber (which will close up) between the different thicknesses of cork, and also between the cork and the iron.

CAST-IRON LIGHTHOUSE FOR THE BAHAMAS.

An engineering work of considerable magnitude and some novelty in its mode of construction has been completed, under a contract with the Admiralty, by Messrs. Grissell, at their ironworks on the Regent's Canal, Hoxton, in the shape of a Lighthouse, built wholly of cast-iron, and intended to be erected on a dangerous rock situated near one of the Bahama group of islands in the West Indies. The height of the tower, exclusive of a large revolving lantern 15 feet high, which surmounts it, is 124 feet; its diameter is 25 feet at the base, and 14 feet at the top; the total weight of metal used in its construction is about 300 tons, and the cost of the whole work is estimated at from 7000*l.* to 8000*l.* This is exclusive of the expense of conveying it to its destination, and of its erection there. It was begun in June 1855, and finished towards the end of January last, with the exception of the interior fittings, which have since been completed. It was erected with the same care and solidity on a spot on the wharf of the contractors, as if that were its final destination.

The whole building is divided into seven floors or compartments, each 16 feet in height. The first, which is about 24 feet from the basement, and reached by an exterior iron stair of the same height from the ground, is fitted up as a kitchen; the second, including also a series of commodious fixtures, will be used as a sitting room; the third as a bedroom; and the remaining stories upwards are to be devoted to purposes connected with the main object of the structure—as a beacon to mariners navigating a perilous gulf in the Atlantic. A huge metal shaft, two feet in diameter, runs up the centre of the building, from its foundation to its summit; and from this, at intervals of 16 feet, strong iron girders radiate to the circumference, and, resting on the framework, there equally ponderous and durable, serve to support the floors of each of the different chambers, and to knit together the exterior portions of the edifice with its centre throughout its whole height. The interior of most of the apartments is lined with corrugated iron, to diminish the heat of a tropical climate; and the whole building is pierced all round at short intervals with small glazed loopholes, for the purposes of light and ventilation. The lantern at the top encloses an immense revolving light, 15 feet in height, containing 21 burners, all showing white lights, except one, which is red, and each of them strongly intensified by a series of brilliant concave reflectors, made of copper, thickly coated with silver. The framework of the lantern is constructed of gun-metal, with a view to the greatest possible durability, and glazed with plate glass five-eighths of an inch thick. The revolver is wound up by machinery, on the principle of an ordinary clock, and will go 15 or 16 hours at a stretch. The whole of the lighting apparatus has been constructed by Wilkins, of Long-acre, who has had great experience in this branch of machinery; and the rest of the work at Messrs. Grissell's has been executed under the immediate superintendence of Mr. Sheaves, the foreman of engineers there. The exterior of the tower consists of 155 cast-iron plates, each weighing from two tons to 15 cwt., and made to fit each other with the greatest nicety. The lighthouse will eventually be fixed on the Great Isaac's Rock, on the Bahama Bank,—a dangerous shoal, situated in the Straits of Florida, between the Island of Bermuda and the Havannah.—*The Times.*

IMPROVEMENTS IN STEREOTYPING.

MR. JAMES HOGG, the publisher, of Edinburgh, and Mr. Napier, a stereotyper of the same place, have invented the following improved process. The first part of it relates to the formation of the matrices, and is as follows:—First, a thick viscid plate is to be prepared by the intimate admixture, in about equal quantities, of red ochre and fine whiting, together with a sufficient quantity of prepared thin glue, starch, and wheaten flour (also in about equal proportions) made up into a paste, a little alum being included in the latter compound. Of the glue and paste there is to be employed just as much as is necessary, when all the components have been properly mixed, to make the compound a stiff paste. A quantity of this is then to be spread upon the surface of a piece of stout packing paper, cloth, or other suitable fabric, and a straight edge of any convenient kind passed over it, so that the coating of paste may be rendered uniform in thickness. The amount of paste spread on should be about equal to the thickness of a threepenny piece, as at present issued from the Mint. This combination of paste and packing-paper (or other substance) is now allowed to stand under the influence of the atmosphere for about half an hour, until the surface becomes nearly dry.* The "page," or "form," of which a cast is required to be taken, is next laid down with the face uppermost, a slight coating of lard or other oil being brushed over it, and the flat matrix laid down upon the face of the types or "form," that surface upon which the paste or composition has been spread being next the oiled face of the "form." In this condition, the whole is to be subjected, in a printing press or other convenient apparatus, to slight pressure, sufficient to press firmly and evenly the matrix into the face of the types upon which it has been laid. A single and very light "soaking" pull at a printing press is sufficient for the purpose, or the impression may be taken by the implements known to printers as a "planer and mallet," used in the same way as when "planing over" a form of types. After the impression is obtained, the matrix must not be moved from contact with the "form" until it has been partially dried, and while this is going on, it is necessary to place a weight of some sort upon the back of the matrix. The best way is to place the bottom of the "form" or "page" upon a plate of heated metal, keeping at the same time some flat heavy weight upon the back of the matrix. In a short time (varying according to the amount of heat employed) the matrix will have partially dried, whilst lying upon the face of the "form," and when withdrawn therefrom will be found to afford an exact reverse copy of the "form" or "page" operated upon.—*Mechanics' Magazine*, No. 1734.

SHARPENING EDGED TOOLS.

It has long been known that the simplest method of sharpening a razor is to put it for half an hour in water, to which has been

* In forming the paste which produces the surface of the matrix, it is to be understood that the patentees do not confine themselves to the exact ingredients or proportions above specified. Various earthy substances, in different proportions, may be employed, but those mentioned are found preferable. It should, however, be distinctly understood that the liquid glue and paste are essential ingredients in the composition, incorporating the earthy substances it may be found convenient to employ.

added one-twentieth of its weight of muriatic or sulphuric acid, then lightly wipe it off, and after a few hours set it on a hone. The acid here supplies the place of a whetstone by corroding the whole surface uniformly, so that nothing further than a smooth polish is necessary. The process never injures good blades, while badly hardened ones are frequently improved by it, although the cause of such improvement remains unexplained. Of late this process has been applied to many other cutting implements. The workman at the beginning of his noon spell, or when he leaves off in the evening, moistens the blades of his tools with water acidified as above, the cost of which is almost nothing. This saves the consumption of time and labour in whetting, which moreover speedily wears on the blades. The mode of sharpening here indicated would be found especially advantageous for sickles and scythes.—*From the German.*

NEW ANCHOR.

IN *l'Avenir d'Anvers* is described a newly-invented Anchor, which has been tested in the Scheldt. The new anchor is called Securitas. Its flukes are moveable. It has no stock, and in any position in which it falls into the water the motion which it receives will infallibly force the two claws to catch instantly, and is stated to produce a hold double the power of the old instrument.

IMPROVEMENTS IN COATING IRON AND STEEL WITH ZINC.

MR. ALEXANDER WATT, the editor of the electro-metallurgical department of the *Chemist*, and whose skill in connexion with electro-metallurgy is well known, has recently patented the following method of Coating Iron and Steel with Zinc :—

He dissolves 200 oz. of commercial cyanide of potassium in 20 gallons of water (rain-water or distilled water being preferable) in a suitable vessel. He then pours into this solution 80 oz., by measure, of strong liquid ammonia (of the specific gravity of 880 by preference). Having stirred these compounds together, he places several large porous cells, such as those used in forming Daniell's batteries, in this solution, and pours into each of them as much of a strong solution of a cyanide of potassium (say about 16 oz. to the gallon) as will be equal to the height of the solution in the larger vessel. He then attaches several pieces of metal (copper or iron by preference) to pieces of copper wire, which are then to be attached to the negative pole of a galvanic battery. These pieces of copper or iron are to be placed in the porous cells. He next attaches a piece or several pieces of zinc to the positive pole of the battery, and then immerses these pieces of zinc in the solution of cyanide of potassium and ammonia. The galvanic battery is now to be set in action, and allowed to continue in action on the above materials until the solution of cyanide of potassium and ammonia has taken up about 60 oz. of zinc, that is to say, about 3 oz. to the gallon of solution. As soon as the pieces of zinc have been weighed to determine the amount dissolved into the cyanide solution, he dips them into dilute hydrochloric acid, and then rinses them, when they are placed aside for future operations if necessary. The porous cells are then to be removed. He now dissolves 80 oz. of a carbonated alkali.

MOORE'S PATENT MILL FOR GRINDING CORN.

MR. T. MOORE, of Retford, has patented an excellent Mill for Grinding Corn and other grain, in which he has combined both steel and stone grinding surfaces. He forms the first and upper grinding surface of a vertical steel cone, which revolves in a correspondingly shaped fixed cone, and below these cones fits ordinary grindstones horizontally. The corn or other grain is fed into and between the steel cones from a hopper, and in its passage through them becomes very quickly bruised and converted into meal, for which purpose it is well known that steel mills are better adapted than stones. After being so converted, the meal falls between the horizontal grindstones, which reduce the meal into flour. The great advantage consists in apportioning each of the grinding surfaces to perform that portion of the grinding operations to which they are best adapted—the steel for converting the grain into meal, and the stones the meal into flour. For an illustrated description of this new mill, see *Mechanics' Magazine*, No. 1712.

IRON LATTICE RAILWAY BRIDGE.

THIS bridge, of novel construction, has been made at Newcastle for the East Indian Railway. It is intended to cross the river Soane, one of the tributaries of the Ganges, and is nearly a mile in length. There will be 29 piers, and the span from pier to pier will be 150 feet, being about 26 feet more than the span of the arches of the High Level-bridge at Newcastle-upon-Tyne. Like that structure it will consist of two roadways, the upper one for the railway, and the lower one for foot-passengers and palanquin bearers, the height from the lower to the upper way being 26 feet. The peculiarity of the construction is that the two roadways are fastened together and supported by latticework of wrought-iron, combining great strength with a light and elegant appearance. The bars are of channel iron, and cross each other diagonally, being firmly riveted together at each crossing. One complete arch was constructed at the Elswick Engine Works, Newcastle, by way of experiment, and the result was most satisfactory. The entire weight is 120 tons. It was made with a slight curve, two inches higher than a dead level, and when tested with a weight of 362 tons it only went down two inches below the level, or four inches altogether in the centre. The separate lengths or arches will rest at each end on five rollers of cast iron, to allow of expansion and contraction, according to the variations of the temperature. The engineer engaged in the construction of this bridge is Mr. George Rendel.—*Manchester Guardian.*

RAILWAYS IN THE UNITED KINGDOM.

THE Report of the Railway Department of the Board of Trade for the year 1855 states that the number of railway bills which came before Parliament in the session of 1855 amounted to 104, and the length of new line proposed to be authorized amounted to 655 miles. But of these bills only 73 were passed; and the total length of line actually authorized was 363 miles. Of the 73 acts passed in 1855, 53 had reference to the construction of works; the length of new line authorized by these acts was as follows, viz.: 196 miles in England and Wales, 76 miles in Scotland, and 91 miles in Ireland.

The number of persons employed on the 30th of June, 1855, upon the railways in course of construction amounted to 38,546, being on the average 43·8 per mile. In June, 1849, when 1504 miles of railway were in course of construction, 103,816 persons were employed upon them, or 69 persons per mile; in June, 1850, 864 miles were in course of construction, and 58,884 persons were employed on them, or 68·15 per mile; in June, 1851, 734 miles were in course of construction, and 42,938 persons were employed, being at the rate of 58·49 persons per mile; in 1854, 889 miles were in course of construction, and 45,401 persons were employed upon them, being at the rate of 51·07 per mile. The money raised by shares and loans for the construction of railways in 1849 amounted to 29,574,719*l.*; in 1850, to 10,522,967*l.*; in 1851, to 7,970,151*l.*; in 1852, to 15,924,783*l.*; in 1853, to 9,158,835*l.*; in 1854, to 12,452,374*l.*; and in 1855, to 11,514,490*l.*, making together in seven years a total of 97,118,319*l.*, being at the rate of 32,000*l.* per mile for the length of railway opened during that period. The number of persons employed on railways open for traffic in the United Kingdom was, in 1851, 63,563, being at the rate of 9·49 per mile; in 1852, 67,601 persons, or 9·55 per mile; in 1853, 80,409, or 10·7 per mile; in 1854, 90,409 or 11·59 persons per mile; and in 1855, 97,952 persons or 12·07 per mile. The number of stations in 1851 was 2107, and in 1855, 2798; showing an increase of 691 stations and of 1418 miles of railway.—*Mechanics' Magazine*, No. 1719.

IRON ROADWAYS IN LONDON.

We have on various occasions in the columns of our journal recorded the several suggestions which have been made for the employment of cast-iron, in lieu of granite, for the purpose of road paving. In the *Mining Journal* of August 16, 1851, May 22, 1852, and November 10, 1855, the subject was fully entered into—the plan of Messrs. Kennard, of Upper Thames-street, submitted to the Commissioners of Sewers, which they were prepared to lay down at their own expense in any leading thoroughfare—that of Messrs. Allen, of Spring Bank Iron Works, Glasgow, who had laid down a portion of iron pavement in that city. As long back as 1836, an experiment of the kind was made on Blackfriars-bridge, and before that a foot paving at the corner of Old-street and the City-road. Iron pavement, like every other mechanical invention, is claimed as of United States origin, which the above dates refute, for it was not until September, 1853, the subject was heard of there, when a trial was made in Boston, on a plan by Mr. W. D. Terry. The Commissioners of Sewers of the City of London determined last year to adopt an iron roadway, on a plan patented by General Knapp, and which was commenced laying down in Leadenhall-street on Wednesday, by the contractors, Messrs. Crook and Son, Tower Royal, London, Messrs. Ransomes and Sims, of Ipswich, being the founders, and Mr. W Haywood, of Guildhall, the engineer. The pavement consists of circular cast-iron rings, about 12 inches in diameter, and 6 inches deep, divided into seven compartments, one in the centre, and six surrounding it, rendering these apertures sufficiently small to prevent the catching of the hoof of a horse. The upper edge of the ring, and all the partitions, are thickly indented with semicircular depressions, about an inch in depth. A projecting hub on one side the ring, and a corresponding depression on the other, fit together, and thus lock the whole roadway into one solid framework. The indentations on the upper edge of the frame, with the gravel employed in filling the whole to the surface, secure a good foothold for the horse, and the advantages claimed for this pavement are—economy in wear and tear, great facilities for removal and relaying, absence of dust in summer, excess of mud in winter, not made slippery in the most severe frosts, and not productive of that noise which is so annoying in granite paving. If the pavement answers these anticipated capabilities, it is the intention of the Commissioners to pave in like manner all the principal thoroughfares of the City.—*Mining Journal.*

IMPROVEMENTS IN RAILWAY WHEELS AND LOCOMOTIVE ENGINES.

MESSRS. W. A. FAIRBAIRN and G. HASLEM, of Manchester, have patented an invention which has first for its object the production of arrangements which will allow the Wheels of Railway Carriages to accommodate themselves to the curved portions of the way, and thus diminish the wear of their flanges, and to provide also against wear on the sides of the axle-boxes. The arrangements consist in giving liberty to the axle-boxes laterally, within certain limits and at certain times, determined by a spring action formed on each side of the axle-boxes, or within the jaws holding the axle-boxes, and acting on each side of them. The spring action may be formed of vulcanized India-rubber, placed in recesses in the jaws holding the axle-boxes, which India-rubber will exert its elastic power upon the sides of the axle-boxes by setting against the plates, loosely fitted in the recesses of the jaws, and coming against the sides of the axle-boxes. The force of the spring action is intended to be sufficient to keep the axles of the wheels at right angles to the straight portions of the railway, but to give way to the pressure created by friction of the rails upon the wheels in curved portions of the way, and by this means allow the axles to assume that position which will accommodate the wheels to the curve of the way. As the spring action will keep the axle-boxes in close contact with the jaws, so as to be at all times a good fit, they will not require "lining" in consequence of wear, as those do of ordinary arrangement.

The improvements relate, secondly, to arrangements in the connecting rods of Locomotive Engines, and principally to those rods connecting the crank-wheels to be coupled together; and they are intended to act as a provision against undue strains, to which such rods are subjected. These arrangements consist in giving liberty to the steps or brasses, within certain limits, determined by a spring action arranged in the slots of the connecting-rods, of wide character, and acting on the steps or brasses (considered to represent the axle-box) in a manner similar to that described above, in reference to the axle-box arrangement.

HOT-AIR LOCOMOTIVE.

The *Scientific American* states that a Locomotive Engine driven by Hot Air, constructed at the Novelty Works, in New York, was tried recently on the Paterson Railway, and attained a speed of eighty miles an hour. It cost 40,000 dollars, and weighs forty tons. This engine is worked by the products of the combustion carried on in the furnace, mixed with some steam which is introduced thereto. The apprehension is expressed in the paper, that such an elastic fluid as is used in this engine must have a corrosive action on the internal machinery of the engine itself.

ELECTRO-MAGNETIC MOTIVE ENGINE.

MR. E. GRENET, jun., has patented an improved Electro-Magnetic Apparatus for Motive Power, part of which may be employed separately for the generation of electric currents. This invention consists —1. In an electro-magnetic engine, consisting of two concentric cylinders placed one within the other, and having formed on them rings of iron, the outer cylinder being stationary and the inner cylinder revolving, both cylinders being provided with electro-magnets, consisting of rectangular soft iron strips or plates fixed to the rings by which the cylinders are surrounded, the plates of the inner cylinder being on its outer surface, projecting radially outwards, and those of the outer cylinder being on its inner surface, projecting radially inwards; copper conducting wires being coiled round the plates for the passage of the electric fluid and the consequent development of magnetic action. 2. In an improved current changer and contact breaker, which effect the simultaneous magnetization of the fixed and revolving parts of the apparatus by two different currents; also in an improved arrangement of contact-makers, and an arrangement of conductors whereby the tension of the electric fluid may be diminished by using derived currents, and which allows of the employment of a single fluid battery. 3. In an arrangement for filling and emptying single fluid batteries. And lastly, in a new arrangement for increasing the surface subjected to the action of the battery.

LOCOMOTIVE ENGINES.

MR. W. BRIDGES ADAMS has patented an invention, consisting in raising the driving wheels of Locomotive Engines to such a height above the rails that they may rest on their peripheries, supported by the peripheries of rolling wheels beneath them. The latter are supported on the rails or road in such manner that each driving wheel will rest on two rolling wheels, and the weight being thus distributed on two wheels, will permit of a great amount of adhesive power, without crushing the tyres, or rails, or road; the rolling wheels being all loose or revolving on their axles, it will not be requisite that they should all be of exactly equal diameters; nor will it be necessary to confine the rolling wheels to any particular diameter, for their rolling movement will correspond to the length round the driving tyres; and two pairs of rolling wheels coupled together, with the driving wheels pressing on them, will be a substitute for what is usually called a coupled engine.

IMPROVED RAILWAY CHAIRS.

A PATENT has been taken out by M. Normandy, for an improved construction of Railway Chairs, which promises to be of importance. The chairs of railways are the cast-iron sockets in which the rails rest, and which attach them to the wooden beams or sleepers stretching across the railway, and which sleepers are covered up finally with gravel. The improved railway chairs, instead of being formed of cast-iron, are formed of wrought-iron. In their manufacture a long bar of the configuration proper for the chairs is rolled out in the same manner as the rail itself, and is then cut into short lengths, each of which forms a chair. A similar result would be attained by rolling the rail with lugs projecting from it at intervals, upon which lugs the rail would rest, and by which it would be secured.—Mr. Bourne, in the *Illustrated London News*, No. 818.

BREAK FOR RAILWAY CARRIAGES.

A MODEL of a Break for Railway Carriages, by Mr. George S. Parkinson, has been exhibited to the Society of Arts. This invention consists in attaching a fixed and a moveable "clutch" on one of the axles of a railway carriage, and to the collar of the moveable clutch is attached a cam. The moveable clutch is put in or out of gear by means of a long rod, working a system of levers. The rod is worked from the guard's carriage by means of chains attached to a drum. The drum being made to revolve by a screw, worked under the control of the guard, the chains are wound up, and the rods drawn, which, by means of the levers throughout the train, cause the moveable clutch on each carriage to be brought into gear with the fixed clutch. The cam attached to the moveable clutch is thus made, on every revolution of the axle, to press against a lever, by which the jambs of the break are brought to bear against the rim of the wheel, during a portion only of its revolution. By this arrangement the wearing of the wheel into "flats" as at present, is said to be prevented, and less destruction is caused to the rails and jambs. It is intended that this invention should be used on two carriages of a train at least, and it can also be applied to work on any number of carriages simultaneously.

WOODHOUSE'S PATENT CROSSING FOR RAILWAYS.

THIS patent consists, as described, in so constructing the rails of crossings that when one part of the wing rail is injured by wear it may be reversed, to bring another portion of the same rail in the place that had been worn; also in substituting the check rails for the wing rails, and using them in the same way. The ends of the wing rails and check rails are of the same length and bent to the same angle; consequently the wing rails may be used as check rails, and *vice versâ*. By reversing the positions of the rails when partly worn, each wing rail can be used four times, and when they are unfit for use as wing rails they can be put in the places of the check rails, and the check rails may then be used as wing rails, thereby enabling the wing and check rails of a crossing to be employed sixteen times before they are completely worn. The improvements are said to be particularly beneficial when the double-headed rails are used, but useful in all other descriptions of rails. The advantages claimed by this crossing are, simplicity of construction and great saving in maintenance, both as regards labour and materials.—*Builder*, No. 674.

POWER OF MEASUREMENT.

At a meeting of the Birmingham Institution of Mechanical Engineers, lately held at Glasgow, Mr. Joseph Whitworth, the President, called attention to " the two great elements in constructive mechanics, viz., a true plane, and the power of measurement." Illustrating his remarks by exhibiting a small machine, by which a difference in the length of the one-millionth part of an inch is detected by the sense of touch, he pointed out the necessity of proper gradations of size in all the branches of the mechanical arts; congratulated the audience on the recent progress of the mechanical arts; and the increase in workmen's wages; referred to the desirability of improving the education of young operatives, predicted that all harvest operations on land properly laid down will very shortly be performed in one-fourth the time now expended in hand-labour; and expressed a hope that the time is not far distant when all remaining legislative obstacles to the progress of the mechanical arts will be swept away.—*Mechanics' Magazine*, No. 1729.

HARMONY OF THEORY AND PRACTICE IN MECHANICS.

Mr. Macquorn Rankine, C.E., on his appointment to the Chair of Civil Engineering in the University of Glasgow, delivered an introductory lecture on the above subject. The lecturer commenced by showing that in geometry, in poetry, in rhetoric, and in the fine arts, the Greeks are our masters, but that in physics and mechanics their notions were pervaded by a great fallacy—a double system of natural laws; and that this fallacy of a supposed discordance between rational and practical, celestial and terrestrial machines, continued in force, and appears to have gathered strength and to have attained its full vigour during the middle ages. In the 15th, 16th, and 17th centuries, the system falsely termed Aristotelian was overthrown, and the truth began to be duly appreciated, that sound theory in physical science consists simply of facts, and the deduction of common sense from them reduced to a systematic form. The lecturer proceeded to show many evils which arise from ingenious and practical men not being acquainted with scientific principles, and how often time and money are expended in visionary inventions, particularly perpetual motion, of which two appeared in the last year's patent list.

A NEW CALCULATING MACHINE.

M. THOMAS, of Colmar, has lately made the finishing improvements in the calculating machine called the arithmometer, at which he has been working for upwards of thirty years. Pascal and Leibnitz, in the 17th century, and Diderot at a later period, endeavoured to construct a machine which might serve as a substitute for human intelligence in the combination of figures, but their efforts failed. M. Thomas's arithmometer may be used without the least trouble or possibility of error, not only for addition, subtraction, multiplication, and addition, but also for much more complex operations, such as the extraction of the square root, involution, the resolution of triangles, &c. A multiplication of eight figures by eight others is made in 18 seconds; a division of sixteen figures by eight figures in 24 seconds; and in one minute and a quarter one can extract the square root of sixteen figures, and also prove the accuracy of the calculation. The arithmometer adapts itself to every sort of combination. As an instance of the wonderful extent of its powers, we may state that it can furnish, in a few seconds, products amounting to 999,999,999,999,999,999,999,999,999,999. A marvellous number, comparable to the infinite multitude of stars which stud the firmament, or the particles of dust which float in the atmosphere. The working of this instrument is, however, most simple. To raise or lower a nut screw, to turn a winch a few times, and, by means of a button, to slide off a metal plate from left to right or from right to left, is the whole secret. The arithmometer is, moreover, a simple instrument, of very little volume, and easily portable. It is already used in many great financial establishments, where considerable economy is realized by its employment. It will soon be as generally used as a clock.—From the *Moniteur*.

SCHEUTZ'S CALCULATING MACHINE.

THIS machine (described in the *Year-Book of Facts*, 1856, pp. 59, 60), having been exhibited at the Paris Exhibition, has also been placed before the Royal Society, who have received a Report upon it from Professors G. Stokes, W. H. Miller, C. Wheatstone, and R. Willis. The history of the origin and progress of this invention was laid before the Royal Society, at its last anniversary, by Mr. Babbage, who took occasion to point out, in a very unselfish and honourable spirit, the claim the ingenious Swede had upon the Society for some distinguishing token of merit and ability. The following is from the address of Mr. Babbage:—

My Lord Wrottesley,—I beg leave to offer a few observations on the distribution of our medals,* but not with the intention of finding fault with their present allotment.

* The Copley Medal of this year was awarded to M. Foucault. "M. Foucault, I present you this medal in testimony of our admiration of the skill, ingenuity, and talent displayed in your very remarkable experimental researches."—*Address of the President of the Royal Society*. The first royal medal was awarded by the Council to Mr. John Russel Hind, superintendent of the *Nautical Almanac*, for his researches and discoveries in astronomy. The second royal medal was awarded by the Council of the Royal Society to Mr. Westwood, on account of his valuable and long-continued researches in entomology.

The distinguished foreigner, whose valuable discoveries you have so ably explained to us, is fully entitled to a Copley medal. I join also most cordially in the justice of the award of the first royal medal to that eminent astronomer who has organized a system for the discovery of new planets, and who has himself already added ten to their number. With the researches rewarded by the second royal medal I am entirely unacquainted; but I am willing to assume that they have been duly considered and justly rewarded.

There is, however, an instrument to which we have given hospitality during many months in these apartments, which I think highly deserving of a medal; and I had hoped that on the present occasion it might at least have been considered worthy of being placed amongst the list of candidates for that honour. I allude to the admirable machine for calculating and printing tables by differences, and producing a mould for the stereotype plates to print the computed results—an instrument we owe to the genius and persevering labour of Mr. Scheutz, of Stockholm. A committee of the Royal Society has already reported upon the machine, and I can myself bear testimony to the care and attention which our Secretary bestowed upon that valuable report. But as some misapprehension exists in the public mind respecting the originality displayed in that invention, I trust that having, as is well known, given much attention to the subject, I may be permitted briefly to explain some of its principles, and thus render justice to its author.

The principle of calculation by differences is common to Mr. Scheutz's engine and to my own, and is so obviously the only principle, at once extensive in its grasp and simple in its mechanical application, that I have little doubt it will be found to have been suggested by more than one antecedent writer.

Mr. Scheutz's engine consists of two parts—the calculating and the printing; the former being again divided into two—the adding and the carrying parts.

With respect to the adding, its structure is entirely different from my own, nor does it even resemble any one of those in my drawings.

The very ingenious mechanism for carrying the tens is also quite different from my own.

The printing part will, on inspection, be pronounced altogether unlike that represented in my drawings; which, it must also be remembered, were entirely unknown to Mr. Scheutz.

The contrivance by which the computed results are conveyed to the printing apparatus, is the same in both our engines; and it is well known in the striking part of the common eight-day clock which is called the "snail." * * * * *

The machine was conveyed to Paris, and placed in the Great Exposition. The jury to which it was referred contained many distinguished names, amongst them that of M. Mathieu, Member of the Institute, who having been for a long period intrusted by the Academy of Sciences with the arduous duty of reporting upon the numerous calculating machines submitted to that learned body, was already familiar with the history of the past. Availing himself of all the printed documents, relating to former difference-engines, and studying those latest illustrations of Mr. Scheutz's machine, which had rendered visible to the eye, in one unbroken chain, the whole sequence of its minutest movements,* this eminent astronomer was in a position to pronounce with authority on the merit of the Swedish engine. That jury, after full examination, concurred with their distinguished colleague in unanimously awarding to it the gold medal.

The Emperor Napoleon, true to the inspirations of his own genius and to the policy of his dynasty, caused the Swedish engine to be deposited in the Imperial Observatory of Paris, and to be placed at the disposal of the members of the Board of Longitude.†

Your lordship is aware that previously to awarding any of our medals, each Member of the Council may place one or more names on the list of candidates whose claims are to be discussed. I regret that (perhaps through inadvertence) the name of Mr. Scheutz was not placed upon that list, and I cannot, my lord,

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* These illustrations were made by my son, Mr. Henry Babbage, an officer of the Indian army, now on furlough in England. They consist of the complete "Mechanical Notations" of the Swedish machine, and were exhibited at the meeting of the British Association at Glasgow, and afterwards sent to Paris for the use of the jury to whom that machine was referred.—See *Phil. Trans.*, 1825, and *Comptes Rendus*, Oct. 8th, 1855, vol. xli.

† This fact was not stated at the meeting, as it had not then reached the author in an authentic form.

sit down without expressing a hope that the Council of the ensuing year may more than repair the omission.

THE WESTMINSTER CLOCK.

We select and abridge the following from a new scientific journal, *The Engineer*, established within the past year:—

The history of the Great Clock for the clock-tower of the New Houses of Parliament dates as far back as the year 1844; for in the month of March, in that year, Mr., now Sir Charles Barry, first wrote to Mr. Vulliamy to furnish him with a plan for the clock, at the same time inquiring upon what terms he would furnish such plan, first, in the event of his being employed to make the clock, and secondly, in the event of his not being employed. In reply, Mr. Vulliamy named 100 guineas for the specification, calculations, working, and other drawings, if he were employed, and an additional 100 guineas if he were not employed.

Shortly afterwards, Sir Charles Barry wrote to the Board of Woods and Forests, saying it was desirable to have the specifications and estimates prepared, forwarding copies of his communications with Mr. Vulliamy, and recommending the acceptance of his offer, which the Board subsequently agreed to. In January, 1845, Mr. Vulliamy, in a letter to Sir Charles, noticed a mistake he had just then observed, viz., that the Board had spoken in its letter of an estimate being prepared, which he (Mr. Vulliamy) had not contemplated making. This communication does not appear to have been answered by the Board or Sir Charles Barry, excepting so far as it was done by a letter, dated July, 1846.

In November, 1845, the late Mr. Dent* wrote to the Board, desiring to be admitted as a candidate for supplying any clocks required for the New Houses of Parliament, including the large one, referring to the Exchange clock as a work of his, and suggesting, in the case of the large clock, that it should be subject to the approbation of the Astronomer Royal, with Sir Charles Barry, and Sir John, or Mr. George Rennie, as referees. To this request the Board replied, that when the drawings and specifications were completed, as the basis upon which the tenders were to be founded, he should be included among the competitors. To this Mr. Dent objected, declining to follow the plans of another clock-maker, but stating his willingness to comply with any suggestions from the Astronomer Royal. In consequence of this objection, it appears that Lord Canning consulted Mr. Airy as to the best means of obtaining such a clock as should be "the very best that the science and skill of the country" could supply. In answer to this inquiry, Mr. Airy alluded to a similar one which had been made by the Gresham Committee, in 1843, with respect to the Exchange clock, and that the reply he then gave was that certain conditions should be laid down, which he himself proposed to furnish; and he further proposed to give a certificate of the work when completed. These suggestions being followed in the case of the Exchange clock, the result had been the production of a clock which was superior to most astronomical clocks, and possessing these advantages, that the first stroke of each hour is correct as to time within less than a second, and that a person standing on the pavement can take time from the face without an error of a second. He suggested the names of Mr. Vulliamy and Mr. Whitehurst as the best makers; but the work was placed in the hands of Mr. Dent, who carried out his views most completely, making some judicious alterations. In conclusion, he proposed that his conditions should be submitted to Mr. Dent, for the purpose of obtaining a

[illegible] Airy's conditions were submitted to both Mr. Vulliamy, [illegible] hurst, and Mr. Dent. It also appears that the tenders were to include the estimated cost of the clock complete. Mr. Airy laid down fifteen principal conditions which were to be followed, the chief of which were, that the frame was to be of cast-iron; the wheels of hard gun-metal, with steel spindles: the pallets were to be jewelled, and the escapement a dead-beat one. Further, the pendulum was to be compensated; the train to have what is called a remontoire.

* It is worthy of note that both Mr. Vulliamy and Mr. Dent died before the completion of the Great Clock.

action; the minute-hand to have a discernible motion at certain definite intervals; and the striking machinery to be arranged so that the first blow for each hour was to be accurate to within a second of time.

In April, 1847, Mr. Vulliamy transmitted to the Board, through Sir Charles Barry, his drawings and specifications, but without any estimate, having previously declined to become a competitor under Mr. Airy's conditions. The tenders of Mr. Dent and Mr. Whitehurst were about this time also forwarded to the Board, and were, together with Mr. Vulliamy's plans, submitted to Mr. Airy. In May, 1847, Mr. Airy reported to the Board to the effect that having examined their factories, either Mr. Dent or Mr. Whitehurst were capable of constructing the clock satisfactorily, noticing the great difference between the two estimates sent in, Mr. Whitehurst's being 3373*l.* and Mr. Dent's 1600*l.*: but admitting that he could not account for it, unless on the supposition that Mr. Dent was disposed to construct the clock at a loss, for the sake of the reputation he hoped to acquire by making it; whereas he presumed Mr. Whitehurst's was a paying price. He finally declined to offer any suggestion as to which of the two candidates should be employed. In a separate letter to the Board, Mr. Airy remarks upon the plans, &c., of Mr. Vulliamy, which had been submitted to him, as wanting nothing in regard to provisions for strength, solidity, or size, but that they failed in delicacy of action; amounting simply to a large village clock, but of a very superior character.

From May, 1847, to January, 1850, nothing further was done in the matter of the Great Clock; and at that time Mr. Denison suggests a doubt in the preface to his book on clock-making, whether the clock would really ever be made at all.

Shortly after this, however, this important and so much talked-of work was finally placed in Mr. Dent's hands, and in 1854, we find it had already been at work for two years, in the very place where it at present stands (October, 1856) in Mr. Dent's factory.

The merit of the design of the Westminster Clock is due to Mr. Edmund Beckett Denison, M.A., a gentleman who has devoted very considerable time to the study of clock and watch-making, and who has at various times introduced many important improvements in their construction. The dials of the clock are to be twenty-two feet in diameter, the largest in the world with a minute hand; the larger dials on the Continent having only hour hands. The minute hand, on account of its great weight, and the velocity at which it must travel, together with the action of the wind upon it, will require about twenty times as much force to drive it as the hour hand. Moreover, the clock going a week instead of a day, again very considerably increases the weight and strength required, especially in the striking parts. It is stated that with hands of the size intended, it would be impossible for the clock to go, even as well as an ordinary church clock, if there were no remontoire work, and this has therefore been adopted. It has, in fact, a train remontoire and a gravity escapement. The train remontoire is for the purpose of giving a visible motion to the hands at every half minute, when the point of the minute hand will move nearly seven inches. The gravity escapement is adopted because it is more independent of these peculiar causes of vibration which are found to affect clocks in such a position as the Westminster Clock will occupy. The great wheel of the going part is twenty-seven inches in diameter; the pendulum is fifteen feet long, and weighs 682lbs.: and the scape-wheel, which is driven by the musical-box spring on the third wheel, weighs half-an-ounce. All the wheels, except the scape-wheel, are of cast iron, but with the teeth cast, not cut, and all have five spokes.

The barrel is 23 inches diameter, but only 14 inches long, as this part will not require a rope above ½ inch thick, and 55 turns in the 8½ days, for which that part is to be capable of going, though the striking parts go only 7½ days, so that in case of an accidental omission to wind it up on the proper day, the clock may not stop, but proclaim the neglect by silence. The second wheel is 12 inches in diameter, with a lantern pinion of 12, driven by 180 teeth on the great wheel; it has 120 teeth, and drives the pinion of the spring remontoire and the fly. This part has all the back pivots on the great clock-frame, and the front ones on an intermediate bar laid upon two cross ones, the width of the frame for the striking parts being very nearly 5 feet, whereas only 2 feet is required for that of the going part. The leading-off arbor, however, comes to the front of the great frame, and there are the snails for discharging the striking parts, and also the first pair of bevelled wheels, which are 16 inches in diameter. The winding arbor also comes through the front frame.

The size of the hour bell, which was originally given as 14 or 15 tons, and therefore above 9 feet in diameter, and nearly 8 feet high, fixes the size of the striking parts; for that determines the weight of the hammer, which must not be less than 4 cwt., according to the usual proportion, with a rise of at least a foot; it will probably be cast from the pattern of the pendulum bob; and that, with a proper allowance for loss by friction, &c., fixes the striking weight at something more than a ton and a half; and that requires a wire rope of a certain thickness (6·10 in.), which must have a barrel of a certain length and diameter for such a number of coils as will give the most convenient arrangement of the striking cams, which are 18 in number, cast on a wheel of 37 inches in diameter; and that size again was necessary in order to keep all the wheels clear of the barrel. The cams are 2½ inches thick, the same thickness as the great wheels; and the hammer lever is of corresponding size. The winding wheel on the end of the barrel, both of the hour and quarters, is of the same size as the respective great wheels, and as a double multiplying power is required for winding up, the second winding wheel and its pinion are also the same as those of the train in each case; these winding wheels push out of gear with the great winding wheels, but not with their own winding pinions, which are made long for the purpose. There is a contrivance for stopping the winding when the clock is going to strike, as the winding of each of the striking parts will take two hours. The second wheels are a little more than 18 inches in diameter. The second train wheel in each striking part drives a bevelled wheel, which drives the fly above the clock on a vertical arbor, as in the Exchange clock, in order to keep it out of the way of people winding or examining the clock. The great wheels all have 180 teeth; the second wheel of the hour-striking part has 105 and a pinion of 15, so that it turns two-thirds round at each blow, and the lifting cylinder upon its arbor has 3 segments cut of it, and two of them are passed at each blow—probably a novel arrangement, but the most convenient here with reference to the numbers of the teeth. The size of the hour-bell also determines that of the quarters; the largest quarter bell will be about the same size as the great bell of St. Paul's, which weighs 5½ tons. In the quarter part the arrangement is much the same as the hour. The eight cam wheels, which in fact form a chime barrel for the eight hammers of the four bells, have been mentioned already. The levers are 19 inches long from the arbor to the end which is pulled down by the cams, and the wire goes up from near the end, the wheel turning, so that the weight acts as directly as possible on the levers, with nothing but differential pressures either on their arbor or on that of the great wheel. The great wheels in this part are 38½ inches in diameter, and the whole mass of the barrel, great wheels, and cam wheels weighs no less than 17 cwt. This clock may be said to be at least eight times as large as a full-sized cathedral clock, since the wheels are rather more than double the size in every dimension. The whole of the wheels, except the fly wheels and winding pinions, lie on the top of the great frame, which is a trussed girder frame 19 inches deep (like the girders of the Crystal Palace), resting on two walls 11 feet apart, which come right up from the bottom of the tower. The frame is 15½ feet long, and the striking pulleys about 2½ feet in diameter, and pivoted in. To test the strength of cast-iron teeth, a segment of one of these great wheels was tried up to breaking point, and it bore a pressure of 6 tons, and then only broke from the pinion not bearing quite flat upon it: the heaviest weight which the teeth can have to bear in action will be about half a ton.

The pendulum of the clock is a compensation one, *i.e.*, it is so contrived that the centre of the bob is always kept at the same height. Various contrivances have been adopted from time to time for the purpose of compensating pendulums, the old form being known as the gridiron pendulum, which was composed of nine alternate bars of brass and iron. This was superseded by a pendulum of the same form, but composed of zinc and iron.

The iron rod which runs from top to bottom, ends in a screw with a nut for adjusting the length of the pendulum after it was made by calculation as near the right length as possible. On this nut rests a collar, which can slide up the rod a little way, but is prevented from turning by a pin through the rod. On a groove or annular channel in the top of this collar stands a zinc tube 10 feet 6 inches long, and nearly half an inch thick, made of three tubes all drawn together, so as to become like one; for it should be observed that *cast* zinc cannot be depended on; it must be drawn. On the top of this tube or hollow column fits another collar with an annular groove much like the bottom one. The object of these grooves is to keep the zinc column in its place, not touching the rod within it, as contact might produce friction, which would interfere with their relative motion under expansion and contraction. Round the collar is screwed a large iron tube, also not touching the zinc, and its lower end fits loosely on the lower collar; and round its outside it has another collar of its own, fixed to it, on which the bob rests. The iron tube has a number of large holes in it down each side, to let the air get to the zinc tube: before that was done it was found that the compensation lagged a day or two behind the changes of temperature, in consequence of the iron rod and tube being exposed while the zinc tube was inclosed without touching the iron. The bottom of the bob is 14 feet 11 inches from the top of the spring, and the bob itself is 18 inches high, with a dome-shaped top and 12 inches in diameter. As it is a 2-seconds pendulum, its centre of oscillation is 13 feet from the top, which is very near the centre of gravity of the pendulum, and higher than usual above the centre of gravity of the bob, on account of the great weight of the compensation tubes. The whole weighs 682lb., which is half as heavy again as the Post-office clock pendulum, which was before the heaviest probably in the world; it has a wooden rod with an iron bob. The same proportions hold for zinc compensation pendulums of smaller size, the zinc tube and the iron tube being always nearly two-thirds of the length of the main rod. The compensation action is this: the iron rod and tube both let the bob down as they expand, and the zinc column pushes it up: and as the ratio of expansion of iron to zinc is ·41, it will be found that by the above proportions the centre of oscillation will remain at the same height.

Two other kinds of compensation pendulums are in use, the one consisting of a wooden rod, with a long lead bob resting on a nut at the bottom; the other being the mercurial pendulum. The best form of the latter being those in which the mercury is enclosed in a cast-iron jar, into the top of which a steel rod is screwed, with its end plunged into the mercury. By this arrangement all acquire the new temperature at any change more nearly together than when the mercury is in a glass jar, hung by a stirrup at the bottom of the rod.

The kind of escapement adopted by Mr. Denison for the Westminster Clock is a remontoire, or gravity escapement, in which the three teeth, or legs, are bent, so that the lifting-pins and the points of the teeth lie alternately on the radii of a hexagon. The pins are plain bits of brass wire riveted into the scape-wheel, which is of steel.

The pins raise the pallets by the projecting faces, and the long teeth rest on the stops, which are bits of steel screwed on, and hardened after they are adjusted. The points of the teeth are about six times as far from the centre as the pins are, and consequently their pressure on the stops is not enough to hold the pallets up if they do by accident get thrown too high; and thus the effects of approximate tripping are prevented, for the pallet immediately falls down again, and rests against the pin which lifted it until the pendulum returns and carries it off; moreover, the friction at unlocking is thus rendered insensible. The beat is adjusted by two thumb screws, with broad and slightly convex steel heads set in the pendulum rod, which are embraced by brass fork pins from the bottom of the pallets. In turret clocks, where there is plenty of room, there are no beat screws, but the fork pins are made eccentric and so adjustable by the nuts which fix them to the pallets. In the finest clocks the lifting faces of the pallets are jewelled, so that no oil is required. In turret clocks, however, there has been a striking proof that the escapement is sufficiently independent of oil, for the first of these clocks was sent out to the cathedral at Fredericton, and the person who takes care of it reports that he could observe no variation of the arc during winter, even while the oil was frozen as hard as tallow. A very material feature in this escapement is the fly, which is set on the scape-wheel arbor, with a friction spring, just like a common striking fly. It is this which moderates the velocity and renders it safe against tripping, and against any damage to the teeth from an accidental run, the motion of 60 deg. at each beat being quite enough to render the fly effective. In turret clocks the fly is made about 5 inches long in each vane, and 1¼ broad; in regulators, or clocks of astronomical size, about 1½ long and ¾ broad. The stop, which is struck upwards, should be set a little higher than the scape-wheel centre; for if not, the blow has a tendency to throw the pallet out and make it trip, if the force is much increased; the other stop may be about on a level with the centre, and the distance of the pins from the centre may be about 1-36th of the distance of that centre from the pallet arbors; the weight of the pallets should be such as to make the pendulums swing not less than 2°, nor more than 2½°. In regulators, the distance of centre has been generally made 6 inches (the scape-wheel being put near the bottom instead of the top of the frame), and in turret clocks 9 inches, except in the great Westminster Clock, where it is 12 inches, on account of the great size of the pendulum, which was made before this escapement was invented. Besides the other advantages, it supersedes the necessity for a long and heavy pendulum, which is generally wanted to resist the variations of force in the escapement; but here no such variations exist, at least none that reach the pendulum.

In working the Westminster Clock, wire-rope has been used in preference to hempen, not only because it lasts longer, if kept greased, but because a sufficient number of coils will go on a barrel of less than half the length which would be required for hemp ropes of the same strength without overlapping, which it is as well to avoid if possible, though it is not so injurious to wire ropes as it is to hemp ones. By this means also the striking cams can always be put on the great wheel instead of the second wheel, which saves more in friction than could be imagined by any one who had not tried both. In the great Westminster Clock it was thought of so much consequence to get the striking from the great wheel, both in the hours and in the quarter chimes on four bells, that eight cam wheels are used for the quarters, as some of the blows are repeated on the same bell too closely to get sufficient drop for the hammer levers without using two alternate hammers to each bell. If it had been made on the plan first proposed, of striking from the second wheel, and the friction aggravated by a number of pulleys and hemp ropes, which must have been an inch and a half thick, the striking weights would probably have been nearly four tons each, although they have the enormous fall of 170 feet; and the clock would have taken a whole day to wind up. As it is, they will be a ton and a half each, allowing a waste of about a quarter of the force, in friction, and in the interval between the fall of the hammer and its beginning to rise again.

In the case of the Westminster Clock, the annoyance of the clattering of the clicks, during the several hours it will take to wind up, is got rid of by stopping their drop on to the teeth by check springs, for which there is plenty of room.

We have thus given what we fear will be considered a somewhat imperfect description of the Great Westminster Clock, and have noticed some of the chief points of interest which render it different from any clock which has yet been constructed. For most of the facts given above we are indebted to the small treatise on Watch and Clock-work by Mr. Denison, as also to the article in the eighth edition of the *Encyclopædia Britannica*. We are also indebted to the present Mr. Dent, and his manager, Mr. Smith, for the assistance they have at all times rendered us in explaining many of the minute parts and most ingenious contrivances which characterize this beautiful piece of mechanism.—From the *Engineer* for October 31, 1856, which see for illustrations of the clock and its details.

THE GREAT BELL FOR THE WESTMINSTER CLOCK.

THIS Bell has been cast at Norton, near Stockton-on-Tees. When raised from the pit, and sounded for the first time with a clapper of 7 cwt., the casting was said to be clean, and the tone fine. The diameter is 9 feet 5½ inches; the height outside, 7 feet 10½ inches; inside 6 feet 8 inches: it shrunk less than was expected in casting. The note is E flat. The bell has the following inscription running round it, just above the sound bow:—"Cast in the 20th year of the reign of her Majesty Queen Victoria, and in the year of our Lord, 1856, from the design of Edmund Beckett Denison, Q. C.; Sir Benjamin Hall, baronet, M. P., Chief Commissioner of Works."

of the founders and patentees of the mode of casting which has been adopted for it,—"John Warner and Sons, Crescent Foundry, Cripplegate, London." The quarter bells will now be proceeded with: the largest of them will be 6 feet in diameter, and will weigh about 4 tons, and is also to be cast at Norton. The weight is now stated to be 15 tons 18 cwt. 1 qr. 22lbs. or 16 tons within a small fraction. The thickness is 9⅜ inches at the soundbow, where the hammer strikes, and 3⅛ in the upper part, being very nearly 1-12th and 1-36th respectively of the diameter of the mouth, 9 feet 5½ inches. The great bell had to be sent down from Norton to West Hartlepool by railway, being too wide for any train meeting it to pass. The composition is 7 of tin to 22 of copper, melted twice over, as in speculum metal, to secure a perfect alloy. The metal is nearly as hard as spring steel, and much harder than is usual in modern bells, in which the proportion of tin is less than in the best old ones. When the bell arrived at Westminster, it was hung for trial at the foot of the clock-tower, with a clapper of half a ton, pulled by five or six men.*

CITY OBSERVATORY AND TIME-BALL.

A TIME-BALL for the City has been erected on the roof of the premises of Mr. French, the eminent goldsmith and watchmaker of 62, Cornhill. This observatory is in direct communication and connection with Greenwich Observatory, the Government ball at Deal, and those of the Electric Telegraph offices in the Strand and at

* Mr. Denison, in a discussion at the Institute of British Architects, has stated the following list of the largest Bells in the world, according to the best information he could get from various sources:—

	Weight. Tons.	Cwt.	Diameter. Feet.	In.	Thickness. Inches.	Note.
The great bell of Moscow, broken in 1737	193		21		23	
Bell at the Kremlin, fell in 1855	63		...		...	
Pekin	53		...		...	
Novogorod	31		...		...	
Vienna, 1711	17	14	9	10	...	
Sens	15	0	8	·7	...	
Westminster, 1856	14	0	9	2	9	E flat
Erfurt, 1497, "Maria Glorioso"	13	15	8	7¼	...	F
Notre Dame, Paris, Louis XIV.	12	16	8	7	7¼	F probably
Montreal, 1847	12	15	8	7	8¼	F
Cologne	11	3	...		...	
York, 1845	10	15	8	4	8	F sharp
Bruges	10	5	...		...	G
St. Peter's, Rome	8	0	...		...	
Oxford, 1680	7	12	7	1	6¼	
Antwerp	7	3	...		...	
Exeter, 1675, very thick in the waist	5	11	6	4	5	A?
Lincoln, 1834	5	8	6	10¼	6	A
St. Paul's, 1709	5	4	6	9¼	...	
Ghent	4	18	...		...	
Boulogne, modern	4	18	...		...	
Old Lincoln, 1610	4	8	6	3¼	...	B
Fourth quarter bell Westminster, 1856	4	0	6	1¼	6	B flat

The Westminster Great Bell has been named after Sir Benjamin Hall, Bart., the Chief Commissioner of Woods and Works, "Big Ben."

Liverpool, and is discharged every day at one o'clock by electric current from Greenwich direct; it being the positive, exact and instantaneous mean time issued by the Greenwich Observatory. The ball is fixed in a very elevated position, on one of the highest spots in London, and is visible to the shipping in the river. The apparatus is surmounted with a cross, to which the ball is wound up previously to each discharge, the cross terminating with the cardinal points, and a vane. The whole is 150 feet above the level of the Thames. The instrument for locking and unlocking the ball is ingenious. The shaft, air-cylinder, and piston are of great size and power. The air-cylinder breaks the fall of the ball, and prevents concussion, although the weight of the ball and piston and rack which fall with it is no less than 5 cwt. Great credit is due to Mr. Sandys, the electric telegraph machine maker, who erected the ball, which is of zinc, 5·6 diameter, 16·6 circumference, and would contain 12 persons sitting round a table inside it, with 6 inches to spare. At a quarter before one, a detent drops into a notch in the periphery of the hour-wheel, within a minute of the hour a similar operation is performed upon the minute-wheel, and within a second of one o'clock a third detent locks a roller on the arbour of the seconds'-wheel, thereby detaining it (the pendulum still oscillating) until the arrival of the current at one, when the magnets attract an armature which releases the train and allows the clock to proceed.

DEEP-SEA SOUNDING INSTRUMENT.

CAPTAIN T. SPRATT, of H. M. steam-vessel *Spitfire*, who has for some time given his attention to the best means for obtaining correct soundings at great depths, and tried several appliances for this purpose, has submitted to the Hydrographic Department of the Admiralty the following description of a Deep-Sea Sounding Instrument, which appears to possess considerable ingenuity, simplicity, and neatness :—

"The inventor of this new and clever instrument," says Captain Spratt, "is Carmelo Bonnici, a Maltese, and the blacksmith of the *Spitfire* since she was commissioned in 1851.

"Several other instruments for this object having been previously made by him, in the course of the past year he produced the one now recommended for a fair trial in depths and conditions that do not occur in the sea I am now employed in.* But it has answered perfectly in depths of 300 fathoms and under; and I have no doubt will answer equally well in any depth yet reached, where it is desirable for the weight to become detached on reaching the bottom, and not possible during its descent.

"The advantage it possesses over the American instrument, of a rod passed through a shot, described by Lieut. Maury, U.S.N., and which has been so generally used by Lieut. Lee, in the recent voyage of the U.S. ship *Dolphin* in the Atlantic Ocean, is obvious at first examination, viz., in its application to any kind of weight that can be slung with a simple white line becket or loop. Thus, a pig of ballast, an old fire bar, or an elongated weight of any kind can be used; which, from its more rapid descent than a spherical body (a shot as used by Lieut. Lee, U.S.N.), possesses great advantages under circumstances of sounding where there is a superficial current.

"With the instrument is used a small cup or hollow cylinder, containing some

* Viz., the Black Sea.

arming to bring up an indication of the bottom. This is fastened to the instrument by a small wire or line, and is attached by the two projecting points that act as springs to grasp the end of the weight, if sufficiently pointed, or to a piece of stick lashed to the pig of ballast or weight for the purpose.

"It will be seen that the weight is taken up by the instrument by placing the arms in such a position as to open the double hook connected with the arms. And with the arms placed erect, the sinker is held by the instrument during its descent; but on reaching the bottom it becomes released through the two arms falling downwards by their gravity.

"This instrument being one that may be of great use in every survey, I trust the inventor will meet the reward his ingenuity merits, and that it may be generally adopted in all our surveying vessels."

NEW NAUTICAL INSTRUMENTS.

MR. R. REEDER, of the Underwriters' Rooms, Liverpool, has invented an instrument which is a combination of a universal dial and chronometer, by the aid of which horizontal bearings in any latitude may be ascertained at any time of day. The accuracy of the instrument depends upon the correctness of the chronometer by which the index is moved, and its adjustment to the meridian of the place. It is said to be well adapted for correcting the errors of the magnetic needle, and would be useful in high latitudes, where the needle acts inaccurately, or, as in many instances, not at all. Captain Comstock, of the British and North American royal mail steam-ship *Baltic,* and Captain Clarke, of the ship *Boston,* have given testimonials of the efficacy of the invention as applied to navigation.

Mr. W. D. Gray, master mariner, of London, has patented the following apparatus for indicating the course or direction and distance run by a ship. He employs outside the hull of the ship a fan or screw, placed below the keel, which fan or screw revolves with the action of the water as the ship moves through it. By means of an axle, cog-wheels, &c., it communicates a rotatory motion to a rod, which in its turn gives rotatory motion to a cylinder by another set of cog-wheels; and this cylinder is in contact with one end of a feeding tube, and has small cavities indented on its circumference. The apparatus is also furnished with a magazine for holding small shot, communicating with the other end of the feeder. The action of the apparatus is such that the shot are conveyed by a number of flexible tubes to a like number of bags suspended around the circumference of a disc, which disc is poised at its centre on a pivot, like the magnetic needle, so that it can incline or dip in any direction whenever a preponderance of shot in the bags may cause it to do so. On one surface is printed the points of the mariner's compass, and on it is also placed a small ball, which acts as an indicator to show the point of greatest inclination, which it does by its gravity, the disc having a raised edge to prevent the ball from rolling off. The point thus indicated is the course of the vessel, and the distance is obtained by ascertaining the force with which the said disc inclines, which is done by placing at the point exactly opposite the point of inclination a weight sufficient to balance the disc. A steelyard is used to facilitate this operation.—*Mechanics' Magazine,* No. 1719.

WATER-METERS.

In a paper read to the Institution of Civil Engineers, by Mr. T. T. Jopling, "On Recent Improvements in Water Meters," it was shown, that there had been at least eleven distinct classes of Meters, and probably not less than ten varieties in each class, which could be taken as one hundred and ten distinct inventions. They might be divided into two great classes:—high-pressure meters, *i.e.*, working under the direct pressure of the mains, and delivering the water without any sensible diminution of the pressure; and low-pressure meters, which, receiving the water under pressure, merely delivered it into a cistern, or other receptacle, generally situated at the top of the building to be supplied. The latter class was asserted to be generally the best, especially in those cases where the consumption was large and irregular,—as that of brewers, dyers, bleachers, calico-printers, &c. Of this class, Parkinson's was said to register accurately under all circumstances of change of head, and velocity, or quantity delivered. The piston, diaphragm, puff-bag, and screw-meters, were then successively described. In reference to Siemens' meter it was asserted, that it was in principle simply a turbine, or a Barker's mill, and that it partook of the errors of those machines, which no superiority of manufacture, or skill in invention, could entirely overcome. It could not register so small a quantity as would not give impulse to the machine. It had also been remarked that, in some situations, it was liable to become corroded, which materially lessened the speed, and that, in some instances, the meters had actually been stopped.

WARSAW WATER-WORKS.

We learn with much pleasure from Warsaw, that the Emperor Alexander has presented Mr. John Head (eldest son of Mr. Jeremiah Head, of Ipswich) engineer of the water-works in that city, with a magnificent gold ring, set with eight diamonds, accompanied by a letter, thanking him for the zeal and energy which he has displayed in the construction of these water-works.

The engines were manufactured by the Messrs. Ransomes and Sims, of Ipswich, under the superintendence of their late engineering manager, Mr. Henry Warriner, and consist of a pair of high-pressure, condensing, expansive beam engines, of forty horse power; their superior construction and excellent finish have elicited the highest encomiums from numerous scientific gentlemen who have inspected them.—*Mechanics' Magazine*, No. 1736.

EXCAVATING MACHINES.

Mr. W. J. Curtis, Islington, has invented an improvement in combining machinery for excavating land for constructing tunnels. For this purpose, a rectangular or suitable form of frame, of a size depending on the intended tunnel, is constructed; and is arranged, when placed in an upright position, to be moved forward by hydraulic pumps or mechanical means pressing against the work which has been completed. There are three uprights: the two outer ones have reversed screw threads formed thereon, in such manner that a screw nut on each of them, when caused to rotate, shall ascend its upright, and then, when it arrives at the end, again descend. These nuts turn between two plates, which carry an endless chain, and chain-wheels by which the chain is carried. The central upright is a shaft which gives motion to the chain-wheels and chain. In order to cut or remove the land in front, the chain carries ploughs or cutters, which cut away the land in front as the chain is caused to move. The central upright or shaft is put in motion by a steam-engine, which moves on suitable rails up to the work. Rails are also laid as the work progresses, so that trucks may bring up bricks and materials to build up and form the tunnel, and the earth is raised into the empty trucks by suitable buckets or lifters, put into motion by the steam-engine.

KIND'S SYSTEM OF MINE-BORING.

MR. KIND has been engaged in boring a new Artesian well in the Avenue Charles X., at the angle of the Avenues St. Cloud and Petit Parc, near Paris, for the purpose of supplying the ornamental lakes of the Bois de Boulogne. A paper has been communicated to the Académie by M. Dumas on the subject, from which it appears that Mr. Kind has undertaken to bore a well 29 inches in diameter, and continue the sinking, if necessary, to the depth of 2500 feet, and thus obtain a daily supply of 10,000 cubic meters of water, being nearly equal to the volume of water delivered by the Seine through the Pont de la Tournelle at Paris. The boring was commenced on August 2nd last, with a diameter of about 41 inches. For some time, when the operations were through marl and chalk, the average daily progress was 16¼ feet; then, through sand, it was reduced to 8¼ to 10 feet; and having reached another stratum of chalk, containing boulders, the speed was 5 feet, the depth being then upwards of 980 feet. By May 1st next, it is expected that the enormous depth of 2360 feet from the surface will be attained, being more than 490 feet deeper than the Artesian well at Grenelle. The sole motive power is a steam-engine of 24-horse power.

MINING MACHINERY.

MR. W. RADLEY has patented certain improvements in machinery, apparatus, materials, and processes for preparing and treating auriferous, argentiferous, and cupreous rocks, minerals, and alluviums.

This invention relates—1. To the preparation of the rock mineral and alluvium. If the substance is quartzose or trappeau the inventor breaks it into pieces a hen's egg in size, and subjects it to calcination in a close kiln, with or without an alkaline or earthy sulphide or chloride, during one to four hours, at a full red to white heat, and withdraws it into water, preferably hot, and thus renders it more friable and easy to crush and grind.

2. To crushing and grinding. The material to be crushed is to be introduced into a "gyro stamper" constructed thus:—A basin or mortar of cast iron or stone, of the general form of an apothe-

cary's mortar, is used; but, instead of being hemispherical in its cavity, it is preferred to make it a paraboloid, and identical with one-half, or less than one-half, of an ellipse sectionally of small eccentricity, cut in its transverse diameter. To this mortar is adapted a pestle-head of cast-iron, steel, or stone, in the general form of this well-known instrument, whose lower surface shall answer to that of the elliptic mortar, and occupy from one-half to two-thirds of the concave surface of the same.

3. To the machinery for effecting the amalgamation of gold and silver as a separate operation; and consists of an amalgamating barrel, a mercury retort and furnace, and an amalgam separator.

4. To exposing pyritic minerals, before or after the process of auriferous amalgamation and the action of the atmosphere, in beds, heaps, or layers, underlaid with conduits leading to tanks to collect and reserve the solutions percolating through. Upon these beds of material water is thrown from time to time in a shower to imitate rain.

5. To those quartzose or trappeau rocks, minerals, and also alluviums, wherein the gold, silver, &c., is in such a state of combination, or is otherwise in a metamorphic condition, that none of the previously described processes can separate them therefrom; and consists in acting upon the substance, before or after calcination, but preferably after being pulverized, first with dilute sulphuric acid to separate all matters that may be found soluble therein; and, secondly, after washing and subsidence, with a proper mixture of hydrochloric and nitric acids within a Woolfe's series of any convenient material, or with chlorine produced from any ordinary generative mixture—the rock mineral or alluvium being diffused in the compound acid in the one case, and in water in the other.

6. To the sulphurous fumes escaping or liable to escape from the processes of calcining or washing pyritic substances generally, and consists in the collection of such fumes, and their conversion into sulphurous and sulphuric acids.

STEAM-HAMMERS.

MR. NAYLOR, of Norwich, is stated to have made an improvement in the Steam Hammer, consisting in its adaptation to all descriptions of work brought under it. It can deal with a small piece of iron with the greatest precision—be it never so small—or it can efficiently operate upon a piece of iron six or seven inches thick. It can be made to strike a light or heavy blow at will, and, if necessary, the light and heavy blows can be given alternately, while it is dealing two hundred blows a minute. The rate of working may, moreover, if desired, be reduced to less than one hundred blows per minute. Most power hammers obtain their force by their accelerated velocity in their fall. Consequently, when working upon a large piece of iron, the greatest force is necessary; but, as the distance of the fall of the hammer is reduced by the thickness of the iron it is operating upon, the full power of the hammer cannot be exercised. Mr. Naylor has, however, a provision for this difficulty; for by his peculiar and exactly weighed, and the balance-lever, by its position, directs a spout to the opening, leading to the division-boxes, which receive the light, the medium, and the heavy pieces. At the same moment the sliding movement impels the blank pieces into the conducting spout, making room thereby for succeeding pieces to fall upon the table of the balance-lever of the machine. By such continued action the machine proceeds uniformly to weigh, as before mentioned, from twenty to thirty pieces per minute, a cone of pulleys regulating the different speeds. The weights used with these machines are crystals, by which the change of temperature, so materially affecting metallic substances, is thoroughly guarded against.

Nearly similar machines, also of Mr. Cotton's invention, are used at the Bank of England for the weighing of light coin brought to that establishment. The difference in the arrangement of the machines used at the Bank from those at work at the Royal Mint is simply as follows :—The Bank machines are directed to only two results, namely, light and standard weights; while those at the Mint have three separate actions, namely, the weighing of gold and silver pieces, standard, light, and heavy—boxes being ingeniously contrived to receive each of these classes. The machines are manufactured by Messrs. D. Napier and Son, the eminent engineers, and are specimens of highly-finished workmanship.—*Daily News.*

A NEW WEIGHING INSTRUMENT.

A NEW Weighing Instrument has been invented by Professor Kaeppelin, and called by him the "Hydrostat." It is based on the same principle as Nicholson's aërometer.

The "hydrostat" consists of a cylindrical case filled with air, hermetically closed on all sides, and entirely immersed in a vessel containing water, where it forms, as it were, a float. (In places in which the temperature is at freezing point, alcohol must be substituted for water.) Two plated steel wires are connected to the air case or float, and rise out of the water vertically. These wires are fixed to the extremities of a horizontal beam, having at its centre a rod, to which are suspended two dishes, placed one over the other. One of these dishes is for the weights which have been required to immerse the float; the other is intended to hold the substances to be weighed.

The instrument is made use of in the following manner :—First, the fixed point at which the horizontal beam is stopped must be noted; then the substance to be weighed is placed on the proper dish, and weights removed from the other dish till the instrument returns to the original point of immersion. The weights removed will indicate the weight of the substance weighed.

The precision of the instrument will depend on the thickness of the steel wires, as the water displaced by them regulates the last and smallest fractions of the course of the float. The nicety of the instrument arises from the absence of all friction except that from the contact of the water against the surface of the float. It is, therefore, especially applicable for weighing precious stones, &c.

Changes of temperature affect the volume of the float as well as the density of the water; the "hydrostat" must, therefore, always be brought back to the fixed point, whenever it has departed from it.

The instrument has been applied with success by Messrs. Haussmann, Jordan, Hirn, and Co., of Colmar, for weighing cotton in the manufacture of table-cloths.—*Moniteur Industriel; Mechanics' Magazine*, No. 1713.

SIEMENS' IMPROVED AIR-PUMP.

In this instrument, as the ingenious patentee informs us, "an essentially new feature, if not, indeed, virtually a new principle also, has been introduced into the construction of this important machine. The new Air-Pump consists of two cylinders, differing in magnitude, of which the smaller is applied either to the bottom or top of the larger, while the valved pistons belonging to each respectively are attached to the same piston rod. The air withdrawn from the receiver, or other vessel intended to be exhausted, is condensed in the lower cylinder into one-fourth of its original volume; and consequently always possesses sufficient elasticity to pass through the discharging valve and escape into the atmosphere, the opposing pressure of which on that valve is thus counteracted in a perfectly novel manner."

The new air-pump (manufactured by Messrs. Knight) is cheaper than those of the ordinary construction, especially when its perfection is taken into consideration; and, *ceteris paribus*, if a well-made pump, of any of the ordinary constructions, will rarefy the air to 99-100, the new one would carry the rarefaction up to 999,999-1,000,000, if a certain valve could be rendered automatic; but, as it is, it will produce a vacuum approaching to the perfection assigned, in proportion to the smallness of the force required to open the said valve. Those who may require a powerful and perfect air-pump will do well to inspect this machine, the capabilities of which were exhibited to us by Mr. George Knight.—*Chemist.*

GRAY'S AZIMUTH AND AMPLITUDE INSTRUMENTS.

Mr. Gray, of Liverpool, has invented a method of arranging Azimuth and Amplitude Instruments in connexion with ships' binnacles, or compasses, in the following manner. On the top of the binnacle shade a short metal cylinder is fixed, which has at the upper end a glass disk divided round its circumference into 360°. These divisions will be rendered visible at night by a lamp in the binnacle. On the upper end of the metal cylinder is applied a revolving ring, which carries a standard to which a telescope is jointed, so that it can be elevated or depressed at pleasure. Opposite to the telescope a mirror is fixed, at an angle of 45° from the vertical, so that when the telescope is placed horizontally it looks into the mirror, which reflects the divisions on the glass circle. When an observation is to be taken, the glass circle is set to correspond with the binnacle compass, and the object is viewed through the telescope, which is then placed horizontally, and the angle on the glass circle read off. There is a line drawn on the mirror to render the reading more accurate.—*Mechanics' Magazine*, No. 1721.

NEW THEODOLITE.

MR. METFORD has produced a New Theodolite, combining several improved arrangements; the more important of which are a traversing stage, and a curved arm, upholding the transit axis. The stage is so constructed, that the whole instrument can be moved, in any direction, one inch from the centre; and the curved arm is so attached to the main centre, as to allow of a transit motion, thus making this theodolite equal to an altitude and azimuth instrument. This substitution of a curved arm, for the heavy works at present generally employed, entirely prevents the usual topheaviness, and greatly reduces the total weight. After six years' use, the instrument has been found to work and wear perfectly steady and well.

The horizontal limb holds a circular level, compass, and memorandum slates, and the transit telescope can be used through it, for very depressed angles. The limbs are divided in a simple way, to read to decimals, either of degrees, or minutes, as well as to seconds. The construction of the pivots gives great stability, on account of their having the broad bearing flanges usual in levels; and the addition of the rectangular eye-piece will enable the observer to remain in one position for all observations, and will be useful in tunnelling, &c. There are, also, improvements in the levelling apparatus—in attaching the transit telescope to its axis,—in the construction of the diaphragms,—in the long level,—in the check telescope,—in the setting of the object glasses in their cells, to facilitate their being cleaned,—in lighting the wires, and in fixing the instrument in its box. It is submitted, that the small weight of the instrument, compared with its power,—its capability of horizontal motion,—its great steadiness in use,—the balance of the optical work to the power of the limbs,—the great range of the vertical circle, it being 320°,—the addition of the circular level, and the many minor improvements, combined with its compact and graceful appearance, are worth attention. The instrument has been constructed by Mr. King, jun., of Bristol.—*Proceedings Institute Civil Engineers.*

THE HOBBS LOCK PICKED.

THE *Illion Independent* asserts that the Day Newell Lock, manufactured at New York, commonly known as the "Hobbs Lock," has at last been picked by Lynus Yale, jun., of the adjoining village of Newport. It states:—"the exact *modus operandi* of picking the lock, of course, is not expected to be made known to the public just at present; but it is sufficient to say that, by a singular and ingenious method, the action of the key upon the curve of the tumblers of the lock is mapped out, and from this a wooden key is made, which unlocks and locks the lock, and in all respects operates on it as perfectly as the true key. In this respect the lock was opened in the presence of the cashier of the Dairyman's Bank, Newport, N.Y., and of the president of the Port Stanwick Bank, Rome, N.Y. And within a few weeks was so opened a 300-dollar lock on a jeweller's safe, in Wall-street, New York; from all of whom certificates to this effect have been taken. This statement of course will astound the world, but it is even true."—*Wolverhampton Chronicle.*

NEW SPHYGMOSCOPE.

DR. G. O. REES has described to the Royal Society a new Sphygmoscope, or instrument for indicating the movement of the heart and blood-vessels:—

The Sphygmoscope consists of a small chamber containing spirits of wine or other liquid, provided with a thin India-rubber wall, where it is to be applied to the chest. At the opposite extremity the chamber communicates with a glass tube, which rises to some height above the level of the chamber. Liquid is supplied to the instrument until it stands in the tube a little above the level of the chamber. The pressure of the column of liquid in the tube acts upon the elastic or yielding wall of India-rubber and causes it to protrude. This protruding part or chest-piece is very readily affected by external impulse; it yields to the slightest touch, and, being pushed inwards, causes a displacement of the liquid in the non-elastic chamber, and forces a portion of liquid up the tube. The protruding wall of India-rubber is driven inwards when it is brought in contact with that portion of the chest which is struck by the apex of the heart, and a rise in the tube takes place. When the heart retires, the India-rubber wall, affected by the pressure of the column of liquid in the tube, is pressed back, follows the chest, and permits the liquid to descend. The degree to which the India-rubber wall is forced in by the apex of the heart is denoted by a corresponding rise in the tube, and the amount of protrusion of the India-rubber wall which takes place when the heart retires is denoted by a corresp·nding fall in the tube. The tube is supplied with a graduated scale to denote the rise and fall with exactitude. The glass tube is provided at the top with some contrivance, such as a brass screw and collar, to prevent the egress of the liquid when the instrument is not in use, or a bulb with an orifice may be supplied. When employed, the glass tube is left open to permit of the passage of the air to and fro.

The sphygmoscope is mounted upon a stand. The chamber and tube are fitted to a horizontal arm, which is made to move up and down so as to carry the instrument to the desired height. The base is so made as to secure the requisite immobility.

The glass tube is a foot or more long, and the round bore is about the one-eighth part of an inch. If the bore be much larger, the movement will be inconsiderable; if much less, capillary attraction will interfere and prevent free motion.

When the instrument is to be employed, mounted upon its stand, it is placed upon a firm table with the chamber projecting beyond it. The person whose heart is to be examined is seated upon a firm chair, with his chest erect and free from motion.

The duration of the impulse of the heart upon the chest is well measured by this instrument: the time occupied by the rise is the time occupied by the impulse.

The instrument, placed upon the heart, indicates strokes of that organ which are so feeble as to have no corresponding pulse at the wrist.

No pause whatever in the movement of the liquid has been at any time observed when the sphygmoscope has been carefully placed so as to receive the full beat, and fall back with freedom. This would go to show that the heart, however slow, is in constant motion, and, contrary to the belief of many physiologists, enjoys no pause.

The sphymoscope indicates with exactitude both the absolute and the comparative influence upon the heart, of food, cordials, stimulants, and tonic medicines. It does the same in respect to depressing causes, such as hunger, cold, and sedatives.

With the aid of this instrument the fact is demonstrated that the action of the heart may be great when the pulse is small. It is found also that, while cold at the surface and extremities may depress the pulse, the heart may remain little enfeebled, or even become excited, and that warmth and friction applied to the extremities may cause an excited pulse without there being any accompanying increased force of the heart.

The sphygmoscope reduced, deprived of its stand, having a level elastic wall instead of protruding one, and having a glass tube with an almost capillary bore, forms a remarkably delicate indicator of the pulse. It is so delicate in its impressions that it is appreciably affected by the regurgitant wave in the jugular veins, and by the wave in arteries greatly smaller than the radial. From its nicety in manifesting the beat of the blood-wave, it is very valuable, and is called the hand-sphygmoscope.

By means of this hand instrument applied to the arteries, a comparison is readily made between the time of the beat of the heart and the rise of the arteries under the influence of the blood-wave.

WRITING IN THE DARK.

MR. W. R. PALMER has patented certain improvements in writing desks, which can be used in the dark, or after a person has retired for the night; or by the blind, or those with weak eyesight. The inventor constructs a box about 10 inches long, 6 wide, and 3 deep. The top, for about half its length, is hinged at the end so as to be elevated, and underneath it is a cylinder on which is wound a continuous sheet of paper, which as it is unwound passes up over the unhinged portion of the top which forms a writing tablet, and then between two cylinders worked by a finger-wheel. The unwinding of the paper is regulated by a pawl which falls into this wheel.

CONSTRUCTION OF GRANARIES.

AMONGST the practical results of the Paris Universal Exhibition, the introduction of M. Fluent's Granaries is not the meanest. Their object is to preserve the corn sound, even in great masses. They are constructed so as to form a division of compartments (*silos*), all on one line, and occupying the whole height of a building. The grain is passed through hoppers, each being regulated by an especial trap. Towards the end of the silo, the grain does not descend perpendicularly, but is prevented by a number of diaphragms, placed one above another, at an angle of 45°, and extending all the length of the silo. In consequence of this division in small and vertical compartments, the mass of grain becomes divided, and has to glide down in a diagonal line. The interval and the dimensions are thus distributed so as to allow the passing of the grain upon the whole length of the compartment, which passage takes place at a rate made uniform by the equality of friction. At the issue from the vertical silo, the grain is conducted through a spout, when it is seized by an Archimedean screw, at each winding of which there is a little palette, which turns the grain as would a shovel. It is thus conducted into a small reservoir, whence it is reconducted to the top of the granary, above the upper orifice of the vertical silos. Here it is taken hold of by a sieve, which agitates it again, and makes it descend into a sort of rain on the lower mass. —*Builder*, No. 684.

FIBROUS SLABS.

THE dome of the new reading-room at the British Museum, now in course of completion under the direction of Mr. Sydney Smirke, has been lined with slabs or sheets of a fibrous material, for which a patent has been obtained; and which, combining many of the properties of wood, is adapted to almost every purpose to which the various descriptions of wood are applied. It is also applicable to many purposes for which marble, slate, lath and plaster, or internal brickwork, are now used: and the price, we are told, will not average more than one-half the cost of woodwork, or other materials now in use.

To render wood available for purposes where the ordinary width of boards (9 to 13 inches) is insufficient, it is requisite to join two or more boards together, by what is technically termed "glueing up," an operation involving much labour, expense, and loss of time, and attended with all the contingent risks of shrinking, expanding, splitting, winding, &c., as well as natural imperfections. This fibrous material can be manufactured in sheets or slabs of any required thickness, length, or width. They are usually made in sizes of 13 feet by 7 feet; but these dimensions may be greatly increased.

It appears to be uninflammable; a non-conductor of heat or sound; free from dry-rot, shrinking, expanding, splitting, or winding; easily worked or bent; and is applicable for large panels, ceilings, floors, and partitions.

Each panel at the British Museum, composed of three pieces, is 22 feet long by 11 feet 6 inches wide: and these, in their spherical form, are raised from the ground to a height of 110 feet, and fixed in one piece to the roof.—*Builder*, No. 684.

METAL ARCHES.

MR. G. A. TABOURIN has patented a new system of Metallic Arch, proper for the construction of bridges, arcades, vaults, roofs, and all other such purposes. The fractional arches of this system are generally made of cast-iron united together by jointed under lugs, somewhat like the legs of a pair of compasses, or the parts of a folding foot-rule; a central joint bolt is passed through the under lugs. Each beam or girder forming a complete arch, is composed of as many fractional arches as may be required to form the total length of the whole beam or arch, the length of each fractional beam or arch having been previously determined. The beams or girders are laid up in parallel lines, at a suitable distance from each other, so as to form bridges, vaults, or arcades of the required breadth.

They are then united by single bolts passing though the centre of the lugs, which are separated by tubular transoms traversed by the same bolts.

SHEER LEGS AT THE VICTORIA (LONDON) DOCKS.

THESE Sheers were erected and proved at the Victoria Docks, Blackwall, in June last (1856), under the direction of Mr. George P. Bidder, V. P. Inst. C. E., Engineer-in-Chief to the Dock Company; and from the designs of Mr. Robert Mallet, Mem. Inst. C. E. The execution had been intrusted to the late firm of C. J. Mare, and Co., Orchard-yard, Blackwall, by whose assignees the work was completed in a most creditable manner, under the charge of Mr. Hynes, foreman of the erecting department.

The three main legs are formed of boiler plate, hollow and tubular, each in form of a parabolic spindle. The two front ones being thirty inches in diameter at the centre of the length, and the back one thirty-three inches, and each about sixteen inches diameter at the ends—the length being from 100 to 102 feet. This construction of sheers in lieu of the enormous built-up masses of mast timber of which they are usually formed, as in the Government and other dockyards, is novel in this country. The advantages are great durability as compared with timber (which rapidly rots at the lower end of the pieces), economy in first cost, and immensely increased strength and stiffness, with saving in top weight.

Several of the details of construction in these legs present features of novelty and of advantage. The total hoisting power is divided between two entirely distinct and separate sets of three and three blocks, either of which can be used separately for lighter loads, with saving in time, or, both used together, combine their forces, and evenly distribute the strain upon the whole twelve lines of chain by the arrangements made for working the two main purchase crabs, either together or separately.

The traverse motion for the back leg has the advantages of great power, admitting of the sheer leg being, if required, traversed either in or out with the load all hanging, combined with great safety, as it is impossible for the carriage of the back leg to run or slip in any position, even though the traversing chain should snap.

These legs were originally designed for being erected on stone foundations and with masonry footings to secure the anchor plates of the main back guys. Motives of economy, however, in relation to the soft under soil of the Victoria Docks, caused Mr. Bidder to decide upon erecting them upon a piled timber platform, and securing the anchor plates beneath a mass of concrete, with some piling in addition. The whole was found, on application of the proof load, to stand without any symptoms of settlement. A large ship was dismasted with these sheers the day after proof.

Mr. Mallet expresses his intention, in any future sheer legs, erected on this design, to carry back the tackle-fall chains from the snatch-blocks at the base of the front legs to the purchase-crane in small chain tunnels under the surface, and to cause the whole of the traverse gear of the rear end of the back leg to travel in a sunk trough with the tramway at bottom.

This was impracticable in the present timber platform foundation, but with a solid foundation would effect what has never yet been done with any traversing sheer legs—viz., to leave the ground beneath and all around the sheers quite clear and free for the movement of great and bulky loads in every direction, unobstructed by chains or obstacles of any sort.—*The Engineer* for October 31, which see for illustrated details.

STONE-CUTTING MACHINES.

THE great annoyance and expense caused by the repeated strikes of stone-cutters have been a serious drawback to the rapid execution of contract works. This evil has been more particularly felt in the Ordnance and Admiralty works now in course of construction at Milford Haven, and has induced Mr. Williams, one of the contractors for Dale Point Works, to apply himself to the construction of a machine, called the "Lithotemer," for cutting stone which shall render contractors less dependent.

The following is an outline of his plan of operation :—The stone is first fixed on a horizontal table to have its bed dressed : this is effected by cutters placed on an iron cylinder, or drum, whose axis is horizontal, and which revolves over the stone. The cutters are fixed on the drum in several series of rows, with vacant spaces between each series, so that when one series of cutters has done its work, and the vacant space is over the stone, the table on which the latter is fixed is moved forward to present a fresh surface for the next series of cutters, and so on until the bed is dressed. When both beds are finished, the stone is removed to have its face and joints dressed in a similar manner by another drum, arranged with cutters like the above, but with its axis vertical.

This machine is capable of dressing twenty superficial feet of limestone per minute, or a much larger quantity of any softer stone in the same time.—*Builder*, No. 686.

M. Eugène Chevallier has introduced a method of combining mechanical parts into a machine, in such manner that quick motion may be given to a wire, and be the means, when aided by a constant supply of sand or grit and water, of cutting stone. The wire, by the arrangement of the machinery, is caused to enter further and further into the stone, according as the cut into the stone is accomplished. For this purpose an endless wire, of soft iron by preference, is placed on two grooved pulleys which are at a distance apart. One of the grooved pulleys is driven or caused to rotate by any suitable power, by which a quick motion is communicated by a band of wire, which is kept distended by a weighted pulley acting on a part of the endless band of wire, at a distance from where the cut is being made by another part of the endless wire. The stone to be cut (when the cut is to pass completely through it) is placed on a suitable bed or stand so as to be supported above the level of the floor between the two pulleys or wheels which carry and more sets of concave brushes, and a small feed-brush dipped into a contiguous trough supplies the blacking. The spindle being put into revolution carries with it the annulus of brushes, and the shoes or boots being presented to the revolving brushes are cleansed, blacked, and polished in an effectual manner. It is clear that in a machine of this kind the brushes may be applied either externally or internally upon the revolving annulus, and the machine may be made to brush clothes as well as shoes, taking the precaution to employ different circles of brushes for the different purposes. The machine is put in motion by a band from a steam-engine, or other moving power.—*Mr. Bourne, in the Illustrated London News*, No. 818.

NEW METHODS OF PRESERVING WOOD.

PROFESSOR APELT, of Saxony, proposes to use the so-called sulphureous coal of Oppelsdorf, a peculiar coal, which is not to be found elsewhere, and which consists of finely-divided marcassite ($Fe\ S^2$, $Fe\ S$) for about two-thirds of its weight. This coal has that remarkable peculiarity of preserving wood by a simple process, which chiefly consists in allowing the sulphuret of iron in the coal to change into sulphate of the protoxide of iron. The plan of working is as follows:—

The sulphureous coal of Oppelsdorf having been changed into "vitriolic" coal, is brought into *immediate contact* with the wood about to be preserved, whilst the coal, by its hygroscopic nature, attracts the humidity of the atmosphere, and by its being exposed to the influence of rain, the sulphate of iron contained in the coal is dissolved, and penetrates slowly and gradually into the wood, and impregnates it. Thus the mere contact of the powers of *nature* achieves the process of impregnation with a metallic salt, which by any other method can only be performed by *art* and by the employing of certain fixed apparatus; and it is most remarkable that, according to this method, a power of nature, that is, humidity, is called upon to effect the preservation of the wood, which, under other circumstances, is the most injurious agent. But not only a *natural* impregnation is obtained thereby, but also the progressive mineralization of wood, which is the chief point to be effected, a problem in *artificial* impregnation still unsolved. This may be proved theoretically as well as practically.

The rot is produced by the tannin of the wood, which has a great affinity for oxygen, uniting with oxygen, and thereby forming "ulmin," the so-called efflorescent ore (mulm). This oxygen is introduced into wood, which, like pine-timber, rots from the interior, much more by the humidity penetrating it than by the action of the atmosphere. Now, if the penetrating fluid contains a solution of sulphate of iron, the protoxide of iron, which is changed at the same time by combining with the oxygen into oxide of iron, unites with the tannin of the wood to form gallate and tannate of iron, whereby the formation of "ulmin" is prevented, and the rot rendered impossible.*

Mons. C. F. L. Oudry, of Paris, has patented the application of copper or other metals on iron, zinc, and other metals and their alloys, and also upon wood, paper, cardboard, and stone, having first covered them with an isolated coating of a composition susceptible also of preserving, waterproofing, and metallizing them, and which coating is a conductor of electricity. The copper is applied to any

* This produces a decomposition of the metallic salt. The protoxide of iron is changed into oxide of iron, and penetrates in the cells in the shape of infinitely small crystals, imperceptible even under the microscope. This substitution causes the gradual agglomeration of these small crystals to take the original shape of the plant cells.

desired thickness by ordinary electro-chemical means, and serves to preserve the metal or other substances thus covered from oxidation by the action of the air, water, or the humidity of the earth. The composition may be made of metal or metallic salts, combined with essential oils or greases, and resins, gums, bitumen, or asphalte, according to the nature of the articles to be covered over, and a conducting property is given by adding copper, graphite, or other metallic powder.

A method of charging the sap-tubes of timber with preserving fluids has been adopted at Paris by Dr. Broucherie, and the prepared timber applied as telegraph-posts, railway-sleepers, &c. A cross cut is made on the prostrate timber to nearly 9-10ths of its diameter: a wedge is then inserted, and a cord is wound round on the cut surface, leaving a shallow chamber in the centre, which is then closed by withdrawing the wedge. A tube is then inserted through an augur-hole into this chamber, and to this tube is attached an elastic connecting-tube from a reservoir placed some 20 or 30 feet above the level in which the wood lies, and a stream of the saturating fluid with this pressure passes into the chamber, presses on the sap in the sap-tubes, expels it at each end of the tree, and itself supplies its place. The fluid used is a solution of sulphate of copper in water, in the proportion of 10 per cent., and a chemical test that ascertains the presence of the copper solution is applied at each end of the tree from which the sap exudes, by which the operator ascertains when the process is perfected. Several French commissions have investigated both the process and its effects, and have, it is said, reported favourably of its results, showing that the soft Scotch fir, green from the wood, may in a few days be cheaply rendered capable of resisting damp and weather more effectually than heart of oak in its unprepared state.

A NEW CEMENT AS HARD AS MARBLE.

M. Sorel has submitted to the Academy of Sciences, at Paris, a New Cement of great solidity, which consists of a basic oxychloride of zinc, obtained by moistening oxide of zinc with the liquid chloride of the same base, or in another chloride isomorphous with the chloride of zinc; for example, protochloride of iron, manganese, nickel, cobalt, &c. These chlorides may be replaced with hydrochloric acid.

He obtains a cement so much the harder as the chloride is more concentrated and the oxide more heavy. He employs washed residues arising from the manufacture of white zinc, or else calcines to redness ordinary white zinc. He employs chloride of zinc, marking from 50° to 60° of Beaumé's areometer; and in order that the cement may set less quickly, dissolves in the chloride about three per cent. of borax or sal-ammoniac, or else calcines the oxide, after having moistened it with water containing a small quantity of borax.

The mastic or cement obtained by the combination of the above substances may be run into moulds like plaster. It is as hard as marble; cold, moisture, and even boiling water are without action on it. Its resists 300° C. (576° Fahr.), and even the most powerful acids attack it only very slowly.

The new plastic matter is not expensive, but its cost may still be considerably diminished by being mixed with the oxide of zinc, metallic, silicious, or calcareous matters, such as iron filings or borings, iron pyrites, blende, emery, granite, marble, and all hard calcareous matters. Soft matters, such as chalk and ochre, will not do.

The highest and most varied colours may be given to the new cement, which allows of its being used for tables and mosaic pavements of great hardness and beauty. M. Fontenelle, the sculptor, has used it with success for this purpose, and mosaics formed with the new cement may be seen in the choir of St. Etienne-du-Mont, at Paris.

INDURATED MARBLE.

MR. H. C. PAGE has patented an improved method of Indurating Marble and Stone, and of permanently fixing colours therein, when colouring matters are applied thereto for producing a variegated pattern or device on the surface thereof. To indurate light coloured stone and marble, the patentee proceeds as follows:—With a soft brush or sponge he wets the surface with a solution of two parts of lime and one pearlash; he then exposes the stone to a gradual heat until it is dried through, and has become sufficiently hot to melt white bees'-wax, which he next passes quickly over the surface thereof. The process for producing a variegated pattern or device in colours on marble and stone is as follows:—The surface should be clean and fine, but not polished, and the colouring matters are applied thereto, and are disposed according to the taste of the artist, after which the stone is subjected to a sufficient degree of heat to melt wax when applied thereto, and when wax is so applied the colouring matters become perfectly fixed.

BRICK AND TILE MAKING MACHINERY.

MR. J. ROBERTS has patented an invention in Machinery for Moulding Bricks and Tiles, in which there are at intervals, in a circular track, separate sets or series of moulds fixed. Each mould has within it a piston or moveable bottom, which, when the clay or brick earth is introduced into the mould, is in the lowest position. Heavy rollers are made to revolve around the circular track and to press on the clay or brick earth, and when they have pressed the clay into a series of moulds, in passing over the end of a lever (to which all the pistons of the series of moulds are connected) they cause the lever to raise the whole of the pistons of such series, and thus lift the bricks or tiles above the upper edges of the moulds, to be removed by hand.

CHAMBERLAIN'S BRICK-MACHINE.

IN this machine the clay is fed into a horizontal pug-mill, which carries it through a cylinder working the clay, and forcing it out in one continuous stream through an oblong aperture, somewhat the shape of a brick with round corners, it being a fact known to those connected with brick machinery, that so large a body of clay as 50 inches cannot be expressed through an aperture with sharp corners to make the edge of the brick, the angles causing so much more friction than any other part: it has therefore been the practice with this class of machinery to perforate the aperture, or make hollow bricks, that the tongues to form the perforations may cause such friction or resistance in the centre of the escaping aperture as to force the clay into the corners, and thereby in some measure meet the difficulty; but this is again balanced by the extra expense required in the preparation of the clay, as, if not of the finest quality, it will not pass the sharp corners smooth. To obviate these difficulties, in this machine the aperture delivers the clay with round corners, which is then received between four rollers, covered with porous fabric, which compress the block of clay into an oblong mass, the size and shape of a brick edgeways, with sharp arrises. The stream of clay is then carried on an endless web to the self-acting cutting-frame, which, as the clay moves, is put in motion from connexion with the four rollers which form the block of clay, the rollers being driven by a belt from the gearing of the pug-mill. If the rollers have the slightest motion given them from the machine being fed with clay, the wire is put in action and traverses at an angle in the same direction in which the clay is travelling, thereby making a square cut while in motion. As soon as the wire has cut off one brick, it changes its action and cuts off the next at the opposite angle to which it before traversed. The bricks pass on to the end of the machine, and are received on pallet-boards by the boys in attendance.

The advantages of this machine, according to the patentee, are as follow:—1. That the clay is thoroughly amalgamated in the pug-mill with some clays requiring scarcely any previous preparation. 2. That the bricks are made of such a stiffness as to bear walling six high at once, which effects a saving of 50 per cent. in floor room. 3. That bricks of greater density are obtained through the great pressure the clay receives during manufacture. 4. From the stiffness of the clay used, less water has to be evaporated in drying, saving one-half the time required for hand-made bricks, and the risk of loss from bad weather, &c. 5. The machine is on one frame and portable, of the most simple construction, very strong, and not likely to break or get out of order. 6. By this machine 2000 bricks can be made per hour with from two to four-horse power, depending on the stiffness and quality of the clay.—*Builder*, No. 682.

VENTILATING BRICK-WORK.

Mr. F. Lloyd, of Snow-hill, London, has devised a plan of arranging hollow bricks, designed especially to afford cheap, simple, and effectual ventilation, particularly in the humbler classes of dwellings. By this arrangement, the air is conducted from the mantel to the upper part of the room, where it is delivered warm, the warmth being acquired chiefly from the smoke-flue, whereby an economy of heat, and consequently of fuel, is obtained. This arrangement, besides giving perfect ventilation, tends to prevent the annoyance of a smoky chimney, and to give uniformity of temperature to all parts of a room.

Another arrangement is also shown in which hollow bricks form, at the back of the fire-place and smoke-flue, air-flues, which may be carried to any desired height, and to the right or left, in the same or other rooms. By this means part of the heat of the back of the smoke-flue, instead of being suffered to escape at the chimney-top, may be carried to any room, and be the means of giving warmth and ventilation to rooms not provided with a fire-place. In cases where a large supply of fresh air is required, as in barracks, lodging-houses, &c., the four sides of the smoke-flue are to be carried up with the hollow bricks. Hollow mantel-pieces are in course of manufacture, in pottery, which will be cheap, of a neat appearance, and occupy less space than brick-work. In first-class houses a hollow box-mantel of marble could be used as the air-conduit, instead of the brick and wood mantel described above as a cheap means. The air-vents at the ceiling could be easily masked by an open ornamental cornice.

The plan above described may be seen in operation at Mr. Looker's Brick Works, Kingston-on-Thames, and those interested in sanitary improvements are especially invited to see it.

JUCKES' FURNACE BARS.

HERETOFORE when furnace bars have been in short lengths, and made into a continuous chain, they have not admitted of one bar being replaced by another, without considerable inconvenience; but the chain of bars has had to be divided across in order to take out the bars when broken, worn, or injured, in order that they might be replaced by others; and this was because of the transverse pins or axes (which coupled the short bars into a cham) being of a cylindrical form, passing through circular holes in the bars. Mr. Juckes, of Islington, the patentee of the revolving furnace, has recently introduced an improvement, which consists of making the circular holes in the bars with narrow outlets below, and in employing transverse pins or axes, with the sides reduced or cut away, so that the diameter of each in one direction may be less than in the other direction, the larger diameter agreeing with the diameter of the holes through the bars, and the smaller diameter agreeing with the outlet, thus admitting of a bar being removed when such axes are placed and held in one direction, but not admitting of the bars being removed when the axes or pins are turned in the other direction.—*Mechanics' Magazine*, No. 1736.

FIRE-PROOF MATERIAL FOR FURNACES.

MR. DAVID HILL, of Tipton, Staffordshire, forge-manager, has patented an invention for "preparing a material capable of resisting fire, and especially suitable for the interior of puddling and other furnaces." In this preparation, the inventor employs materials that have been subjected to the greatest heat that furnaces excite. The combination consists of limestone and ironstone, or the cinder from furnaces, which are melted together and cast into moulds. The proportions of materials may be varied, but the following are preferred;—one-sixth part of limestone, and two-third parts of ironstone or cinder. These are mixed together and fused. Mr. Hill's experience as a forge-manager has no doubt taught him that the vitrified slag of the furnace is well adapted to resist the heat by which it has been melted, and in this respect it accords with the observations of Mr. Truran, that the vitreous covering of the bricks protects them from the farther action of fire. The specification of the invention is one of the shortest on record: the descriptive part and the claims only occupy twelve lines.

NEW MUSEUM ON THE KENSINGTON GORE ESTATE.

An unsightly building has been erected upon the lower portion of the Kensington Gore Estate, not far from Trinity Church, Brompton. "The cost of the article," says the *Builder*, "with the fittings, is estimated at 15,000*l.*, a sum which might surely have been increased by a small per centage extra for the sake of appearance. The only imaginable excuse for its ugliness is the allegation that the structure is to be merely a temporary one; but this is scarcely consistent with the declaration of the Board of Trade Report to the Treasury, that 'it will at all times and for a lengthened period prove of much service.' The Report in question is the last in an Appendix to the Third Report of the Exhibition Commissioners of 1851, which Report, comprising 273 pages, and containing plans of the Gore estate, and of the new museum, has been printed for Her Majesty's Stationery Office.

"According to the specification given in the appendix to this Report, the building covers an area of 3700 square yards, exclusive of the galleries, which give an additional space equal to 2700 yards, making an entire space for exhibition of 6400 yards, or 1⅓ acre. The walls of the building are composed of cast-iron uprights or standards, placed 7 feet apart, and *tottled to a foundation-frame of* timber. The spaces between the columns are filled up with corrugated sheets, and the interior of the walls lined with boarding, tongued and grooved.

"The building is covered by three segmental roofs, each 42 feet span, supported on the outside walls, and on two intermediate rows of columns. The trusses are of malleable iron, 7 feet asunder, and covered with corrugated sheets. A skylight, 12 feet wide, and raised 18 inches from the surface, runs along the entire ridge of each roof, the sides being fitted with moveable wrought-iron louvres.

"Galleries 42 feet wide run down each side of the building, and fill up the whole space beneath two of the roofs. They are connected at the ends by cross galleries 21 feet wide. And these galleries are carried by a system of longitudinal and cross girders—the longitudinal girders being placed 14 feet apart, and at an equal distance from the outside walls, and supported by columns placed 14 feet asunder. The cross girders spring from each of the standards of the outside walls, the principal ones resting on the interior columns, and the intermediate ones being tottled to the longitudinal girders. Joists are fixed between the cross girders, and the flooring spiked to them. The galleries are fenced by a light trussed railing, and lighted by the skylights in roof."

The design, or rather the want of design in this building, has been invariably condemned in every journal wherein it has been noticed. It is hard to say with precision for what purpose it has been erected; but, surely, in these days of Government Commissions and Departmental dealings, a little taste might have been displayed in this building, which cannot have emanated from the School of Design. When the pupils from the provinces see this tasteless work, they will form but a low estimate of the talent at head-quarters.—*Ed. Year-Book.*

MUSIC HALL AT THE SURREY GARDENS.

THE roof of this new Hall (Horace Jones, architect) presents the following structural peculiarities:—

The division of the roof is into five bays. The roof-framing is composed of main and intermediate ribs, which spring from the floor level of the top gallery, and are cut to the curve, the main ribs being 13 inches by 6 inches, in four thicknesses of 1½ inch stuff, breaking joint and bolted together, and with a rib of wrought iron riveted, in the centre—an addition which is perhaps not necessary. The upper ends of these ribs are notched or tenoned to a strong sill, at the base of the external lantern, and which sill running all round it, forms part of a system of framing after the manner of a queen-post truss. This system of roof is a modification of the well-known arrangement revived at the Exhibition building in Hyde Park, the Great Northern Railway Station, and other important works, and has been employed by the architect of the Surrey Music-hall in many instances, and successfully. It will be seen that particular care would be required as to the sufficiency of the sill or continuous member at the heads of the ribs, and to the manner of notching or tennoning to it; and which care in the present case has doubtless been taken. There is, however, a further important distinction between this roof and such as have the ribs built to compass the whole span. In the Hyde-park building the arched ribs were thought not to exercise thrust; and abutment, if provided, was, we believe, regarded only somewhat as a measure of precaution. In the other case, however, there being no tie, abutment is obviously the sole dependence for the safety of the structure. This the architect here has provided by bracing from the towers—that is, by a system of framing, within the thickness of the gallery floor, and which may be compared to a trussed partition laid flat. In some degree the contrivance resembles one used in iron, at the Crystal Palace, Sydenham. Further, the framing at the opposite sides is connected at the ends; and the whole principle and arrangement might seem free from objection. The district surveyor, however, thought that tie-rods were still necessary, and these now detract much from the effect of the interior. The main and intermediate ribs are covered with rafters laid purlinwise,—every fifth or sixth rafter being a deep one running through the whole thickness, and to these last the ceiling rafters cut to the curve are fixed. The purlin rafters are of course boarded for the zinc. The ceiling is relieved only by mouldings on the main ribs and along the centre; but the apsidal form of the ends gives it a good effect. The central portion, from end to end, it will be understood, is flat,—here there are three deep octagonal apertures, panelled with perforated zinc, and glazed at the top.—*Builder*, No. 701.

ON VENTILATION.

A PAPER has been read to the Royal Institution "On Ventilation, and the Means of determining its Amount," by Dr. Bence Jones. The author stated, that he commenced the researches he was about to lay before the meeting by inquiries to discover how far any actual data existed, by which the Government Boards were guided in ventilating workhouses, prisons, ships, &c. He found that the Poor Law Board assigned the space of 300 cubic feet to each individual for the night,—but 150 for the day. He could not discover the cause of the adoption of these numbers; nor why 300 cubic feet were thought necessary for eight hours, the average time passed in sleep, and 150 only for the remaining sixteen hours. Again, in lodging-houses, the police regulations are: that in every room from 5 feet 6 inches to 6 feet high, 50 superficial feet of floor should be allowed to each individual, giving an extent of from 275 to 300 cubic feet; but if the room should exceed the height of 6 feet (even by one inch) 30 superficial feet are deemed sufficient. In a room 6 feet 1 inch high each person would thus have 183 cubic feet. The smallest space of air in which a human being was expected to exist was in some of the slave-ships. In one of these taken by the British cruisers, containing 311 persons, 14 cubic feet only were assigned to each. In the best slavers only about 28 cubic feet are afforded. In Her Majesty's Navy from 76 to 145½ cubic feet are allowed between decks. As a contrast to these, Dr. Jones noticed the hospitals, particularly the London Hospital and the new wards of Guy's Hospital, where as much as 1700 cubic feet are assigned to each individual. Cubic space, however, he did not consider as any test of the wholesomeness of a chamber, since a diver can live perfectly well with only a few inches' space in his helmet, if the air contained in it be constantly changed; while a man would die as surely in a very large room, if perfectly closed, as in a more confined one, but not so soon. Dr. Jones, therefore, proposed that in considering the healthiness of a room, the amount of change of the air and the superficial extent should be regarded, and not the cubic space.

After giving a statement of the quantity of air used by a man in twelve hours, the amount of carbonic acid given out in expirations of different lengths (a subject of considerable importance in estimating the amount of air which should be supplied to every person), and showing, by an ingenious apparatus, the greater amount of carbonic acid in the latter part of an expiration, he proceeded to describe the apparatuses used to estimate the quantity of carbonic acid in any given amount of air. He then described the modification which he had made use of. This consists of a gas-meter, moved by means of a descending weight, which acts as an aspirator, and at the same time registers the amount of air which passes through it. To this is attached a system of U tubes, in which the air is perfectly dried by chloride of calcium, and the carbonic acid absorbed by caustic potash. The increase in weight of this tube indicates the amount of carbonic acid in the number of cubic feet of air which is pointed out by the gas-meter.

Dr. Bence Jones also proposed to attach a gas-meter to the other extremity of the system of U tubes, which would record the amount of air entering the apparatus; the difference of volume pointed out by the two meters would indicate the amount of carbonic acid absorbed. Another method, which has some advantages in particular cases, is filling a graduated tube with the air to be examined, inverting it over mercury, and introducing some pieces of caustic potash. The carbonic acid is gradually absorbed; and by lowering the tube in a mercurial trough till the mercury on the interior and exterior are of the same level, the volume can be read off. By taking necessary care, determinations of considerable accuracy may thus be made. The speaker then noticed the physiological effects of carbonic acid; and stated his belief that in cases of death from breathing air containing carbonic acid, it was the carbonic acid already in the lungs which acts as a poison, the air inhaled being already charged with the gas refusing to take up an additional quantity. He concluded by alluding to the great want of an efficient system of ventilation in private dwellings, in most cases the chimney being the chief, if not the only, instrument for this purpose.

MARSDEN'S PATENT ARTERY AND VEIN SYSTEM OF VENTILATION.

MR. MARSDEN'S mode of ventilating sewers, public or other buildings, mines, tunnels, &c., consists of the action of a series of small "vein" pipes, as he calls them, concentrating from various parts of the cavity, chamber, or locality to be ventilated, into one air-tight and trapped receiver, communicating with what he calls an "artery;" but which, by parity of similitude, he ought, in fact, to call a great vein, the whole system being venous or concentrating and withdrawing, and not arterial and radiating and distributive, so far at least as regards the withdrawal of foul air through his ventilating pipes. These "arteries," or larger vein pipes, in turn convey the noxious gases collected by the smaller vein pipes onwards, either to a trunk vein or directly to a main-receiver, trapped, and leading them into an extracting shaft with fan, which, in the ventilation of sewers or mines, not only generates the suction power (worked by steam-engine or water power), whereby the gases are withdrawn, but also hands them up to furnaces prepared in a main shaft for their combustion. What Mr. Marsden appears more especially to claim, is the idea of ventilation from various points by a concentration of "vein" pipes, at once separating and enclosing the gases while conveying them away to trapped receivers and main-pipe conductors, to be expelled and consumed by modes already suggested and indeed already realized. The reverse process or distribution of pure air to mines, &c., a true *arterial* system,—may be carried out through the same system of pipes and fans, &c.—*Builder*, No. 683.

OIL FROM THE AVOCADO PEAR-TREE.

THE Avocado pear-tree (*Laurus Persea*), a native of the West Indies, produces a highly oleaginous fruit, which yields an oil that promises to be useful in the arts. The Governor of Trinidad lately forwarded some specimens of this oil to Professor Hofmann, who states that the oil has an acrid principle in it which he has been unable to separate, and also contains much mucilage; but that when treated with a small quantity of sulphuric acid, after the manner practised in France for the refinement of rape oil, a very excellent oil for purposes of illumination was obtained, being, in fact, as good nearly as sperm oil. The oil is also very suitable for the manufacture of soap, either in its unbleached state or after having been bleached with chlorine.

OIL FROM PETROLEUM AND COAL.

MR. BANCROFT, of Liverpool, has patented a method of manufacturing Oil from the Petroleum, or earth oil, found in Burmah and other countries of the East, which is as follows:—The crude petroleum, or earth oil, as imported, is placed in a cast-iron still of ordinary construction, to the centre or body of which a spiral worm of copper is fixed, attached to a steam-pipe passing out of the side near the bottom, and communicating with an ordinary steam-boiler capable of resisting a pressure of 60lbs. to the square inch. The copper worm should be open at the top, and terminate one foot above the cylindrical part of the still, or one foot within the dome. The still should be supplied with longitudinal copper condensing-pipes placed in an iron or wooden cistern lined with lead, which is to be supplied also with a steam-pipe communicating with the boiler, and filled with water. The still being charged with the crude petroleum, the first part of the distillation is carried on by the aid of high-pressure steam being passed through the spiral worm until the most volatile parts, among which is eupion, are driven off; the steam so applied should not be less than fifty and not more than sixty pounds pressure to the square inch. Fifty pounds pressure is found to answer in practice. The distillation is then continued, aided by a gentle fire placed underneath the still, until one-fifth part of the contents of the still have passed over into the receiver, and that one-fifth part is found to be eupion nearly pure. The contents of the receiver are then discharged into another vessel, and kept separate from the further distillation which is continued, the fire being urged and the steam supplied to the still until the remaining ninety-five parts, or nearly so, have passed over; these will be impure eupion, that is, eupion combined with other carbo-hydrogens, holding a large quantity of paraffine in solution, and called eupion oil, the production of which is the object of the second course of distillation. During the latter part of this distillation large quantities of paraffine and a small part of pyrelaine pass over; and great care must be taken to keep the condensing pipes at a temperature of about 90 degrees Fahrenheit at the middle of the distillation, gradually raising it to about 120 degrees Fahrenheit towards the end. This object is obtained by means of the steam-pipe passing into the water contained in the refrigeratory cistern surrounding the condensing-pipes. There will remain a residuum in the bottom of the still after the charge has been worked off, containing a small quantity of paraffine; this is placed in an iron retort (similar to those used in gas-works), and is heated to a low red heat; paraffine vapours pass off, and are condensed by means of a straight iron condensing-pipe of at least three inches in diameter, issuing from the interior of the retort, and maintained at a temperature of about 120 degrees Fahrenheit, by passing it through a cistern of hot water kept at a uniform temperature of 120 degrees Fahrenheit, or thereabouts, throughout the distillation. The impure paraffine thus produced is mixed with the eupion oil before mentioned, or it may be purified. A very useful oil called paraffine oil is now manufactured by Mr. James Young on a large scale. It is obtained from coal by distilling it at a low temperature.—*Mr. Bourne, in the Illustrated London News*, No. 818.

AUSTEN'S IMPROVED CANDLES AND NIGHT-LIGHTS.

MR. A. J. AUSTEN, of Price's Candle Company, Belmont, Vauxhall, has patented an improvement in the manufacture of Candles and Night-lights, which has for its object an improvement in applying to the external surface of candles and night-lights harder or less easily fusible materials than that of which the interior is manufactured. Heretofore, when manufacturing candles with harder materials externally, it has been usual to employ such harder materials at their natural points of melting; but this is objectionable. The present improvement consists in employing a solvent with the harder or less easily fusible material used, in order to reduce the melting point, and thus to facilitate its application to candles and night-lights, the solvent quickly evaporating after the casing or external coating has been produced. It is preferred to employ a mixture of stearic acid and white wax; but other hard candle-making material may be used, combined with a solvent, when carrying out the invention. It is proposed to mix stearic acid with about five per cent. of white wax, and to dissolve these materials in a proper solvent; and it is preferred to use about half their weight of ordinary, or the methylated spirits of wine. By rapidly dipping candles made of low melting materials, or night-lights, into this solution, and withdrawing them, they will be found to be covered by a thin film of hard material, which may be immediately handled. A similar coating may also be obtained by pouring the solution of stearic acid and wax or other solutions of candle material into the ordinary moulds, and then pouring out the solution, so as to leave a thin casing of the material in the moulds, in like manner to what has before been done when using hard material in a melted state without solvent, and concluding the formation of the candles or night-lights by pouring in an inferior material, or one melting at a lower temperature.—*Mechanics' Magazine*, No. 1705.

LAMPS FOR PARAFFINE AND NAPHTHA.

MR. W. LITTLE, Strand, has patented the invention of Lamps for burning Paraffine and bituminous oils or Naphtha. Each lamp is made with one or more wick tubes, and each tube is filled with a wick of cotton. The wicks are not consumed as in oil lamps, but they last a very long time, and only require that the small portion which is charred should at long intervals be scraped off the top of the wicks. When a lamp has only one wick tube, there is placed over the upper end of such tube a hollow cap open below, and it has a hole through it at its upper surface. Atmospheric air is allowed to pass through numerous small perforations below the gallery into the interior of the cap, and it passes up with the flame through the hole in the cap. The wick is raised and lowered by a pinion acting in a rack formed on the tube which contains the wick, or by other convenient means, a glass chimney is placed in the gallery which carries the cap, and the arrangement is such that the supply of air to support combustion comes all into and through the cap, air not being admitted between the chimney and the cap. When two, three, or more wicks are used in a lamp, each wick is placed in its own tube, and the tubes are by preference so connected that one rack and pinion will move and adjust all the wicks at one time. The hollow cap used with such lamps has as many holes through it at its upper surface as there are wick tubes. The air for supporting combustion is introduced through numerous perforations below the gallery into the cap, and the air and flames pass together through the several holes in the cap. Air is not admitted into the glass chimney except through the cap.

PARAFFINE CANDLES.

MESSRS. FIELD and HUMFREY have patented certain improvements in making paraffine candles. The patentees melt paraffine, and at about 140° Fahr. run it into candle moulds heated to the same temperature, or rather higher. The pipes thus filled are allowed to stand a few minutes to permit the air bubbles to escape, and are then plunged into cold water. The sudden cooling of the paraffine prevents its forming itself into crystals; the candles are nearly transparent, and draw freely from the pipes.

PEAT GAS.

MR. JOHNSON, R. L., has patented certain improvements in the manufacture of Gas for illumination, from Peat or other substances, and in the apparatus employed. The object of these improvements is to decompose, more completely than heretofore, the peat or other substance employed to produce illuminating gas, and to convert into such gas some of the other matters evolved in the form of condensible volatile matter for the substance employed. A peculiar arrangement of apparatus is employed, consisting principally of a retort, in which are plates or rods, placed in such manner as to form horizontal shelves. Above the upper shelf are placed rods or plates, on which is placed charcoal or coke. On the bottom of the retort, and on the lower shelf or shelves, is placed the substance to be distilled. In front of the shelves, and extending downwards from the top rods or plates (which support the charcoal or coke) to the bottom of the retort, there is a moveable stopper, to prevent the matter evolved from leaving the retort before passing through or over charcoal or coke. The shelves are not extended to the back or end of the retort, but a passage is there made by which the volatile and gaseous matter generated passes to, and comes in contact with, the charcoal or coke, by which contact the condensible volatile hydro-carbons are converted into permanent illuminating gas, and the water usually contained in the substances distilled is caused to be expelled or decomposed before it can act injuriously on the gaseous products. The patentee also maintains a higher and more equable temperature of the retort, which is often lowered by the usual mode of placing in it the substance to be distilled.

Mr. R. A. Brooman, has patented improvements in manufacturing Gas from Peat, and in treating hydrogen gas, in order to render it illuminating. The inventor first fills a retort with peat, closes it, and heats the furnace containing it to the same temperature as that required for distilling coal. The gas evolved passes into a cylindrical receiver, carrying with it the tar, oils, and ammoniacal waters, the greater portion of which becomes disengaged from the gas in the receiver and condensed therein. The gas passes thence into a condenser, in which the tar, oils, and ammoniacal waters which may have escaped the action of the cylindrical receiver are condensed. The gas then passes through purifying and drying apparatus containing pumice stone, coke, or brick impregnated with sulphuric acid. The gas next passes through a regulator, which transmits it regularly into a carburetting retort. In this retort the tar contained in a vessel, placed above the furnace, is also admitted through a reversed syphon, the lower end of which passes across the gas admission pipe. The tar becomes decomposed in the retort, and, entering into the gas, carbonizes it, and imparts illuminating power thereto. The gas next passes through a chamber, in which the tar which may have escaped the decomposing process is collected, and then undergoes a final purification, and passes into the gasometer. Pure hydrogen gas is to be carburetted in a somewhat similar manner to that employed for gas produced from peat.

The following is stated as the result of this new illumination in Dublin:—268 jets of gas, representing the word "Peat," were presented in front of the street, showing a soft, permanent, and brilliant light. These jets were fed by gas which burned for more than an hour, consuming in that period but sixpence worth of common turf peat. The following is the estimate of the value of turf as an illuminating agent, contrasted with coal.

From one pound of turf as much as six cubic feet of gas of excellent illuminating quality may be obtained. From good coal about the same may be obtained. The peat gas burns with a soft luminous light, equal, if not exceeding in brilliancy, the best coal gas. Coal costs in Athlone from 30s. to 40s. per ton. In the same place turf may be obtained for about 5s., so that in such a place the cost of peat gas is no less than 75 per cent. cheaper than coal gas. From four tons of turf one ton of peat charcoal is obtained as a residual product, worth at present 3*l*. This may be used with great advantage in smelting iron. A great advantage is, that the retorts are not acted upon by the turf; whilst, on the contrary, the coal, by reason of the sulphur mixed through it, rapidly corrodes the retorts.

In manufacturing gas from coal, two hours is the general time for working off a charge. From turf the gas may be made in a few minutes.

NEWLY-DISCOVERED GAS-COAL.

A FORMIDABLE rival to the well-known Boghead cannel has just been discovered in the United States, which will, probably, diminish the demand for English cannel coal in America, and have some effect upon the future price of that article at home. The newly-discovered deposit is situate near the banks of the Ohio, in Breckenridge County, State of Kentucky. A sample sent to this country produced at the rate of about 11,000 feet of gas per ton, of a quality 15 per cent. superior to Boghead cannel gas, one cubic foot per hour giving a light equal to nearly ten standard sperm candles.—*Journal of Gas Lighting.*

THE VULCANIZATION OF INDIA-RUBBER.

THIS has become a very important and extensive process, better known hitherto in America for the multiplicity of its uses than with us. Vulcanized rubber is worked in the plastic state, especially by the aid of steam and boiling water, just as if it were plastic clay, and is in this state moulded at once into all sorts of forms, such as those of workmen's tool handles, or compounded with other ingredients, so as to assume the aspect of bronze, ivory, buckhorn, cameos, &c. For chisel-handles, and such like, subject to concussion, the vulcanite possesses the rare quality of permitting the hardest blows being dealt with the hammer or mallet indifferently without splitting or other injury. Gum elastic, or India-rubber, as remarked in an interesting article on the subject in the *Mechanics' Magazine*, can be readily mixed or combined with almost every other substance. It may be mixed with other gums, oils, coal-tar, carbon, and with the earths and oxides, or pulverized metals and ores. It can likewise be combined with all fibrous products. It is compounded in the manufacture with many of the above substances, for the purpose of obtaining particular advantages for special uses. Ground cork and other light materials are sometimes mixed with the gum to increase the bulk and make the articles light. The oxides of metals, their filings and pulverized silicas, will give imitations of marble. The fibre of cotton or the dust of different woods will afford simulations of wood of greater or less gravity, as may be required. The combining of plumbago gives the crayon, oxide of zinc produces lithographic stone, and so on and on.—*Builder*, No. 712.

VENEERING WITH VULCANITE.

THE extraordinary toughness of the veneers prepared for the covering of furniture, however simple in form or ornate in design, is remarkable. The exquisite beauty of the slightly relieved patterns upon some of this veneer ought not solely to weigh in its recommendation, inasmuch as, in the act of rolling or pressing the material into veneer, the process adopted may either involve the most finished and intricate designs, or simply a plain surface. There is an additional feature in this method of rolling or pressing these veneers and the material itself: a perfect and indelible polish is simultaneously obtained in those parts where it is required to give relief to the rest. In a word, finish is consequent upon the act of making the veneer, and the act of pressing or rolling the material into veneer is the ultimate act of its finish. But what is, perhaps, the most surprising fact to those not familiarly acquainted with the nature of the material, is to see done, or to take themselves a hammer, and strike the delicate tracery of the vulcanized surface in right earnest, without making the slightest impression upon it, or effacing its polish in the least. The handles of knives, cornices, brackets, and other articles in vulcanite which are electro-plated, may be struck a very severe blow with the hammer—a blow, indeed, which would leave its mark to some depth upon gold in the solid—without the merest perceptible indentation. Furniture veneered with vulcanite may be made to assume at once both finish and perfection of character, with an amount of labour scarcely appreciable. The facility with which this veneering may be effected upon any kind of woods is perfectly startling. The cabinet-maker has but to steep the veneer for a few minutes in boiling water, and a sheet of it becomes as tractable as moist paper. Thus he may veneer round and over the sharpest curves and angles, and cover a surface with the ease of the paperhanger.—(*Mechanics' Magazine.*) There are various specimens of this kind of veneering, we may add, as well as a great variety of other articles made of vulcanite, in the Crystal Palace at Sydenham.

INDIA-RUBBER PENS AND TUBES.

MR. J. H. JOHNSON has made certain improvements in the treatment of hard India-rubber, for the purpose of rendering the same applicable to the manufacture of Pens, Tubes, Springs, and other similar articles. In this invention the caoutchouc is manufactured and hardened after the manner adopted by the Paris Hard India-rubber Company, being vulcanized in sheets on plates of glass or tinned metal, the composition consisting of about 100 parts of gum to from 40 to 50 of sulphur. The sheets, when intended for pens, are divided into strips of a width corresponding to the length of one or more pens. These strips are passed between polished cast-iron or steel rollers, heated internally, being first softened slightly by moderate heat. Or, in place of rolling, the strips may be subjected to a hammering process—the object of both processes being to draw out the strips longitudinally, whereby elasticity is imparted to them. The strips are then cut transversely, the width of the pieces cut off being sufficient to form, when curved up, either a semicircle or an entire tube, according to the style of pen to be made. The pieces are then nibbed and split, and exposed for a short period to a temperature somewhat higher than that adopted in the previous process, which has the effect of causing the material to shrink unequally or curl up lengthwise, the side of the material which was in contact with the glass or metal vulcanizing plate being much more sensible of the action of heat than the upper side of the material, so that the material will itself assume the curved or tubular form requisite for a pen.—*Mechanics' Magazine*, No. 1734.

NEW APPLICATION OF INDIA-RUBBER.

A COMPANY called the Beacon Dam Company exists at New York for the manufacture of "Hard India Goods." By a process originated by Mr. Chaffee, coal-tar is mixed with the rubber, and the compound makes a solid, elastic, and elegant article. It resembles polished stone, is as black as coal, needs no finish, and has of itself a polish hard and exquisite as it is possible for any metal to bear. "Canes" constructed out of it are as tough as steel, and as elastic as whalebone. Spectacle bows and frames for eye-glasses, opera glasses, castors, and sand stands; inkstands, brushes for the hair that cannot be harmed by hot water; tape lines, penholders, pencil-cases, cigar-cases, government boxes for the army and navy, government buttons, and an endless variety of articles are thus made; also, syringes of a novel form and character; machines for oiling oars and engines on a new principle, &c.—*Boston Journal.*

PETITJEAN'S PROCESS FOR SILVERING GLASS. BY PROFESSOR FARADAY.

M. PETITJEAN'S process consists essentially in the preparation of a solution containing oxide of silver, ammonia, nitric and tartaric acids, able to deposit metallic silver either at common or somewhat elevated temperatures; and in the right application of this solution to glass, either in the form of plates or vessels. 1540 grains of nitrate of silver being treated with 955 grains of strong solution of ammonia, and afterwards with 7700 grains of water, yields a solution, to which, when clear, 170 grains of tartaric acid dissolved in 680 grains of water is to be added, and then 152 cubic inches more of water, with good agitation. When the liquid has settled, the clear part is to be poured off; 152 cubic inches of water are to be added to the remaining solid matter, that as much may be dissolved as possible; and the clear fluids to be put together and increased by the further addition of 61 cubic inches of water. This is the silvering solution, No. 1; a second fluid, No. 2, is to be prepared in like manner, with this difference, that the tartaric acid is to be doubled in quantity. The apparatus employed for the silvering of glass plate consists of a cast-iron table box, containing water within, and a set of gas-burners beneath to heat it: the upper surface of the table is planed and set truly horizontal by a level, and covered by a varnished cloth: heat is applied until the temperature is 140° Fahr. The glass is well cleaned, first with a cloth; after which a plug of cotton, dipped in the silvering fluid, and a little polishing powder, is carefully passed over the surface to be silvered; and when this application is dry it is removed by another plug of cotton, and the plate obtained perfectly clean. The glass is then laid on the table, a portion of the silvering fluid poured on to the surface, and this spread carefully over every part by a cylinder of India-rubber stretched upon wood, which has previously been cleaned and wetted with the solution; in this manner a perfect wetting of the surface is obtained, and all air-bubbles, &c., are removed. Then more fluid is poured on to the glass until it is covered with a layer about the $\frac{1}{10}$ of an inch in depth, which easily stands upon it; and in that state its temperature is allowed to rise. In about ten minutes or more, silver begins to deposit on the glass, and in fifteen or twenty minutes a uniform opaque coat, having a greyish tint on the upper surface, is deposited. After a certain time the glass employed in the illustration was pushed to the edge of the table, was tilted that the fluid might be poured off, was washed with water, and then was examined. The under surface presented a perfectly brilliant metallic plate, of high reflective power, as high as any that silver can attain to; and the coat of silver, though thin, was so strong as to sustain handling, and so firm as to bear polishing on the back to any degree, by rubbing with the hand and polishing powder. The usual course in practice, however, is, when the first stratum of fluid is exhausted, to remove it, and apply a layer of No. 2 solution; and when that has been removed and the glass washed and dried, to cover the back surface with a protective coat of black varnish. When the form of the glass varies, simple expedients are employed; and by their means either concave or convex, or corrugated surfaces are silvered, and bottles and vases are coated internally. It is easy to mend an injury in the silvering of a plate, and two or three cases of repair were performed on the table.

The proposed advantages of the process are,—the production of a perfect reflecting surface; the ability to repair; the mercantile economy of the process (the silver in a square yard of surface is worth 1s. 8d.); the certainty, simplicity, and quickness of the operation; and, above all, the dismissal of the use of mercury. In theory the principles of the process justify the expectations, and in practice nothing has yet occurred which is counter to them.

The above description by Professor Faraday of M. Petitjean's process, for which a Patent has been obtained in this country, formed part of a lecture delivered at the Royal Institution.

PROCESS OF SILVERING METALS.

MR. L. B. ADVIELLE has patented an improved process for Silvering metallic articles. The patentee dissolves 3¼ ounces of silver in about 6½ oz. of nitric acid. He likewise dissolves about 32 oz. of cyanuret of potassium in ten quarts of water, and pours this solution into the nitrate of silver. To this he adds about 6½ oz. of well-pounded whiting, and thus obtains "Argentine water." He immerses the articles in a bath composed of one part of this diluted with two parts of water, and when the article is well impregnated it is to be rubbed with dry whiting, and washed and rubbed with a dry cloth, and the article will assume a white and brilliant appearance.

THIS article is now largely introduced into the manufactures of this country. It is described as an Indian grass. It much resembles a coarse flax, having a long fibry texture, and when dyed has a very woolly appearance. In and around Dundee there are no fewer than seventy-six mills, all engaged spinning this jute and flax—the principal of which is said to be the largest mill in Scotland. There are in this mill some two thousand hands all wholly employed in spinning jute, which is used to a large extent in the manufacture of carpets and rugs. Some three houses in that quarter dye for this branch of trade alone some seven tons a-day. The carpets are sold as low as from 7d. to 11d. per yard; the rugs again as low as 3s. Jute can be spun to a very fine thread. If so, might it not be turned to a good account in our shawl trade to supplant the cotton? In its unmanufactured state it is said only to cost 11s. per cwt.—a very great contrast to our very coarsest wool, at least 1s. per lb. in its oily state. —*Paisley Journal.*

IMPROVEMENTS IN PAPER-MAKING.

MR. DICKENSON has introduced a method of manufacturing a paper which, by possessing on its opposite sides varying characters of surface, will permit of its being used indifferently for copper-plate or lithographic printing. For this purpose are brought together in a very wet state (that is to say, in an unfinished stage of manufacture) two webs of paper, as they are delivered from their respective machines; these webs are combined into one by pressure, and are then dried and consolidated, so that they shall form one homogeneous web of paper. One of these webs is formed on what is known in the trade as the "Fourdrinier" or "Shaker" machine, and the other is formed on the cylinder machine. The arrangement of machinery which is employed in carrying out this new manufacture consists of a shaker machine, and a cylinder machine, combined with a suitable arrangement of felts and guide rollers, for traversing the two webs, and also of pressing rollers for expressing the moisture from the paper, and effecting the consolidation of the two webs into one.

Mr. J. L. Jullion has patented the manufacture of paper, card, and millboard from certain vegetable productions.

The patentee's claims are thus enumerated:—1. The manufacture of white paper and card from the fibres of the plantain and banana plants, sugar cane, and reeds, by certain described processes. 2. The employment of alkaline sulphurets, or a mixture of alkaline and earthy sulphurets with hydrates of alkalis in the manufacture of paper from straw. 3. The application of percolation under high pressure, combined with an alternating tumbling motion, in boiling all substances intended for the manufacture of paper, card, and millboard. 4. The employment of a rotatory vessel in which a pressure of chloride gas is generated for the purpose of pickling or bleaching materials used in the manufacture of paper. 5. The employment of a current of atmospheric air, either warm or cold, in the process of bleaching, as described.

Mr. J. Fraser has patented an improvement in the manufacture of paper or paper pulp, relating to a mode of treating straw, grass, hay, &c. These are first cut up into suitable lengths, and then submitted to a solution of soda and lime in boiling water, to which is added common resin. To prepare the solution the patentee dissolves 1lb. of soda or potash in two gallons of water; to which he adds, in small quantities at a time, about 1lb. of common lime; and the liquor is first kept well stirred, and then settled and strained; and to every 100 gallons of clear liquid 2lbs. of common resin must be added. The mixture should then be boiled again until the resin is dissolved, and the liquor is uniform. Thus prepared, a vat should be about half-filled with the liquor, and as much fibre as the liquor will thoroughly saturate placed in the vat, and completely immersed. The whole should then be boiled three or four hours. The straw is then to be washed in water, and it will be ready to be ground into pulp.

Mr. J. Fraser has patented the means of making paper from straw by the following process. An alkaline ley is prepared by dissolving 1lb. of soda or potash in 2 gallons of boiling water, and then adding 1lb. of lime in small quantities, keeping the mixture stirred and boiling for an hour after the lime is added. Salt is then added in the proportion of about ¼lb. to 100 gallons of the mixture. As much as the liquor will saturate is now placed in the vat, and boiled for three or four hours (or the straw may be steeped in the liquor when cold, for twenty-four hours). The straw is next taken out of the vat, drained, and well washed with water, after which it is ready to be ground into pulp.

MANUFACTURES FROM BEET-ROOT.

A NEW species of manufacture has just been created in France—the fabrication of pasteboard from the pulp of Beet-root. This fabrication is carried on to some extent in the commune of Foulaine (Haute-Marne), and can be employed, it is said, with advantage in ornaments, tea-trays, and other such articles. A new alimentary production has just been invented, made from beet-root. It very closely resembles coffee, and has received the name of *betterave torréfiée.* When mixed in equal proportions with West India coffee, the taste is by some persons thought more agreeable than that of the genuine article; it is less heating, and does not require above half the quantity of sugar.—*Galignani.*

TORTOISESHELL BOOKBINDING.

THIS novelty has been patented by Mr. W. Hartwill, a tortoiseshell-worker, of Bermondsey. The designs of inlaying upon the covers and backs are various, some of the books having leather backs, others velvet to match; and others having tortoiseshell, with the name of the book thereon, obtained by dies of various patterns. Some of the book covers are attached to the books by means of very ingeniously made joints, which enable the books to be opened as widely as desired without incurring the slightest injury or straining to them, which the present mode of binding does not permit. The patent is also applicable to inlaying pianofortes.—*Times.*

TRANSFERRING.

MR. L. CORNIDES has patented certain improvements in obtaining impressions of prints or drawings, and in transferring, printing, and colouring, or ornamenting the same on glass, &c. His claims are:—1. A peculiar mode of transferring impressions to the gelatined surface of glass in water, by which the impression is rapidly and evenly spread over the surface. 2. A process of transferring negative impressions to the gelatined surface, so as to produce a positive effect or picture by the light seen through such negative impression. 3. A process of sifting fine glass powder on the transferred impression, so as to heighten the effect of, or colour the same. 4. The use of the gelatined glass surface for the purpose of making photographic impressions, as described. 5. The heightening the effect of the transferred impression, or colouring the same, by powdering the impression as described, and then transferring the same so produced to the gelatined surface.

FORGERY OF BANK-NOTES.

MR. H. BRADBURY, of Whitefriars, has delivered an interesting lecture at the Royal Institution, upon the "Manufacture of Bank-Notes, in connexion with the subject of Forgery." The lecturer said it was his object principally to direct attention to the engraving, as the most important feature in the manufacture of bank-notes, because upon that depended their security in the eyes of the public. The main feature of the note, the engraving and its security, depended upon the vignette: the higher the quality of the artistic impress, therefore, which this vignette carries, the greater the security of the note. The vignette derived its great value from being the uncounterfeitable seal of the note,—uncounterfeitable, because its individuality could not be imitated. However similar, there was a difference in the human countenance: however similar, there was a difference in handwriting; and if any number of the most eminent engravers were to endeavour to copy each other, it would be detected by a casual examination. The Bank of England note, the lecturer continued, had always been characterized by simplicity, but, carried to an extreme in the opposite direction, in its present form it was unworthy of the bank and nation. In the case of the Anastatic and the photographic processes, the antidote consisted in the adoption of printing in different colours. If the water-mark of the bank-note were backed by excellence of art and engraving, it might be regarded as unforgeable; but if this should be found not to be the case, then it should be imperative on the Government in committee to resolve this question, or offer a reward for its solution. For further details see Mr. Bradbury's published Report of the Lecture, with illustrations.

GEM-ENAMELLED PAPIER-MACHÉ VASES.

MESSRS. JENNENS and BETTRIDGE'S patented process of Gem-enamelling has been successfully applied in the manufacture of two large Vases for the Queen, from the designs of Mr. Lewis Gruner. These vases are seventeen inches in height: the material employed in their construction is glass with electro-gilt mountings, the style adopted by the designer being that of the Renaissance. The ground colour is a rich purple, relieved in various parts by maroon. The ornamentation is wrought in "patent" or "imitation" gems, and the success with which the sparkling lustre of the originals is simulated is most remarkable. The surface of each vase is divided by floral festoons of gold and diamonds into four equal compartments; one of which is occupied by laurel wreaths of emeralds, with ruby bands or scrolls, surrounding the initials "V" and "A" emblematically entwined on a maroon ground in topaz and gold. Above the wreaths is the crown in appropriate jewels and gold, and supported by dolphins. In the centre of each of the remaining divisions are the rose, shamrock, and thistle, in their natural colours. Around the shoulders of the vases are the legends, "Dieu et mon Droit," and "Treu und Fest," in diamonds and gold. The neck is encircled by a continuous double wave or scroll of diamonds, enriched with wreaths of flowers in jewels of proper colours. The lower part is inclosed by pierced mountings, the spaces between each of which are devoted to geometrical figures, also of jewels and gold; and the whole rests upon a suitable metallic base. The last named adjuncts were supplied by Messrs. Elkington and Mason, and are of excellent workmanship. The effect which results from these combinations, in which about 10,000 "gems" have been employed, is superb, but chaste.

The vase, if not of Etruscan or classic form, has a very elegant appearance; indeed, until closely inspected, the decoration looks like enamelled work ornamented with real diamonds, emeralds, and rubies. The motto "Treu und Fest" is beautifully worked to represent brilliants and rubies; the ornaments are a Roman laurel wreath and festoons of diamonds.

A MANUFACTORY OF ULTRAMARINE AT NUREMBERG.

THE manufactory belonging to Messrs. Zeltner and Heyne has acquired a European reputation, and sends its produce to all parts of the globe. Its exterior aspect is somewhat imposing, the whole being surrounded by a wall; one of the buildings looks rather like a fortress, and the entire space occupying an area of seven Bavarian acres (*Morgen*). The central building consists of a polygon of twenty-four sides, with ninety-six furnaces, arranged in twelve compartments with as many high chimneys. Thence issue twelve branches of rails to all parts of the manufactory, being provided at the intersecting points with turning platforms. From the upper stories similar rails of wood are laid; the iron rails being 4,500 feet long, the wooden ones a trifle less. If we enter the polygon, which has a diameter of 136 feet, and is surrounded by buildings 300 feet long, and two stories high,—the dim twilight gives the idea of being in the pit of a mine. All these buildings are vaulted and bombproof. The departments of this manufactory are manifold. In the middle is a building for mechanical contrivances, with two steam-engines; to the east the above polygon; towards the west a high-pressure engine, with a mill and a washing apparatus. The mills have twenty-eight troughs, and are mostly of cast-iron; of the two stores one is 300 feet long, and this alone can hold 3000 to 4000 cwts. of ultramarine. A swinging rail transfers the colours from one end of the building to the other. Covered passages connect the single buildings, and there are seven large roads and six courts, presenting everywhere a fine perspective. Towards the west is a long row of drying-houses, in which a constant tropical heat is to be maintained, so that winter loses its power in all the vicinity. The merit of the discovery of artificial ultramarine belongs to Professor Gmelin, who died in scanty circumstances. This manufactory arose in 1839, and the proprietors preserve yet the weather-boarded shed in which they began business. The manufactory employs 200 workmen, of whom 180 are married. They have established a sick-fund and a pension fund for widows, orphans, and invalids, as well as a singing chorus. The best blue artificial ultramarine has to pass eighty different processes, until it is ready for use, and is now applied to the colouring of cotton and wool-stuffs, tapestry, paper, sealing-wax, &c.; besides its purely artistic use.—*Builder*, No. 684.

GIGANTIC GLASS CHANDELIER, OR GASELIER.

AMONG the great advances in Glass Manufacture of late years, the improvement and economy of cut glass for Chandeliers, by British makers, has led to a very extensive manufacture for the home and foreign trade. This pre-eminence was well sustained at the Paris Exhibition by Messrs. J. Defries and Sons, of Houndsditch, who exhibited a Chandelier, or Gaselier, of gigantic proportions, tasteful design, and beauty of material; though it is hardly possible to estimate properly the effect of cut glass except under the influence of the light for which it is adapted.

Messrs. Defries' large chandelier (designed under the superintendence of Mr. Moss Defries) consists of 72 lights for gas—36 upon the main band, and 18 upon each of the two rows above. The material is the best cut "crystal glass;" the main supports in the design are six glass pillars, or columns, between which are "fountain bodies," surmounted by a beautiful "spangle tent," above which is another "fountain body," terminating in a richly-cut vase. The entire height is about 23 feet; weight, about 22 cwt. The work throughout is executed very ably; and the effect of the gaslight playing through the various richly-cut forms is extremely brilliant.

We may here mention that Messrs. Defries and Sons executed the set of ten superb cut glass lustres with which is lighted the new Music Hall, at Evans's Hotel, Covent-garden.

COCOA-NUT FIBRE.

THE prison authorities have become large manufacturers of Cocoa-nut mats and matting; and in prisons, where profitable labour is a primary consideration, this trade has greatly lessened the expenses of the establishments. For instance, in the prison at Wakefield, in Yorkshire, 500 or 600 prisoners are kept employed at this trade, and their weekly earnings average 7*s.* per week each man. Many other prisons and workhouses also manufacture these goods to great advantage. Two-thirds of the goods manufactured in prisons and workhouses are bought by the agents of Manchester and City houses, and exported to America and the Continent. The total annual consumption of cocoa-nut fibre in Great Britain, for all purposes, is now about 5000 tons, the value of which may be fixed at about 100,000*l.* In France the material is scarcely known, the high rate of duty chargeable upon it acting almost as a prohibition. It is, however, eagerly sought after, and the numerous inquiries made for the articles of cocoa-nut fibre in the Paris Exhibition, prove that a modification of the present duty would lead at once to the introduction into that country of this new branch of industry, and to a large consumption of the raw material.—*Mr. Digb Wyatt's Report on the Paris Exhibition.*

THREAD AND FIBRE GILDING.

A VERY interesting paper has been read to the Society of Arts, on "Thread and Fibre Gilding," by Mr. Francis Bennoch, the inventor of a new process, by which the more tedious and expensive processes of India and Europe are in a measure superseded.

Mr. Bennoch introduced his subject with a historical sketch of fibre plating, or the covering or entwining of threads of silk or cotton with gold or silver flattened threads; and a description of the processes by which, in India, an ingot of gold or silver is gradually lengthened out, by passing it through orifices of smaller and smaller diameter, till the bar assumes the form of a delicate thread, many miles it may be in length, and which is then laid over a rotating thread of silk or cotton, the whole work being done by hand, with the aid of the simplest possible machinery. He also described the more elaborate and rapid European processes, in imitation of the Indian, and pointed out the difficulties in the way of still greater improvements and economizations of these processes; concluding the whole with an account of the new invention, by means of which threads are simply *gilded* with the ordinary gold-beater's leaf. This is done by winding the threads in close array, but single file, round rollers, after passing through a glutinous liquor, and then laying over the surface leaves of gold, which are then burnished, so that one side of each thread is completely gilded; and on reversing the side by winding the thread on a second cylinder, the process is just repeated, and the whole thread is then completely gilded. This may be done with copper-leaf, as well as with gold or silver, and the copper thread is said to be scarcely distinguishable from the golden, except, doubtless, in its liability more easily to tarnish. The threads thus gilded may then, of course, be woven into cloth of gold or silver, or into gold or silver lace, in the usual way. This ingenious new process is likely to open up an important trade with the Eastern nations, who delight in sumptuous apparel, and perhaps to induce a similar taste to some extent in the west,—at least amongst the female sex. As regards cost, the new thread of gold is, size for size, considerably dearer than the ordinary gold thread; but, as it measures a much greater length for the weight, it virtually becomes, for weaving purposes, very much cheaper. Mr. Bennoch anticipates a still greater improvement some of these days by help of electro-gilding.—*Builder*, No. 601.

A more copious Report of Mr. Bennoch's important and interesting paper will be found in the *Journal of the Society of Arts*, No. 178.

IMPROVED SEWING MACHINES.

Mr. J. Lobstein has patented a new Sewing Machine, with which it is possible to form tubular pieces, either open at both ends or at one end only. Instead of turning the article to be sewn round the machine, when a curvilinear sewing is required, it is the cloth holder which is moved round the needle, so as to drive it in the direction of the required curve. This portion of the machine constitutes one of the chief improvements.

Mr. F. Whitaker has patented a Sewing Machine in which two threads are employed, and the stitch is made as follows:—The needle passes through the work, and carries a loop of its thread through with it. This loop is then caught by a hook, which carries it round and over a globular box, which is loosely held between suitable supports, and in this box a ball of thread is placed. The end of the thread is drawn through a hole in the ball, so that when the needle thread is drawn over the ball as before mentioned, the ball and needle threads are looped through each other; the hook which catches the needle thread travels about three quarters round the ball, so that when it gets near the end of its course the loop slips off (because of the reversed position of the hook), and when the needle thread is drawn tight the stitch is complete, and the hook returns.

Mr. B. Hughes has patented a knot-tying Sewing Machine, consisting in so arranging and operating the parts of sewing machines, that the thread from the needle, when passed through the material to be sewed, is tied by a half or a whole knot of the shuttle thread; and also in so operating the feed motion, that the thread to be tied shall be tied at the will of the operator by a half or whole knot at any stitch that may be thought necessary, thus providing a seam that will not rip when the thread is cut.

AMERICAN WASHING MACHINE.

The essential character of this new implement consists in the employment of floating balls in the operation of Washing. Some 200 or 300 of these balls, each of which is about the size of a Seville orange, and made of elm wood, are put into a wooden trough, two or three feet long by fifteen inches deep, containing water or soap-suds, in which they all float. A fulcrum is placed at the back of the trough, having a cross-beam attached to it, resembling a common pump-handle. On one side of the fulcrum an apparatus like a small window-sash, to which the clothes to be washed are fastened, is suspended from the cross-beam immediately over the mouth of the trough; and at the extreme end of the beam, on the opposite side of the fulcrum, is a box into which any weight may be put until it slightly weighs the sash up in the air. This done, the person performing the operation moves the beam handle up and down, as if she were pumping water, the effect of which is to immerse the sash laden with clothes among the balls and suds, and move it about among them. The balls produce a gentle friction upon the linen, which, without in the slightest degree injuring its fabric, or breaking or tearing off buttons, effectually removes every trace of dirt in an incredibly few minutes, and the operation is complete. The labour required is so slight that a child from twelve to fourteen years of age may perform it with ease. In some of the machines of larger size and greater cost, the requisite motion, produced by turning a wheel, is even done at less trouble. The action made on the linen is equivalent to the ordinary threefold process of pounding, rubbing, and squeezing, and as it can never exceed the resistance offered by the floating balls, it is thereby kept within bounds, which are perfectly safe for the most delicate fabric, the wear and tear being, indeed, less than in ordinary washing by hand. The machine was invented two or three years ago by one Christopher Hollingsworth, a farmer in Indiana, whose patent rights, so far as they relate to the whole continent of Europe, have been purchased by Mr. Moore and his partners in Holborn. They exhibited the implement at the Paris Exhibition, where it attracted considerable interest, and numbers were sold. The consumption of soap and fuel is much less than in washing by hand; and the fingers of the operator are never wet during the process, except to the extent necessary in putting the clothes into the sash, and taking them out and wringing them when washed. In the saving of labour, time, and material, its advantages can scarcely be exaggerated, while the price is not such as to preclude it coming into general use.—*Times.*

A METROPOLITAN STEAM WASHING COMPANY.

THE works of this new Company are situated at Wharf-road, City-road. The patent, it seems, is that of Messrs. J. Wallace and Co. of Glasgow, originally taken out for bleaching, but subsequently applied to washing. The privilege has been sold, it is stated, to Messrs. Cockran and Co., bleachers, for four years, at about 3000*l.* a year. The dash-wheel forms the leading feature in the process. The patent has been taken for the union of steam with the dash-wheel. Each wheel is divided into four compartments, and each compartment holds 100 shirts: the 400 shirts are washed in thirty minutes. The diameter of the ordinary wheel is 6 feet and a half, but those for blankets are 9 feet, and will hold twenty-five blankets in each compartment: these are cleansed also in about thirty minutes. The shaft is hollow, admitting simultaneously the supplies of steam, soap, and soda, but by different pipes. Each wheel makes twenty-one revolutions in a minute, and the goods enclosed have two falls on each revolution, making forty-two falls per minute. The weight washes the goods. The Company propose to wash for laundresses at so much per pound weight. There are drying and laundry rooms also on the premises; and Manlove's drying or rinsing apparatus is at work there.—*Builder*, No. 717.

A SMOKELESS FIRE.

MR. JOHN LESLIE has patented an arrangement, which is thus described. Air is brought to the front of the fire-place by pipes, and the gases (he maintains there is no *smoke*) are allowed to escape only by an opening close to the *bottom* of the grate, formed by means of a false back. An opening into the flue from the upper part of the room serves to ventilate the apartment. The patentee states that 15lbs. of coal supply the fire for nine hours, and looks forward to the abandonment of projecting chimney-breasts (a very small flue being sufficient), and to the avoidance of disfiguring cowls.

SILICATE STARCH.

THIS is a discovery by Mr. Leigh, of Manchester, surgeon and analytical chemist, of a substitute for the *size* hitherto made from flour, and used to an enormous extent in the manufacture of cotton cloth. This substitute is a Silicate of Soda, or preparation of sand and soda. It is calculated that a saving of 25 to 50 per cent. will be effected by the adoption of this instead of flour size, whilst the quantity of flour which will be set at liberty for the purpose of food, should it become generally adopted, will be equal, it is thought, to about 3,000,000*l.* to 3,500,000*l.* worth per annum,—a hopeful redeliverance of the staff of life to its more legitimate purposes; but it is a sad circumstance, revealed in the recent agitation against adulterations of articles of food, that flour itself is often adulterated with just such silicates, and is but too likely to be so now, we fear, more than ever. The adaptability of soluble silicate of soda as starch, or size, will be obvious to all who know that with water it forms a gelatinous mass not unlike solution of gum.—*Builder*, No. 718.

NEW MODE OF PRESERVING MEAT.

M. MARTIN DE LIGNAC, of Paris, has patented a new mode of Preserving Meat, which is as follows:—The raw meat is first to be cut into cubes of about an inch square, and subjected in hot-air chambers to a current of air at twenty-five to thirty degrees centigrade, until, by the continuous and energetic action of this current, the meat has lost about fifty per cent. of its weight. It is to be then powerfully compressed in cylindrical tin boxes, so that a vessel capable of holding about a quart shall receive eight rations, the whole (vessel, liquor, and meat) weighing from two pounds to two pounds and a half, and representing five pounds weight of fresh meat. The operation is concluded by filling with concentrated liquor any space left in the box. The cover is then to be soldered on, and the box and its contents are submitted in a cooking-vessel (or digester) to a temperature sufficiently high to produce steam in the box. It will be understood that by this cooking the water remaining in the meat will be partially converted into steam, and will expand the tissues and render them fit for the ulterior absorption of the water when immersed therein, causing them readily to assume their original volume, and to be more promptly acted upon by the consequent cooking operations.—*Mr. Bourne, in the Illustrated London News*, No. 818.

COOKING APPARATUS.

MR. F. A. WILSON has patented a Portable Cooking Apparatus, suitable for campaigning purposes. This invention comprises the following parts :—1. A camp-kettle or apparatus for roasting, baking, broiling, frying, stewing, and boiling purposes, the stove, oven, boiler, pans, kettles, and other articles (portions of which are also designed for eating and drinking purposes), being so constructed and varied in dimensions that the respective parts, when not in use, can be packed one within the other, the whole being enclosed within the largest part. 2. A stove for cooking purposes only, comprising a stove, oven, boiler, pans, and kettles, the various parts of which are also formed so as to fit one within the other. 3. A revolving apparatus, which consists of a single cylinder and covering plate, or double cylinders placed one above the other, the upper one fitting in the lower. By the revolving principle the whole of the pans, &c., may be turned round to any required position at the side. 4. A roasting apparatus, which consists of a shield to which a telescopic pipe is attached, this pipe enclosing a string or worsted which is fixed where the pipe is attached to the mantelpiece or other support.

KNIFE-CLEANING MACHINE.

MR. T. KEY has patented a rotary Knife Cleaner, made by mounting upon a spindle a circular or roller brush double the length of the knife blades, around the surface of which is placed a thin sheet of iron or other material, of sufficient width and length to encircle the same, and around this sheet of iron are placed two leathern straps, which, when buckled or drawn tightly round, bring the inner surface of the iron in close contact with the surface of the brush. It is then fixed in a box or case, in which are a number of apertures describing a circle, the diameter of which is equal to the diameter of the brush. Through these apertures the knives are passed, and the blades pass between the surface of the brush and the sheet.

HOW THE FRENCH OBTAIN FINE FLOUR.

IN M. D'Arblay's establishments the harder kinds of wheat, chiefly

Sardinian, Sicilian, and Russian, are ground; and by means of the adjusting process there applied, the grains are first ground high in the mill; the white middlings are then separated by coarse sieves and reground low in the mill; finally, the flour is repeatedly passed through fine silk sieves. In the manufacture of these sieves the French excel; and the superior fineness of the French flour, so well adapted for patés and the like culinary preparations, in great measure depends upon that important part of the flour manufactory. By the combination of the superior sieves with the gruaux principle of grinding, the wheat-flour may be made to contain more or less gluten in proportion to starch, and a saving of the finest and most nutritive portion of the flour is effected. There was no evidence in the British department of the Paris Exposition of any improvement likely to render us less dependent upon France for the peculiarly fine kinds of flour, which continue to be extensively imported for the purpose of mixing with and bettering our inferior flours. The gruaux principle of grinding is well worth the attention of the Australian colonists; the hard wheats of that climate most resembling those kinds of European wheat which M. D'Arblay finds best adapted for the application of his principle of flour-grinding.—*Professor Owen's Report on Alimentary Substances in the Paris Exhibition.*

HORSE-CHESTNUT FLOUR.

RECENT experiments in France are likely to result in bringing the horse-chestnut into common use as food. A paper in *La Presse* shows that by a thorough washing in pure water the starch of the horse-chestnut becomes free from acridity, and is a more valuable article than the starch of wheat—absorbing more water. It is found that the horse-chestnut contains more starch than the potato. Thirty-five per cent. of the chestnut flour mixed with wheat flour produces excellent bread. This has originated a new and important branch of manufacture in France, as the horse-chestnut is there a large crop.

BUTTER ADULTERATED WITH FLINT-STONE.

THIS heartless and wicked fraud is especially practised in the low kinds of butter usually sold in large manufacturing towns to the poorer and industrious population. The flint-stones are ground and then manipulated, until they are reduced into a soluble substance, which is known by the denomination of "soluble silica." When this latter preparation is dissolved in water, it becomes a stiff gelatinous body, somewhat resembling strong jelly. This jelly is mixed to a considerable extent with butter of low quality, to which fresh salt and colouring matter are added. The product is a compound which resembles a very good-looking dairy-made butter. But it has not the firmness or bright appearance of genuine butter, and is devoid of the richness and wholesome qualities of the latter. We have seen this gross adulteration at the laboratories of the Northern Analytical College, Sheffield.—*Doncaster Gazette.* (*See page* 107.)

CENTRIFUGAL CHURN.

A NEW Churn has been invented by Major Stiernsward, and has received a first-class medal at the Paris Exhibition. The advantages of this churn are:—1st. The milk is put in at once from the cow, without standing for cream (although cream may be churned in it as well). 2nd. After the butter is formed, which is with certainty in a few minutes, the milk is not soured, not being in any sense buttermilk, and can be boiled without coagulation. 3rd. The churn is not subject to get out of order; is easily kept sweet, and is inexpensive in its construction.

HANSON'S MACHINE FOR DIGGING POTATOES.

MR. J. HANSON, farmer, of Doagh, Belfast, has recently introduced an Apparatus to be used for Digging or removing growing Potatoes from the earth, as a substitute for the ordinary hand-fork, the object being the more rapid and economical removal of the roots.

The implement consists of a light, open timber frame, supported on four running wheels, the motion of the main axle being applied to the driving of an arrangement of rotatory digging forks. It is drawn by a pair of horses attached to a transverse bar, at the end of the frame opposite to the forks, the connexion being similar to that usually adopted in the common plough. The end transverse bar projects at one side, and serves as a handle for turning the machine at the headlands. The front pair of running wheels, next the horses, are of large diameter, and are furnished with radial spikes on their peripheries, so as to have a firm hold upon the ground in revolving, and thus provide sufficient resistance for the fork-driving action. The main axle, revolving with these large running wheels, carries a toothed bevil wheel, in gear with a bevil pinion fast on the forward end of a horizontal shaft, supported in bearings in the centre of the hind part of the frame. The opposite end of this shaft projects slightly at the extreme rear of the frame, at which part it has upon it two or more radial rotating forks, which of course revolve in a plane at right angles to the line of the implement path. At the part of the frame immediately behind the small back running wheels there is attached a horizontal plough piece, slightly inclined on its upper surface, the rear portion of which is just clear of the forks, as they work round. This plough piece, which is adjustable vertically, to suit the depth of action required, passes along beneath the drill of potatoes deep enough to lift up both the manure and the potatoes. In this way, as the manure and potatoes are elevated upon the incline, the rotatory action of the forks scatters out the potatoes, which can then be easily removed. Provision is made for allowing one of the large driving wheels to turn back, to facilitate the turning of the implement at the end of a drill.—*Mechanics' Magazine*, No. 1699.

GRIST'S PATENT CASK-MAKING MACHINERY.

MR. GRIST, of Russell-place, Islington, has patented this method of the manufacture of Casks, and the parts of casks, by machinery. The making of casks, otherwise than by hand, is an operation to which but comparatively few inventors have directed their attention and efforts with any considerable degree of success; and no one has done so with anything like the same results as Mr. Grist. The most recent of his inventions comprises the best set of cask-making machines that has yet been produced. The jointing-machine can in ten minutes be altered to a cross-cutting-machine, for cutting the staves to the required length, or to a machine for deepening and jointing heading. As a jointing-machine it is adapted to the various peculiarities in the formation of staves, giving to them the necessary bilge, quarter, and bevil, and may be arranged to suit any lengths or widths, so as not to cut the timber to waste. Two of the machines might be easily worked by one unskilled person, and joint enough staves for one hundred casks (hogsheads) per day. The apparatus for drying and bending the staves, and setting them to the shape of the required cask also possesses great merit, for with it staves may be prepared, jointed, and shaped (even from green timber, which becomes effectually seasoned in the process) and then piled away or laid aside until wanted, occupying comparatively little space. Staves thus produced must greatly increase the facility of transporting casks to foreign parts by avoiding the necessity of making up *packs*, as is now done. The machine for cutting in the heads of casks is peculiarly arranged, in order to cut them of an elliptical shape instead of round; this machine is also convertible, for the parts for cutting the heads can be removed, and it at once becomes a turning lathe. It is worthy of remark that this set of machines has been contrived with a view to simplicity and cheapness, and will, we should think, fall within the reach of nearly all master coopers. The casks formed by means of them are almost mathematically exact, as regards their contents—a circumstance of great value in the case of brewers' casks, for when they are returned empty they can be taken to pieces ("knocked down"), cleaned, and piled away in a small space until they are required, when, by means of the raising or gathering-machine, they may be put together by an unskilled person, each in a few minutes.—For a detailed description of the invention see *Mechanics' Magazine*, No. 1722.

Mr. R. B. Cousens has invented an apparatus for curving and setting the staves of casks before being trussed; it consists mainly in the employment of a pair of bending-rollers working in iron side standards, and driven by separate driving bands and gearing, in order to allow them to move slightly, towards or from each other, according to the varying thickness of the stave. Another pair is also carried by the standards, and situated, one in front of, and the other behind the former ones. The upper surfaces of the front and back rollers are slightly above the contact surfaces of the central ones, so that when a stave is passed through (in a steamed or heated state), it is set or curved.

MONSTER ORGAN.

At Brussels has been constructed a magnificent Organ by the eminent builders, Merklin and Schütze, for the cathedral church of Murcia, in Spain. From the dimensions of this gigantic instrument, the front of which measures 43 feet, and the extreme height 65 to 70, it will be seen that only a few organs, such as those at Haarlem, Fribourg, and one or two others, can compare with it in size, while in the perfection of its mechanism, and the immense resources it offers to the organist, it is acknowledged to be superior to any of them. It has 4700 pipes and 68 stops; four complete keyboards, exclusive of pedals, and 18 pedals for coupling and effecting combinations on the different manuals. By means of these any one of the manuals may be coupled to any one or two, or all the others in an instant, while by an ingenious piece of mechanism, invented by Mr. Merklin for the purpose, the whole power of the instrument may be concentrated in a moment upon any one of the manuals, at the will of the performer. By the use of Barker's pneumatic lever the excessive weight of the keys, and all the inconveniences it entails, are totally done away with; and the most florid passages can be performed with as much ease and rapidity as on a pianoforte. The instrument is as remarkable for the sweetness and variety as for the power of its tone, every part having been brought to a pitch of perfection it would be difficult to surpass. Many of the stops approach so near to the instruments they represent as to be easily mistaken for some one accompanying the organ on them. The exterior is also worthy of notice. Owing to the cathedral of Murcia being built in two different styles, and the position which the organ is to occupy, it has two fronts, the principal one being Gothic, the other Renaissance. It has also another peculiarity. In accordance with an ancient custom in Spanish organs, four large groups of pipes project horizontally just above the beaufet, and immediately below the vertical pipes which form the great front. No Spanish organ is considered complete without this arrangement, and the taste displayed by the builders in carrying it out, causes it to add rather than detract from the general effect, which is grand and imposing.—*Abridged from the Times.*

IMPROVED CARRIAGES.

Mr. H. R. Abraham, the eminent architect, has patented a carriage on two wheels for passenger traffic and general conveyance of a number of persons, or invalid, or wounded persons, to be called a Rotaltar. This invention consists of an arrangement and adjustment of the body of the carriage, its seats and springs, which admit of their being carried on one axle with ease and security, the seats on the roof being nearly perpendicularly over the axle, across the carriage in a line with the axle, thus balancing or regulating the weight in reference to the draught, and rendering it easy. A public carriage called the "Cosy Express," upon a principle somewhat resembling the foregoing, has likewise been constructed from a design by Mr. Abraham.

Mr. Abraham has also patented certain improvements in carriages and in appurtenances and appendages which belong to those used as hospital conveyances or Ambulances. The patentee describes a vehicle which is said to combine a uniform balance with a full or partial load of passengers; also, the capability of dividing passengers from one another by the formation of separate compartments, with separate entrances.

DURANT'S REGISTERING APPARATUS FOR PUBLIC CARRIAGES.

Mr. A. Durant, of Tong Castle, Salop, has patented an apparatus called a "Monitor," for indicating the number of passengers entering a public carriage. For this purpose motion is communicated to a pointer from a moveable step, on a passenger entering a carriage; the pointer is acted on by a spiral spring tending to force it outwards, so that when it has made one revolution in a circular groove on the dial, it is by the spring forced outwards and caused to enter another circular groove, around which it passes, step by step, as passengers enter, or distances are told, till the pointer arrives at the end of the second groove, when it is again forced outwards and enters a third groove.

In order to ascertain more particularly how far passengers in cabs, or such like carriages have travelled, the seats are hinged, and by springs and levers, are held up, by which means the counting instruments are kept out of action so long as there are no passengers, but so soon as the seats are depressed by passengers sitting thereon, the measuring and counting of distance proceeds, and is recorded by the dial; and in order that the time also may be indicated, a time-keeper and a second hand on a similar principle are combined with the apparatus on the same dial if necessary.—*Mechanics' Magazine.*

AN AMERICAN STEAM BATTERY.

THE Harbour Steam Battery has been building at Hoboken for a long time past by Mr. Stevens, the surviving brother of the original projector. Among the estimates of appropriation by the United States Government for the year 1857 is $86,717 for this enterprise. She has been planked up to the main deck with heavy iron plates, and amidships the planking had been extended several feet higher, for the protection of the machinery. It is understood that other layers of plates are to be added, so as to make a wall at least six inches in thickness, proof against shot and shell. The appropriation already made and expended for this object was $250,000. In addition, a large amount has been expended by the builder in the excavation of the dry dock in which to construct the vessel. The length of this iron battery is about 400 feet. She will be equipped with a heavy armament and furnaces for heating shot, and be propelled by steam power, at unusual speed. It is asserted that she might be run into any ordinary vessel, cutting her in two. This work was commenced after a long series of experiments, under the supervision of Commander Stewart and Colonel Patten, representing the army and navy, to determine the penetrating power of common shot upon plates of iron. Their Report was satisfactory, showing that wrought-iron plates, 4½ inches in thickness, formed a perfect defence against a solid 64lb shot, fired at a distance of ten yards; or that successive layers of iron plates, with intervening spaces, were equally efficacious. The Secretary of the Navy was soon after authorised to contract for the work here noticed. For harbour defence, such a craft as this must prove highly efficient—moving about rapidly, choosing its positions at pleasure, regardless of the most formidable missiles of the enemy, and hurling its heated shot and other projectiles in every direction, the havoc committed would be fearful. The cost of this "infernal machine," complete, has been estimated at $1,000,000.—*New York Journal of Commerce.*

Natural Philosophy.

PLATO'S SURVEY OF THE SCIENCES.

A PAPER has been read to the Cambridge Philosophical Society by the Master of Trinity, on Plato's Survey of the Sciences, contained in the seventh book of the *Republic*.

Plato, like Francis Bacon, took a review of the sciences of his time; and like him, complained how little attention was given to the philosophy which they involved. The sciences which Plato enumerates, are arithmetic and plane geometry, treated as collections of abstract and permanent truths; solid geometry, which he "notes as deficient" in his time, although, in fact, he and his school were in possession of the doctrine of the "five regular solids;" astronomy, in which he demands a science which should be elevated above the mere knowledge of phenomena. The visible appearances of the heavens only suggest the problems with which true astronomy deals; as beautiful geometrical diagrams do not prove, but only suggest geometrical propositions. Finally, Plato notices the subject of harmonics, in which he requires a science which shall deal with truths more exact than the ear can establish, as in astronomy he requires truths more exact than the eye can assure us of. It was remarked also, that such requirements had led to the progress of science in general, and to such inquiries and discoveries as those of Kepler in particular.

In a subsequent paper, Dr. Whewell observes, at the end of the Survey, Plato speaks of *Dialectic* as a still higher element of a philosophical education, fitted to lead men to the knowledge of real existences and of the Supreme Good. Here he describes Dialectic by its objects and purpose. In other places Dialectic is spoken of as a method or process of analysis; as in the *Phædrus*, where Socrates describes a good dialectician as one who can divide a subject according to its natural members, and not miss the joint, like a bad carver. Another Dialogue, in which there are examples given of dividing a subject, is the *Sophistes*, where many examples of dichotomous or bifurcate division are given. But this appears from the Dialogue to have been a practice of the Eleatic rather than of the Platonic school. Aristotle proposed a division of subjects according to his ten *Categories*, which he and others since have extensively used. Xenophon says that Socrates derived *Dialectic* from a term implying to *divide a subject into parts*, which Mr. Grote thinks unsatisfactory as an etymology, but which has indicated a practical connexion in the Socratic school. The result seems to be, that Plato did not establish any method of analysis of a subject as his Dialectic; but he conceived that the analytical habits formed by the comprehensive study of the exact sciences, and sharpened by the practice of dialogue, would lead his students to the knowledge of first principles.

THE MEAN SPECIFIC GRAVITY OF THE EARTH.

LIEUT.-COL. JAMES, R.E., has communicated to the Royal

Society an "Account of the Observations and Computations made for the purpose of ascertaining the amount of the deflection of the Plumb-Line at Arthur's Seat, and the Mean Specific Gravity of the Earth." After the preliminary explanations, a detailed account is given of the mathematical investigation; and the paper, which is illustrated with plans and geological sections, and a model of Arthur's Seat, concludes with the following statement of the principal results:—

1. "The effect of the attraction of the Pentland Hills is observed in nearly equal amount at each of the three stations on Arthur's Seat.

2. "The calculated attractions of the mass of Arthur's Seat at the three stations are—

South Station.	Arthur's Seat.	North Station.
2″·25 North.	0″·34 South.	1″·98 South.

and, since the observed deflection at Arthur's Seat is 5″·27, the apparent effect of the Pentlands is 4″·93 at the summit of the hill.

3. "Of this deflection of 4″·93, the computed attraction due to the configuration of the ground within a radius of fifteen miles accounts for about 2″·6; and, inasmuch as we know that the igneous rocks of Arthur's Seat and the Pentland Hills have an origin at a great depth below the surface of the earth, the difference between the observed and computed attraction is probably owing in part to the high specific gravity of the mass of rock beneath them.

4. "The deflection at the Royal Observatory, Calton Hill, being 5″·63 south, exceeds that at Arthur's Seat by 0″·70. Of this deflection, 0″·60 is due to the configuration of the ground comprised within a circle of a mile and a quarter round the Observatory.

5. "The latitude of Arthur's Seat or points in the neighbourhood varies to the amount of 0″·02 between high and low water.

6. "The mean density of the earth, determined from the observations at the three stations on Arthur's Seat is 5·14, with a probable error of ±·07 due to the probable errors of the astronomical amplitudes."

MAGNETICAL SYSTEM OF THE EARTH.

Professor Hansteen, of Christiana, has transmitted to the Royal Society a research on "the Secular Changes of the Magnetical System of the Earth, and more especially on the Secular Variation in the Magnetical Inclination in the Northern Temperate Zone," wherein the Professor states:—"By calculating newer and more ancient observations of the magnetical declination, I have ascertained the movement of the four magnetical polar regions, which I had already found in my work, 'Untersuchungen über den Magnetismus der Erde (Christiana, 1819, with Atlas);' whereof the two northern ones have a motion from west to east, the two southern ones in the contrary direction; and have attempted thereby in general to declare the cause of the known variations, as well of the system of declination as that of inclination and of intensity.

"As I am indebted for the greatest part of the materials to English observations, I have found it my duty to render my thanks to English science, and to express my hopes of future exertions towards the solution of this, in my thoughts, most interesting problem of the general physics of the globe."

PHYSICAL STRUCTURE OF THE EARTH.

A PAPER on this inquiry has been read to the British Association by Professor Hennessy. After some preliminary observations as to the impossibility of accounting for the earth's figure, without supposing it to have been once a fused mass, the exterior of which has cooled into a solid crust, the process of solidification of the fluid was described. The influence of the connexion and circulation of the particles in a heterogeneous fluid was shown to be different from what would take place in a homogeneous fluid such as usually comes under our notice. As the primitive fluid mass of the earth would consist of strata, increasing in density from the surface towards the centre, its refrigeration would be that of a heterogeneous fluid, and the process of circulation would be less energetic in going from its surface towards its centre. Thus, the earth would ultimately consist of a fluid nucleus inclosed in a spheroidal shell. The increase in thickness of this shell would take place by the solidification of each of the surface strata of the nucleus in succession. If the matter composing the interior of the earth is subjected to the same physical laws as the material of the solid crust coming under our notice, the change of state in the fluid must be accompanied by a diminution of its volume. The contrary hypothesis had been hitherto always assumed in mathematical investigations relative to the form and structure of the earth. The erroneous supposition that the particles of the primitive fluid retained the same positions after the mass had advanced in the process of solidification as they had before the process commenced, had been tacitly or openly assumed in all such inquiries until it was formally rejected by the author, who proposed to assume for the fluid similar properties to those exhibited by the fusion and solidification of such portions of the solidified crust as are accessible to observation. The results to which the improved hypothesis has led show that it fundamentally affects the whole question, not only of the shape and internal structure of the earth, but also of the various actions and reactions taking place between the fluid nucleus and the solid shell. If the process of solidification took place without change of volume in the congelation of the fluid, the strata of the shell would possess the same forms as those of the primitive fluid, and their oblateness would diminish in going from the outer to the inner surface. If the fluid contracts in volume on passing to the solid state, the remaining fluid will tend to assume a more and more oblate figure after the formation of each stratum of the shell. The law of density of the nucleus will not be the same as that of the primitive fluid, but will vary more slowly, and the mass will thus tend towards a state of homogeneity as the radius of the nucleus diminishes by the gradual thickening of the shell. The surface of the nucleus, and consequently the inner surface of the shell, will thus tend to become more oblate after each successive stratum added to the shell by congelation from the nucleus.

This result, combined with another obtained by Mr. Hopkins, proves that so great pressure and friction exist at the surface of contact with the shell and nucleus as to cause both to rotate together nearly as one solid mass. Other grounds for believing in the existence of the great pressure exercised by the nucleus at the surface of the shell were adduced. If the density of the fluid strata were due to the pressures they support, and if the earth solidified without any change of state in the solidifying fluid, the pressure against the inner surface of the shell would be that due to the density of the surface stratum of the nucleus, and would, therefore, rapidly increase with the thickness of the shell. Contraction in volume of the fluid on entering the solid state would diminish this pressure, but yet it may continue to be very considerable, as the co-efficient of contraction would always approach towards unity. The phenomena of the solidification of lava and of volcanic bombs were referred to in illustration of these views, and their application was then shown to some of the greatest questions of geology. The relations of symmetry which the researches of M. Élie de Beaumont seem to establish between the great lines of elevation which traverse the surface of the earth appear to Prof. Hennessy far more simply and satisfactorily explained by the expansive tendency of the nucleus which produces the great pressure against the shell than by the collapse and subsidences of the latter. The direction of the forces which would tend to produce a rupture from the purely elevatory action of the pressure referred to would be far more favourable to symmetry than if the shell were undergoing a distortion of shape from collapsing inwards. The nearly spherical shape of the shell would also greatly increase its resistance to forces acting perpendicularly to its surface, so as to cause it to subside, while the action of elevatory forces would not be resisted in the same manner. —*Athenæum*, No. 1504.

MAGNETISM OF IRON SHIPS.—DR. SCORESBY'S VOYAGE.

IN the *Year-Book of Facts*, 1856, p. 131, we gave Dr. Scoresby's important communication to the Royal Society, "On the Magnetism of Iron Ships, and its accordance with Theory, as determined externally, in recent Experiments." The learned Doctor has, during the past year, made a voyage to Australia, in the screw iron steamship *Royal Charter*, in order to add his own personal experience to the peculiar views held by him on the magnetism of iron ships. This is rare devotion to science, when we consider that Dr. Scoresby, although verging upon seventy years of age, with the object of testing the soundness of his own views, undertook a voyage of adventure of 30,000 miles. The result we give in the Doctor's own words, from a lecture delivered by him in November last, in his native town of Whitby, in Yorkshire.

"The object," (says Dr. Scoresby,) "was to determine certain important facts, or the accuracy of certain theories which I had promulgated many years ago, with reference to the magnetism of iron ships. The compass—so important an instrument in the hands of the navigator, and so dangerous a misguidance, if it happens to go wrong, gave very peculiar interest to my researches, in respect to the magnetism of iron, and the influences of the magnetism of the iron ship upon her compass. So long ago as the time when I was quite a youth, I had investigated certain phenomena of magnetism, wherein I found these facts :—I will first represent to you the direction of the earth's magnetism, by pointing a rod to the north. Every one knows that if I point the compass it will take a direction something towards the north, but there is another grand fact—that if I have my compass so adjusted, that it can turn not only to the north, but in any other direction equally as well, the end of the needle will dip down. This is an important fact, a feature in all my magnetic researches, not itself due to my magnetic inquiries, but only its application. When I first made my magnetic experiments, I had ascertained that if I held a bar of iron in an oblique position, the lower end would become a north pole, whereas, the upper end would attract the north pole, showing a difference of polarity. It follows, therefore, that if the lower end be northern polarity, and the upper southern polarity, there must be some part in the middle in which there is no polarity at all. It also fell to my lot to discover, by scientific deduction, that if I vibrated the bar, the magnetism would instantly be doubled, trebled, and quadrupled.

"On the first employment of iron as a material for ship-building, the navigator was immediately placed in a dilemma as to the action of his compasses, for the very fact of the ship being intensely magnetic, served to throw aside the compasses, or to cause them merely to perplex the navigator. If, however, the perplexity thus resulting had been the only evil, this might have been overcome, for the quantity of error might have been ascertained, and allowance made for it. It fell to me again to assert, from scientific investigation, that the ship's magnetism must be very changeable, and not permanent, for I found that when I had magnetised a bar of iron so as to make it powerfully magnetic, even so as to direct the compass in any direction, if I turned it in any direction, I found that by striking a blow again I knocked out the original magnetism and changed the poles. A ship built of iron must receive a vast amount of percussive action, and become intensely magnetic. If that ship could change her position upside down, her magnetism would be changed and inverted. These principles went still further, for inasmuch as I have pointed out that the earth's magnetic force would have a certain direction, I inferred that if a ship were built with her head towards the north, the magnetism would have a particular distribution ; if she were built with her head towards the south, the magnetism would have a different direction, and so with the other points of the compass. The earth's magnetism being the same way, this line of the earth's force would be nearer one side of the vessel than the other ; hence I inferred that the side on which the earth's magnetic force so laid would be the strongest, and that if two vessels were built with their heads in different directions, the earth's magnetism would in one lay on the starboard, and in the other on the port side, and the needle of their respective compasses would be attracted in different directions.

"These theories were instantly denied and contradicted by some of our most eminent philosophers. They assumed that there was no such thing as any casting of a ship in this manner, and that my views were merely speculative. I also asserted that the ship's magnetism being in a certain direction and her head turned in another direction, if the ship got a heavy blow her magnetism would be changed from that side which had been strongest to the other side, and the compasses would be changed also. Dangerous results might thus ensue. Now, as one could not conveniently turn an iron vessel upside down, I considered that by going a voyage to Australia—to the antipodes—the earth's magnetism being changed, I could get the ship turned positively upside down, and I could also see whether the action of the storms of the southern seas and the vibration by straining in a sea or steaming were sufficient to upset the magnetism, which was of one quality in England and turned itself upside down and changed its quality in Australia. The subject was of immense importance, because of the number of losses which have ensued by the variance of compasses on iron ships, as in the very frightful cases of the *Birkenhead*, *Tayleur*, and other vessels, owing to the unsuspected change of compass action. When I first promulgated this subject, in Liverpool, it was received with great alarm, as if it would damage the property of iron ships. I persevered under the persuasion that a ship was more safe if the captain knew the liability of his ship to go wrong, than if he had blind confidence in its correctness. However, a number of things being questioned, and others denied, I determined to go to Australia and prove all the facts I had asserted. The *Royal Charter* was about to proceed to Australia, and the owners very liberally offered to give me my passage out and home. It did not, however, suit me to have a single berth, and I declined the adventure, unless I could get a whole cabin for Mrs. Scoresby and myself. This was made known to the Liverpool Shipowners' Association and the Compass Committee, who, in one morning, subscribed the sum necessary to secure the whole arrangements."

Dr. Scoresby's experience is summed up as follows:—"I have stated that a ship at Melbourne would have her magnetic condition, according to my theory, turned upside down. The upper part of the ship, which in England always has southern polarity, and attracts the north pole of the compass, would in Melbourne have northern polarity, and repel it. When the *Royal Charter* left Liverpool, and when she turned, her state might thus be represented:—

Stern of vessel.	Deck. Southern magnetism. Northern magnetism. Keel.	Head of vessel.

"The question is—was the opposite the case in Melbourne?* The first opportunity of trying this was in entering Port Phillip, when I found that the upper part of the ship had changed its polarity, and was now northern. On going down the vessel, I found the polarity diminished until, in the middle, there was no polarity. I subsequently found that the longitudinal line of non-polarity was not straight, but waved. Above this line the north pole was repelled, below it was attracted. My theory was verified. Everything that in Liverpool was northern was now southern. This went so far, that the pillars, anchor-stocks, and standards of the upper parts, instead of having southern polarity, had in every case northern polarity. Every principle I had asserted was completely verified. The compasses were adjusted on the very ingenious principle of the Astronomer Royal, the errors being adjusted by antagonistic magnets in England. Exactly as I had said before the British Association, in 1846, these compasses not exactly ceased to be useful, but they actually went further wrong than any others on board. Every principle of a compass aloft, as the only means of safe guidance, was fully established. If he cannot combat with an enemy, a wise general gets as far away from him as he can. In our compass aloft we had a perfect guide and standard of reference at all times. We always knew what course the *Royal Charter* was steering, and never had the slightest doubt, notwithstanding the changes going on in other parts of the ship."

We have abridged the above from the Report of the Lecture in the *York Herald*.

We add another instance by Dr. Scoresby, upon the above subject. When he heard of the loss of the *Tayleur*, an iron ship, he stated to a friend that he would venture, without knowing anything of the ship but her fate, to say she was built with her head to the North. It turned out on inquiry, that she was built with her head to the north-east. Dr. Scoresby was led to his conclusion by having observed that iron has magnetism induced upon it by hammering, and when the bar thus magnetized is turned in an opposite direction and hammered again, the magnetic poles were reversed. If an iron ship be built with her head to the North, the hammering will give her a magnetic polarity, which will have a certain effect on the magnetic needle of the compass. Her variation from this cause may be ascertained, and so long as the magnetic polarity of the ship con-

* On April 29, a splendid entertainment was given to the veteran voyager at Melbourne. In reply to the toast of the evening, Dr. Scoresby said he was an humble connecting link between the old and the new. He was an humble experimenter. In 1820 he found that the properties of magnetism in iron were developed by hammering; and when again, in 1824, he brought the phenomenon before the public, his experiments were looked upon as curiosities. But when ships came to be built of iron and were found intensely magnetic, the inquiry arose how that could be. Since that, iron shipbuilding had become exceedingly common, and the more necessity arose for the settlement of the question how to isolate the compass. He accordingly came out to Australia for the purpose of testing principles and suggesting a simple contrivance, so that our iron shipping may traverse the ocean with safety. Everything had so far corresponded with theory. The contrivance consisted simply of a compass erected as far off the deck as possible. The result had been excellent.

tinues the same, the compass may be as serviceable as if it were not affected by the ship.

DEEP SEA SOUNDINGS.

A VERY interesting Map has been prepared by Captain Berryman, showing the Soundings of the Ocean, as taken on the United States steamer *Arctic*, by order of the Secretary of the Navy, and has been suspended in the rotunda of the Merchants' Exchange, at New York. It is 22 feet in length, with a breadth of about 18 inches, and gives a perfect profile of the earth's surface, on the route of the proposed ocean telegraph between Newfoundland and the coast of Ireland, with soundings at every 30 miles, indicated by figures. The depth of water is also shown by a colouring of blue—the surface by a curved line, drawn on a radius of 50 feet.—*New York Journal of Commerce.*

PROBABLE ORIGIN OF THE ENGLISH CHANNEL BY MEANS OF A FISSURE.

M. AMI BOUÉ, For. Mem. G.S., having met with a published proposal to construct a submarine tunnel across the Straits of Dover, pointed out that it was highly probable that the English Channel had not been excavated solely by water-action, but owed its origin to one of the lines of disturbance which have fissured this portion of the earth's crust, and that, taking this view of the case, the fissure probably still existed, being merely filled with comparatively loose material, and would prove a serious obstacle to any attempt to drive a submarine tunnel which would have to traverse it.—*Proceedings Geological Society.*

TRANSMISSION OF SIGNALS IN SUBMARINE CIRCUITS.

A PAPER has been read to the British Association, entitled, "The Law of the Squares—is it applicable or not to the Transmission of Signals in Submarine Circuits?" by Dr. Wildman Whitehouse. Before proceeding to the consideration of this subject, the author wished to explain, with reference to his paper read on a previous day, that it was for the purpose of determining the force of either intermitting or alternating currents, whose duration was not sufficient to admit of the needle assuming a position of rest, that he proposed the use of the magneto-electrometer—an instrument rendering available the force of magnetic attraction instead of the deflection of the needle—as a means of measuring the amount of current circulating. This force was, he said, until we approach the point of magnetic saturation of the iron, strictly proportioned to the energy of the current under examination. The number of grains thus lifted on the arm of the lever the author proposes to call the practical "value" of the current for telegraphic purposes. The most striking features of this instrument are—1st. The facility of determining the value of currents which do not admit of being tried by the galvanometer;—2nd. The very great range which this instrument has (viz., from unity up to half a million), as well as the definiteness and accuracy of the results, even the extremes of the register being strictly comparable with each other;—3rd. Unlike the degrees upon the galvanometer, these grains of force are units of real "value" and of practical utility, as was shown by a telegraphic instrument in circuit being worked perfectly by a current of four grains.

Referring to the proceedings of the Section in 1855, at Glasgow, the author quoted Prof. W. Thomson's paper on this subject, where he stated "that a part of the theory communicated by himself to the Royal Society last May, and published in the Proceedings, shows that a wire of six times the length of the Varna and Balaklava wire, if of the same lateral dimensions, would give thirty-six times the retardation, and thirty-six times the slowness of action. If the distinctness of utterance and rapidity of action practicable with the Varna and Balaklava wire are only such as not to be inconvenient, it would be necessary to have a wire of six times the diameter or better, thirty-six wires of the same dimensions, or a larger number of small wires twisted together, under a gutta-percha covering, to give tolerably convenient action by a submarine cable of six times the length." The author then stated, that circumstances had enabled him to make very recently a long series of experiments upon this point, the results of which he proposed to lay before the Section; adding, that an opportunity still existed for repeating these experiments upon a portion of cable to which he could obtain access, and that he was ready to show them before a committee of this Section in London, if the important nature of the subject should seem to render such a course desirable.

Although the subject of submarine telegraphy had many points of the highest importance requiring investigation, and to the consideration of which he had been devoting himself recently, Dr. Whitehouse proposed to confine his remarks on this occasion to the one point indicated in the title, inasmuch as the decision of that one, either favourably or otherwise, would have, on the one hand, the effect of putting a very narrow limit to our progress in telegraphy, or, on the other, of leaving it the most ample scope. He drew a distinction between the mere transmission of a current across the Atlantic (the possibility of which he supposed everybody must admit) and the effectual working of a telegraph at a speed sufficient for "commercial success;" and we gathered from his remarks that there were those ready to embark in the undertaking as soon as the possibility of "commercial success" was demonstrated. The author then gave a description of the apparatus employed in his researches, of the manner in which the experiments were conducted, and, lastly, of the results obtained. The wires upon which the experiments were made were copper, of No. 16 gauge, very perfectly insulated with gutta-percha—spun into two cables, containing three wires of equal length (83 miles), covered with iron wires and coiled in a large tank in full contact with moist earth, but not submerged. The two cables were subsequently joined together, making a length of 166 miles of cable, containing three wires. In addition to this, in some of the latest experiments he had also the advantage of another length of cable, giving, with the above, an aggregate of 1020 miles. The instruments, one of which was exhibited, seemed to be of great delicacy, capable of the utmost nicety of adjustment, and particularly free from sources of error. The records were all made automatically, by electro-chemical decomposition, on chemically-prepared paper. The observations of different distances recorded themselves upon the same slip of paper,—thus, 0·83 and 249 miles were imprinted upon one paper, 0·83, 498 miles upon another slip, 0·249, 498 upon another, and 0·535, 1020 upon another. Thus, by the juxtaposition of the several simultaneous records on each slip, as well as by the comparison of one slip with another, the author has been enabled to show most convincingly that the law of the squares is not the law which governs the transmission of signals in submarine circuits. Dr. Whitehouse showed next, by reference to published experiments of Faraday's and Wheatstone's (*Philosophical Magazine,* July, 1855), that the effect of the iron covering with which the cable was surrounded was, electrically speaking, identical with that which would have resulted from submerging the wire, and that the results of the experiments could not on that point but be deemed reliable.

The author next addressed himself to the objections raised against conclusions drawn from experiments in "Multiple" cables. Faraday had experimented, he said, upon wires laid in close juxtaposition, and with reliable results; but an appeal was made to direct experiment, and the amount of induction from wire to wire was weighed, and proved to be as one to ten thousand, and it was found impossible to vary the amount of retardation by any variation in the arrangement of the wires. Testimony, also, on this point was not wanting. The Director of the Black Sea Telegraph, Lieut.-Col. Biddulph, was in England, and present at many of the experiments. He confirmed our author's view, adding, "that there was quite as much induction and embarrassment of instruments in this cable as he had met with in the Black Sea Line." The author considers it, therefore, proved "that experiments upon such a cable, fairly and cautiously conducted, may be regarded as real practical tests, and the results obtained as a fair sample of what will ultimately be found to hold good practically in lines laid out *in extenso.* At the head of each column in the annexed table is stated the number of observations upon which the result given was computed,—every observation being rejected on which there could fall a suspicion of carelessness, inaccuracy, or uncertainty as to the precise conditions; and, on the other hand, every one which was retained being carefully measured to the hundredth part of a second. This table is subject to correction, for variation in the state of the battery employed, just as the barometrical observations are subject to correction for temperature. Of this variation as a source of error the author was quite aware, but he was not yet in possession of facts enough to supply me with the exact amount of correction required. He preferred, therefore, to let the results stand without correction.

Amount of Retardation observed at various Distances. Voltaic Current. Time stated in Parts of a Second.

Mean of 550 observations	Mean of 110 observations	Mean of 1840 observations	Mean of 1960 observations	Mean of 120 simultaneous observations.	
83 miles. ·08	166 miles. ·14	249 miles. ·96	498 miles. ·79	535 miles. ·74	1020 miles. 1·42

"Now it needs no long examination of this table to find that we have the retardation following an increasing ratio,—that increase being very little beyond the simple arithmetical ratio. I am quite prepared to admit the possibility of an amount of error having crept into these figures, in spite of my precautions; indeed, I have on that account been anxious to multiply observations in order to obtain most trustworthy results. But I cannot admit the possibility of error having accumulated to such an extent as to entirely overlay and conceal the operation of the law of the squares, if in reality that law had any bearing on the results. Taking 83 miles as our unit of distance, we have a series of 1, 2, 3, 6, and 12. Taking 166 miles as our unit, we have then a series of 1, 3, and 6. Taking 249 miles, we have still a series of 1, 2, and 4, in very long distances. Yet even under these circumstances, and with these facilities, I cannot find a trace of the operation of that law."

The author then examined the evidence of the Law of the Squares, as shown by the value of a current taken in submarine or subterranean wires at different distances from the generator thereof, which he showed were strongly corroborative of the previous results. He next examined the question of the size of the conducting wire; and he had the opportunity of testing the application of the law, as enunciated by Prof. Thomson in 1855. The results, far from confirming the law, are strikingly opposed to it. The fact of trebling the size of the conductor augmented the amount of retardation to nearly double that observed in the single wire. The author, however, looked for the *experimentum crucis* in the limit to the rapidity and distinctness of utterance attainable in the relative distances of 500 and 1020 miles. 350 and 270 were the actual number of distinct signals recorded in equal times through these two lengths respectively. These figures have no relation to the squares of the distance. "Now, if the law of the squares be held to be good in its application to submarine circuits, and if the deductions as to the necessary size of the wire, based upon that law, can be proved to be valid also, we are driven to the inevitable conclusion that submarine cables of certain length, to be successful, must be constructed in accordance with these principles. And what does this involve? In the case of the Transatlantic line, whose estimated length will be no less than 2500 miles, it would necessitate the use, for a single conductor only, of a cable so large and ponderous, as that probably no ship except Mr. Scott Russell's leviathan could carry it,—so unwieldy in the manufacture, that its perfect insulation would be a matter almost of practical impossibility,—and so expensive, from the amount of materials employed, and the very laborious and critical nature of the processes required in making and laying it out, that the thing would be abandoned as being practically and commercially impossible. If, on the other hand, the law of the squares be proved to be inapplicable to the transmission of signals by submarine wires, whether with reference to the amount of retardation observable in them, the rapidity of utterance to be obtained, or the size of conductor required for the purpose, then we may shortly expect to see a cable not much exceeding one ton per mile, containing three, four, or five conductors, stretched from shore to shore, and uniting us to our Transatlantic brethren, at an expense of less than one-fourth that of the large one above mentioned, able to carry four or five times the number of messages, and therefore yielding about twenty times as much return in proportion to the outlay. And what, I may be asked, is the general conclusion to be drawn as the result of this investigation of the law of the squares applied to submarine circuits? In all honesty, I am bound to answer, that I believe nature knows no such application of that law; and I can only regard it as a fiction of the schools, a forced and violent adaptation of a principle in Physics, good and true under other circumstances, but misapplied here."

ROTATORY MOTION.

MR. W. GRAVATT, F.R.S., has communicated to the Royal Society, "Elementary Considerations on the subject of Rotatory Motion."

The author explains the subject of rotatory motion in a series of propositions by the use of prime and ultimate ratios. He commences with a simple problem, determining the law of the forces by which a particle of matter is deflected into any given course, and pursues the inquiry by a consideration of the effect of these forces as referred to a sphere, going on to the investigation of the character of the motion of any body enclosed within an imaginary sphere, such sphere itself being supposed to revolve upon two axes inclined at any angle to each other. Hence the author determines the position of some point of the circumscribing sphere momentarily at rest, or in other words, of the *resultant axis*, from which he insists that all centrifugal forces must really be calculated.

His first application of the law thus enunciated is to the motion of the peg-top; and upon the principles he has already laid down, he shows that there is in the first instance rotation round a momentary horizontal axis, calling up rotation round a momentary vertical axis; and that the ratio of the velocities of these two rotations, together with the length of the peg, determines the angular inclination of the top, contrary to the received explanation as given by Euler and other mathematicians.

The law is further applied to the effect produced upon a falling body by the axial rotation of the earth, in the discussion of which, La Place, in the opinion of the author, has committed two important errors; one in denying any deviation towards the equator, the other in his calculation of the amount of the deviation towards the east.

This is followed by an investigation of the motion or direction of flight of a cannon-ball or shell fired in a northerly or southerly direction, from which it appears that a large shell will be subject to a deviation from the true line of projection, in consequence of the earth's rotation, amounting to no less than 22 feet.

The author then refers to the well-known experiment of M. Foucault for proving sensibly the rotation of the earth, and shows from calculation that the errors which would be sufficient to vitiate the results in this experiment are so extremely minute and so difficult of avoidance by any perfection or manipulation which can be employed, that its performance cannot perhaps be safely adduced as proving such rotation.

Mr. Gravatt illustrated his views by the exhibition to the meeting of a model apparatus, in which the vertical and horizontal motions may be variously combined, but which could not be intelligibly described without a series of complicated drawings unfitted for the compass of a mere abstract.

PENDULUM EXPERIMENTS.

THERE has been read to the Royal Society, the following "Supplement to the 'Account of Pendulum Experiments undertaken in the Harton Colliery;'* being an Account of Experiments undertaken to determine the correction for the Temperature of the Pendulum." By G. B. Airy, Esq., Astronomer Royal.

Adverting to the circumstance that, in the Harton Experiment, there was a mean difference of 7° between the temperature above and below, and that a careful determination of the coefficient for temperature-correction was therefore necessary, the author describes the process by which the correction was now investigated by experiment on the same pendulums which were used in the Harton Experiment. Two rooms were selected at the Royal Observatory, Greenwich, having firm stone floors, and admitting of being heated, one by a stove in the room, the other by a hot-air apparatus below. One pendulum was mounted upon its iron stand, with clock and other apparatus, in one room, and the other in the other room. Care was taken that the pendulums and their thermometers should be effectually protected from radiation. The two clocks were compared by carrying a chronometer from one to the other, and remarking the time of coincidence of beats; a method which admits of very great accuracy, when (as in this instance) the distance through which the chronometer is to be carried is small. In the Fifth Series (counting the series in sequence to those of the Harton Experiment), Pendulum 1821 was kept in heat, and Pendulum 8 cool, and continuous

* The Account of these Experiments, to which the above paper is Supplementary, was communicated by Professor Airy to the Royal Society, on January 31, 1856. An abstract of the results appeared in the *Year-Book of Facts*, 1855, pp. 4, 5, 6.

observations were kept up during forty hours. In the Sixth Series, Pendulum 8 only was kept in heat, and observations were again kept up during forty hours. The Seventh and Eighth Series were similar, respectively, to the Fifth and Sixth. The temperatures are referred to two of the thermometers used in the Harton Experiment, and to two other thermometers supplying the place of two of the Harton thermometers which cannot be found. The observations were conducted entirely by Messrs. Dunkin and Ellis, Assistants of the Royal Observatory.

On discussing the results of the observations, there appears to be reason for supposing that a change has taken place in one of the pendulums after the Seventh Series. This appears from the circumstance that, though the Fifth and Seventh Series agree well, the Sixth and Eighth are discordant; and also from this circumstance, that the abstract relation between the two pendulums given by the Fifth, Sixth, and Seventh Series agrees closely with that found at Harton; but that if the Eighth Series is included, there is a considerable discordance.

If the Eighth Series is rejected, it appears that Colonel Sabine's coefficient ought to be increased by about $\frac{1}{28}$th part; and on introducing this correction into the computations of the Harton Experiment, the result for the earth's mean density is 6·809. If the Eighth Series is retained, the correction is reduced to less than one-fourth of that just mentioned, and the earth's mean density is 6·623.

The author subjoins an investigation with which he has been favoured by Professor Stokes on the effect of the rotation and ellipticity of the earth in modifying the numerical results of the Harton Experiment. It appears that the numbers found in the paper ought to bemultiplied by

$$1+m-\frac{\epsilon}{2}+\frac{3}{2}\epsilon \cos 2l,$$

$$\text{where } m=\frac{\text{equatorial centrifugal force}}{\text{gravity}}$$

$$\epsilon=\text{ellipticity}$$

$$l=\text{latitude of place.}$$

On converting this formula into numbers, for Harton, the factor is found to be 1·00012, which produces no sensible change in the result.

At the equator the factor would have been 1·00679.

THERMAL EFFECTS OF FLUIDS IN MOTION.

PROFESSOR WILLIAM THOMSON, F.R.S., and MR. J. P. JOULE, F.R.S., state, that a very great depression of temperature has been remarked by some observers when steam of high pressure issues from a small orifice into the open air. After the experiments we have made on the rush of air in similar circumstances, it could not be doubted that a great elevation of temperature of the issuing steam might be observed as well as the great depression usually supposed to be the only result. The method to obtain the entire thermal effect is obviously that which we have already employed in our experiments on permanently elastic fluids, viz., to transmit the steam through a porous material and to ascertain its temperature as it enters into and issues from the resisting medium. We have made a preliminary experiment of this kind, which may be sufficiently interesting to place on record before proceeding to obtain more exact numerical results.

A short pipe an inch and a half diameter was screwed into an elbow pipe inserted into the top of a high-pressure steam-boiler. A cotton plug placed in the short pipe had a fine wire of platina passed through it, the ends of which were connected with iron wires passing away to a sensitive galvanometer. The deflection due to a given difference of temperature of the same metallic junctions having been previously ascertained, we were able to estimate the difference of temperature of the steam at the opposite ends of the plug. The result of several experiments showed that for each lb. of pressure by which the steam on the pressure side exceeded that of the atmosphere on the exit side there was a cooling effect of 0·2 cent. The steam, therefore, issued at a temperature above 100° cent., and, consequently, *dry*; showing the correctness of the view which we brought forward some years ago as to the non-scalding property of steam issuing from a high-pressure boiler.—*Proceedings of the Royal Society.*

MOLECULAR PROPERTIES OF ZINC.

BOLLEY gives, in a paper in Liebig's *Annalen*, "On the Molecular Properties of Zinc," a *résumé* of less-known observations on the physical properties of that metal by other chemists, in addition to experiments of his own. Zinc is generally stated to have a crystalline lamellar structure, but the author had found that this was only the case with zinc which had been heated to almost a red heat, and then cooled; while that which had been simply melted and then cooled, had always a small granular structure. The differences in the observations on the specific gravity of zinc are greater than in any other metal; they vary from 6·86 to 7·2. Bolley ascertained by actual observation on various specimens, that there existed hollow spaces in the interior of the zinc, which were amply sufficient to account for these variations. He cast small cylinders of zinc about 10 grms. in weight, using every precaution to prevent air being enclosed. These pieces were divided and subdivided, and the specific gravity taken in small pieces until well-agreeing results were obtained. It was found, the smaller the pieces, the higher was the specific gravity. He found that zinc which had been heated to melting, and then quickly cooled, had a specific gravity of 7·178, and when slowly cooled 7·145; that which had been heated to redness and quickly cooled, of 7·109, and slowly cooled, 7·120. Zinc which had been simply melted was comparatively malleable, while that which had been heated to redness was not at all so. The ease with which commercial zinc dissolves is ascribed to the presence in it of foreign metals. But even in pure zinc there are differences in the solubility, which arise from the temperatures to which it has been heated. Pure zinc was heated to melting, one part poured in cold water, and another poured on a warm plate. Another specimen of the same zinc was heated to redness, and cooled by the same method. It was found that the latter was far more easily dissolved in dilute acids than the former. He concludes that zinc melted at as low a temperature as possible is distinguished by—1. granular fracture; 2. probable higher specific gravity; 3. greater malleability; 4. less solubility in dilute acids; while that melted at a higher temperature has—1. crystalline lamellar fracture; 2. probable less specific gravity; 3. greater brittleness; and 4. far greater solubility in dilute acids.

Bolley suggests that zinc is dimorphous. He finds a support for this idea in the fact that the atomic volume of zinc is very near that of platinum, iridium, and palladium, three metals which are dimorphous.—*Philosophical Magazine*, No. 71.

ON THE INCANDESCENCE OF METAL WIRES IN ALCOHOLIC VAPOUR. BY H. REINSCH.

Reinsch long since showed that wires of all the infusible metals, as also most of the metallic oxides, continued incandescent in the vapour of alcohol, so that this property is by no means peculiar to platinum. He has had the opportunity of making some experiments upon this phenomenon, which have led to a remarkable observation. When a spiral of copper wire is fastened in the manner described by Reinsch upon the wick of a spirit-lamp, and the lamp is lighted and then quickly blown out, the copper wire continues incandescent just as well as platinum. This incandescence, however, only lasts two or three minutes. But if a small fragment of coke be inserted into the spiral, and the whole be brought to a red heat, the wire will continue to glow permanently after the extinction of the flame. The author attempted to explain this phenomenon by the supposition that the high temperature was better maintained by the fragment of coke, as it does not carry off the heat so quickly as the wire, and as it were forms a sponge, which always retains sufficient heat to communicate to the wire the temperature necessary for its incandescence. This supposition, however, was not confirmed, as the spiral was not extinguished even when the piece of coke was removed. If it be then blown out and again ignited, it continues to glow without the piece of coke, so that by contact with the coke it has passed into a peculiar state, which, in the author's opinion, must arise from an electrical action between the two substances.—*Archiv der Pharm.*; *Philosophical Magazine*, No. 71.

TEACHING PERSPECTIVE.

Mr. H. R. Twining has exhibited to the British Association, "Models to illustrate a new Method of teaching Perspective." The object of this communication is to explain the principles of perspective in such a manner as may enable those who draw to distribute their objects not only in a correct manner, but in one agreeable to the eye. It is an intermediary step between those rules which are demonstrated by diagrams in the usual treatises and those appearances which characterize natural objects themselves. The chief difficulty in enabling an audience to follow out the principles of perspective when applied to solid objects is, that every individual sees these from a different position; so that such an explanation of the effect observed as is adapted to one individual cannot suit another. Mr. Twining's method aims at overcoming this difficulty by placing an image (with which each individual is supposed to identify himself) in the exact spot which the observer ought to occupy, and which serves to mark the true focus of the picture.

NEW DOUBLE-ACTING AIR-PUMP WITH A SINGLE CYLINDER.

MR. T. TATE, F.R.A.S., describes this new instrument in the *Philosophical Magazine*, No. 71. Its chief points of novelty consist in a double piston acting in a single cylinder, and in the superior system of valves. This double piston with a single cylinder gives to the instrument all the properties of an ordinary air-pump with two cylinders: this new instrument, in fact, may be regarded as a single-barrelled pump, capable of performing its work with only one-half the usual motion.

The advantages of this new pump, as compared with the common pump of the same capacity of cylinder, are as follows:—

1. To effect the same exhaustion, the driving pressure moves over one-half the space.

2. From the superior construction of valves, the exhaustion is carried to a much greater extent.

3. From having a double stroke in a single cylinder, the expense of construction is considerably reduced.

4. As the exhaustion proceeds, the pressure requisite for moving the pistons becomes less and less. The contrary takes places in the common pump.

In the pump which Mr. Tate has constructed, the valves are made of oil-silk, and the piston-rod is moved by the direct application of the pressure; but he purposes to construct a pump on the new principle, with metal valves covered with oil-cisterns, and lifted up by the stroke of the piston, and also with a pump-lever (or crank) attached to the head of the piston-rod. The pump thus constructed will most certainly exhaust the air from the receiver until its elasticity is reduced to that of the vapour of the oil.

ABSORPTION OF AMMONIA BY CRYPTOGAMIC PLANTS.

M. BINEAU has made some observations on the Absorption of Ammonia and the Nitrates by Cryptogamic Plants. His experiments were made on the *Hydrodictyon pentagonale* and the *Conferva vulgaris*. He infers from them these consequences:—1. The demonstration of the fact of an absorption or of a decomposition of ammoniacal salts with an intensity analogous to that of CO^2. This has hitherto had no parallel in the case of saline matters, which are generally absorbed much less abundantly than their solvents. 2. That the nutrition of the Algæ is promoted by their tendency to remove the nitrates from the waters in which they vegetate, either by directly assimilating the nitrogen, or by converting the nitrates into ammoniacal salts. 3. That the elaboration by green plants of nitrogen compounds, as well as of carbonic acid, is facilitated by light.—*Liebig's Annalen; Philosophical Magazine*, No. 73.

NEW FORM OF CAST-IRON GALVANIC BATTERY.

MR. W. SYMONS has exhibited to the British Association a very simple wooden frame for holding the plates of zinc and of cast iron, which were cast on the same pattern. In this frame he had two samples of the mode of arranging the plates which might be adopted: one, in which each zinc plate had an iron plate on each side of it, as in Wollaston's battery; the plates arranged in this form could be set at such distances by pieces of wood and a simple binding screw that each galvanic pair, as the three may be termed, can sit in the cell of a Wollaston earthenware trough. In the other arrangement, one to act on the principle of Groves's battery may be produced without the use of porous cells by placing the plates alternately, as described in the second volume of Walker and Lardner's Treatise on Electricity in *Lardner's Cyclopædia*. This combination the author affirmed to be cheap, convenient, and very energetic.

ON A PROCESS OF ENGRAVING IN RELIEF ON ZINC. BY J. DEVINCENZI. REPORT BY M. BECQUEREL.

ZINCOGRAPHY, or the art of drawing upon zinc so as to print from it, has already been practised for some years. In England and Germany zinc has long been substituted for stone in lithography, but in France this substitution has not been adopted. M. Devincenzi, wishing to obtain plates in relief on zinc for the purpose of typography, has arrived, after many trials, at the process which will be hereafter described. But in the first place we may observe, that M. L. P. Dupont has since tried a very different process. This new method consists in drawing on a plate of zinc with an insoluble chalk of his invention, or with lithographic chalk or ink; liquefying the fatty matter of the drawing by heating it slightly, spreading over the plate a powder composed of resin, Burgundy pitch, and bitumen; removing the portion of the powder which does not adhere by means of the bellows; and heating afresh to fix that which covers the drawing. The plate when prepared in this manner is immersed in a bath of sulphate of zinc, and connected with the negative pole of a battery, whilst the liquid is in relation with the positive pole. In this manner a relief is obtained, which serves for the formation of a gutta-percha mould, and from this a plate in relief is produced by electrotype.

M. Devincenzi's process is different from the preceding. The surface of an ordinary zinc plate is grained by means of sifted sand, and the drawing is made upon this with lithographic chalk or ink. It is then passed into a weak decoction of galls, and afterwards into gum-water, in order to hinder the portions of the zinc which are not covered with the drawing from taking the varnish, which will be mentioned hereafter. The plate is washed with water, and the chalk or ink is then removed with oil of turpentine, as in the preparation of lithographic stone. When these operations are completed, the plate is moistened, and a varnish composed of asphaltum, drying oil, and turpentine, thinned with oil of lavender, is applied to it with a roller. The varnish only adheres to the portions which were covered with chalk or ink. It is left to dry for twelve or fifteen hours, when a brush soaked in a very weak solution of sulphuric acid is passed over the plate to clean the surface which is not covered with varnish; the plate is then immersed in a solution of sulphate of copper of 15°, at the same time that a plate of copper of the same dimensions is placed parallel to it at a distance of 5 millims., and connected with it by a copper rod. The portion of the zinc not covered by the varnish is chemically acted upon by the solution of sulphate of copper, and electro-chemically by the action of the voltaic couple, whilst the solution has no action upon the varnish. The zinc plate is taken out every minute to remove the copper deposited, and in from four to eight minutes the relief is sufficient for the printing of a great number of copies in the ordinary printing-press.

To prove the applicability of this process, the Commission had a very fine drawing made upon grained zinc and treated by M. Devincenzi; when printed, all the copies exhibited an exact reproduction of the drawing.

A trial of the effect of the chemical action of the sulphate of copper alone, without the intervention of the electro-chemical action, gave unsatisfactory results; the outlines of the drawing were not distinct, and several parts were not given. It appears, therefore, that the voltaic action is necessary. Of some plates, M. Devincenzi has printed three thousand copies, the last being as fine as the first; and he considers that zinc, from its presenting more resistance than the alloy of lead and antimony employed in *clichés*, will allow at least as many copies to be printed from it.—*Comptes Rendus; Philosophical Magazine*, No. 70.

MACHINE FOR POLISHING SPECULA.

Dr. R. Greene has exhibited to the British Association a beautiful working model of a machine, invented by him, last year, for Polishing the Specula of reflecting Telescopes. His object in constructing it was to produce a machine at the cost of 60*s*. or 70*s*. which should be equally efficacious for that purpose with a very complex machine invented by Mr. Lassell, of Liverpool, which has produced the finest telescopes ever constructed. Having accurately attained this object, the Doctor found that by adding three or four more pulleys to the machine it was capable of moving the polisher over the speculum in an almost endless variety of curves, so that the operator could choose any variety of figure he might fancy to experiment with. We have ourselves seen a great variety of those beautiful figures traced by the machine itself by fixing a black-lead pencil on the working crank. A machine costing not more than 60*s*. or 70*s*. is amply powerful for polishing a speculum of 12 or 14 inches in diameter, which it will generally finish in from four to six hours. The principle of the machine consists of a vertical shaft carrying a sliding crank and a horizontal table or chuck attached to another vertical shaft, but which, being supported by sliding collars, can have its axis moved at pleasure to any distance out of the line of direction of the axis of the crank. The table can be made to revolve from right to left, or the reverse, at pleasure, and move with various velocities. All the journals move in box-wood collars or boxes, which the Doctor finds after many years' trial to be superior to bell-metal, as not heating, soiling the oil, or working loose, and recommends them for general use in mounting every kind of machinery. He also mentions the great advantage he derived from placing the centre of the speculum a little out of the centre of the revolving table, thus making the eccentricity a variable quantity, being sometimes the *sum* and at other times the *difference* of the two eccentricities of the table and of the speculum on the table. Lastly, he recommended making the polisher of three circular pieces of light wood joined together, one in the centre and the other two at right angles to the centre-piece, in place of two pieces only as usually employed, and which are liable to warp, while three pieces will never warp with any change in the dryness or dampness of the atmosphere; and in place of forming the grooves in the pitch by indentation with the edge of a strip of thin wood, the Doctor preferred fastening small squares of thin wood to the face of the polisher, and covering them with the pitch, leaving about a quarter of an inch space between the squares.

The paper gave rise to an animated debate, in which many members joined, particularly Mr. Lassell, who highly approved of the machine and the Doctor's suggestions in using it.

In the course of the discussion upon this paper, the interest in which was much increased by Mr. Lassell taking part in it, Professor Stoney remarked that two of the main points now brought forward have been already published. The motion which is given to the spindle carrying the speculum in order to secure the requisite motions without complex mechanism above, and the scoring up of the polisher so that the pitch may have ample room to expand laterally without getting into the ridges, are both parts of the Earl of Rosse's original invention, as published in the *Philosophical Transactions* for 1840. Lord Rosse not only was the first to polish large specula successfully by machinery, but further pointed out in the clearest manner the principles which should be kept in view in contriving other machines to effect the same result.—*Athenæum*, No. 1503.

DICHROMATIC PHENOMENA.

DR. GLADSTONE has communicated to the British Association a paper "On some Dichromatic Phenomena among Solutions, and the means of representing them." This paper is an extension of Sir John Herschel's observations on dichromatism, that property whereby certain bodies appear of a different colour, according to the quantity seen through. It depends generally on the less rapid absorption of the red ray as it penetrates a substance. A dichromatic solution was examined by placing it in a wedge-shaped glass trough, held in such a position that a slit in a window-shutter was seen traversing the varying thicknesses of the liquid. The diversely coloured line of light thus produced was analyzed by a prism, and the resulting spectrum was represented in a diagram by means of coloured chalks on black paper, the true position of the apparent colours being determined by the fixed lines of the spectrum. In this way the citrate and comenamate of iron, sulphate of indigo, litmus in various conditions, also cochineal, chromium, and cobalt salts, were examined and represented. Among the more notable results were the following:—A base, such as chromic oxide, produces very nearly the same spectral image with whatever acid it may be combined, although the salts may appear very different in colour to the unaided eye. Citrate of iron appears green, brown, or red, according to the quantity seen through. It transmits the red ray most easily, then the orange, then the green, which covers the space usually occupied by the yellow; it cuts off entirely the more refrangible half of the spectrum. Neutral litmus appears blue or red, according to the strength or depth of the solution. Alkalies cause a great development of the blue ray; acids cause a like increase of the orange, while the minimum of luminosity is altered to a position much nearer the blue. Boracic acid causes a development of the violet. Alkaline litmus was exhibited so strong that it appeared red, and slightly acid litmus so dilute that it looked bluish-purple; indeed, on account of the easy transmissibility of the orange ray through an acid solution, the apparent paradox was maintained that a large amount of alkaline litmus is of a purer red than acid litmus itself. Another kind of dichromatism was examined, dependent, not on the actual quantity of coloured material, but on the relative proportion of the solvent. —*Athenæum*, No. 1504.

SOLAR LIGHT—SIMPLE PHOTOMETER.

MR. MUNGO PONTON has communicated to the Royal Society of Edinburgh a paper, the first part of which was occupied with a detail of some observations, made in the course of the summer of 1855, on the quantity and intensity of Solar Light, as compared with familiar sources of artificial flame. The instrument employed for these observations was a simple monochromatic photometer, whose construction was minutely described.

The results obtained were stated to be, that a small surface, illuminated by mean solar light, is 444 times brighter than when it is illuminated by a moderator lamp, and 1560 times brighter than when it is illuminated by a wax candle (short six in the lb.),—the artificial light being in both instances placed at two inches' distance from the illuminated surface. It was then pointed out, that as the electric light may be easily obtained of a brilliancy equal to 520 wax candles, three such electric lights, placed at two inches from a given small surface, would render it as bright as when it is illuminated by mean sunshine.

It was thence inferred, that a stratum occupying the entire surface of the sphere of which the earth's distance from the sun is the radius, and consisting of three layers of flame, each $\frac{1}{1000}$th of an inch in thickness, each possessing a brightness equal to that of such an electric light, and all three embraced within a thickness of $\frac{1}{40}$th of an inch, would give an amount of illumination equal in quantity and intensity to that of the sun at the distance of 95 millions of miles from his centre.

It was then shown, that were such a stratum transferred to the surface of the sun, where it would occupy 46,275 times less area, its thickness would be increased to 94 feet, and it would embrace 138,825 layers of flame, equal in brightness to the electric light; but that the same effect might be produced by a stratum about nine miles in thickness, embracing 72 millions of layers, each having only a brightness equal to that of a wax candle.

The various possible causes of the light proceeding from the luminous envelope of the sun were then considered; and an attempt was made to show, that the shining particles in that envelope may possibly be minute luminiferous organisms, floating in an elastic atmosphere, each emitting only a small amount of phosphorescence, the enormous flood of splendour emanating from the surface of the medium being due to the combined action of these individually feeble agents.—*Edinburgh New Philosophical Journal*, No. 6.

COLOUR-BLINDNESS.

A PAPER has been read to the Royal Society, "on Colour-Blindness," by William Pole, Esq. The author's object is to state his own case of colour-blindness, which he believes to be one of the most decided on record—to compare it with others of the same kind—and to show that the general phenomena attending this defect of vision are more uniform and consistent, as well as more easy of explanation, than is generally supposed.

After stating reasons which justify a colour-blind person in undertaking the investigation and description of his own case, the author gives a preliminary statement of his views in regard to the general theory and nomenclature of colours, adopting the ordinary hypothesis that red, blue, and yellow, are the three primaries. Colour blindness may be described as of three kinds:—1. Inability to discern any colour except black and white. This is very rare. 2. Inability to discriminate between the nicer distinctions of colour. This is so common as to be apparently rather the rule than the exception. 3. The third variety is the only one at present treated of by the author. Its outward manifestation is the inability to distinguish between many of the colours most marked to normal eyes; and its most complete form is what is called dichromic vision—being total blindness to one of the three primary colours.

The description of a case of colour blindness may either be confined to the symptoms of the malady—that is, the effects it produces on the individual's judgment of colours—or to the sensation experienced. The first is the plan usually adopted, but the author combines both in the account of his own case. The symptoms are as follows :—Blue and yellow are perfectly distinguished, and are the only colours seen in the spectrum. Almost all colour-blind persons think they see red, but it is frequently confounded with green (the most common mistake), black, orange, yellow, brown, blue, and violet. Crimson and pink appear to have no relation to scarlet. Green is a most perplexing colour. It is not only confounded with red, but also with black, white or grey, orange, yellow, blue, violet, and brown. Violet is confounded with blue or grey, and orange with yellow. More difficulty is manifested with light or dark tones of compound colours than with full ones.

In explaining more accurately the real nature of the author's vision of colours, he states that his vision is perfectly *dichromic.* Blue and yellow he sees perfectly well, and he has no reason to doubt that his sensations of these two colours are the same as those of the normal-eyed. The third primary—red—is the one in regard to which his vision is defective; but the study of the sensations produced by this colour has been involved in some difficulty. Carmine, the artificial representative of what is usually considered fine red, presents to the author's eye a very positive sensation, which he long supposed to be a distinct colour; but on examining it more closely he found it to be merely a dark shade of yellow. In passing on to the green division of the colour circle, lying between the blue and yellow, the author calls attention to the apparent anomaly that, though colour-blind persons see blue and yellow perfectly well, their combination, green, should be so great a stumbling-block. This fact appears to have perplexed everybody who has treated on the subject, excepting Sir John Herschel, who discovered that the equilibrium of blue and yellow produces green-white—that is, the white of the colour-blind is not white at all, but green. And this is consistent with theory; for if normal white be a combination of three elements, the invisibility of one of these elements to the colour-blind should naturally have the effect of changing the appearance of their compound. Since, therefore, green is only a colour to the normal-eyed, as it is contrasted with white light, it becomes no colour at all to the colour-blind. Thus the dichromic explanation of the author's vision is complete. He has only two sensations of colour properly so called, namely, blue and yellow—all other hues in nature being reduced to shades of these.

The colours of light, or the hues resulting from their combination, may be called green, white, or grey, at pleasure. It is shown that this explanation of colour-blind vision will fully account for the whole of the varied symptoms above enumerated. Red and green, for example, are both seen only as shades of yellow; and if the yellow is of the same intensity in each, they will appear alike, and of course be confounded with each other.

The author then proceeds to consider how far his own case may be regarded as a type of the defect in general. The varied and incongruous nature of the symptoms has given rise to a belief that there are many varieties of colour-blindness, or at least many different degrees of it; but after carefully examining the published accounts, he has arrived at the conviction that the true dichromic affection is much more general than is commonly supposed. From the results of his investigations, he draws a few inferences in regard to the theory of the primary colours, although admitting his incompetence to deal fully with this part of the subject. He considers that, from the extreme simplicity of the phenomena of colours as seen by the colour-blind, their experience may serve as a stepping-stone to the more complex problems of normal vision. Their light is divisible into two colours, blue and yellow; and since these must be undoubtedly primaries to the colour-blind, it is reasonable to infer they should also be primaries in the normal system. The dichromic eye further becomes of use as an analyser of colours, and can detect the presence of blue or yellow in compounds whose elements may be inseparable to normal eyes.

The principal symptom of colour-blindness being the mistaking of red for green, and *vice versâ*, it has been thought that the use of these colours for railway and ship signals becomes dangerous when colour-blind persons may have to observe them. The author points out that this danger may be obviated by very simple means. Red and green are not confounded with each other generally, but only such hues of them as lie in both cases on the yellow side of the neutral; and therefore, if the green be made a *blue*-green, at the same time that the red is a *yellow*-red, they become quite as distinct to the colour-blind as to the normal-eyed.—*Saturday Review*, No. 34.

THEORY OF COMPOUND COLOURS.

A PAPER has been read to the British Association "on the Theory of Compound Colours with reference to Mixtures of Blue and Yellow Light," by Mr. J. C. Maxwell. When we mix together blue and yellow paint, we obtain green paint. This fact is well known to all who have ever handled colours; and it is universally admitted that blue and yellow make green. Red, yellow, and blue being the primary colours among painters, green is regarded as a secondary colour, arising from the mixture of blue and yellow. Newton, however, found that the green of the spectrum was not the same thing as the mixture of two colours of the spectrum, for such a mixture could be separated by the prism, while the green of the spectrum resisted further decomposition. But still it was believed that yellow and blue would make a green, though not that of the spectrum. As far as I am aware, the first experiment on the subject is that of M. Plateau, who, before 1819, made a disk with alternate sectors of Prussian blue and gamboge, and observed that, when spinning, the resultant tint was not green, but a neutral grey, inclining sometimes to yellow or blue, but never to green. Professor J. D. Forbes, of Edinburgh, made similar experiments in 1849, with the same result. Professor Helmholtz, of Königsberg, to whom we owe the most complete investigation on visible colour, has given the true explanation of this phenomenon. The result of mixing two coloured powders is not by any means the same as mixing the beams of light which flow from each separately. In the latter case we receive all the light which comes either from the one powder or the other; in the former, much of the light coming from one powder falls on a particle of the other, and we receive only that portion which has escaped absorption by one or other. Thus, the light coming from a mixture of blue and yellow powder consists partly of light coming directly from blue particles or yellow particles, and partly of light acted on by both blue and yellow particles. This latter light is green, since the blue stops the red, yellow, and orange, and the yellow stops the blue and violet. Mr. Maxwell has experimented on the mixture of blue and yellow *light*—by rapid rotation, by combined reflexion and transmission, by viewing them out of a focus, in stripes, at a great distance, by throwing the colours of the spectrum on a screen, and by receiving them into the eye directly; and Mr. Maxwell has arranged a portable apparatus by which any one may see the result of this or any other mixture of colours of the spectrum. In all these cases, blue and yellow do *not* make green. Experiments have been made on the mixture of coloured powders. Those used principally were "mineral blue" (from copper) and "chrome yellow." Other blue and yellow pigments gave curious results; but it was more difficult to make the mixtures, and the greens were less uniform in tint. The mixtures of these colours were made by weight, and were painted on disks of paper, which were afterwards treated in the manner described in Mr. Maxwell's paper "on Colour as perceived by the Eye," in the *Transactions of the Royal Society of Edinburgh*, vol. xxi., part ii. The visible effect of the colour is estimated in terms of the standard-coloured papers:—vermillion (V), ultramarine (U), and emerald green (E). The accuracy of the results, and their significance, can be best understood by referring to the paper before mentioned. Mineral blue is denoted by B, and chrome yellow by Y; and B_3 Y_5 means a mixture of three parts blue and five parts yellow.

Given Colour.			Standard Colours. V.	U.	E.	Co-efficient.
P_8	100	=	2	36	7	45
P_7 Y_1	100	=	1	18	17	37
B_6 Y_2	100	=	4	11	34	49
B_5 Y_3	100	=	9	5	40	54
B_4 Y_4	100	=	15	1	40	56
B_3 Y_5	100	=	22	−2	44	64
B_2 Y_6	100	=	35	−10	51	76
B_1 Y_7	100	=	64	−19	64	109
Y_8	100	=	180	−27	124	277

The columns V., U., E. give the proportions of the standard colours which are equivalent to 100 of the given colour; and the sum of V., U., E. gives a co-efficient, which gives a general idea of the brightness. It will be seen that the first admixture of yellow *diminishes* the brightness of the blue. The negative values of U.

indicate that a mixture of V., U., and E. cannot be made equivalent to the given colour. The experiments from which these results were taken had the negative values transferred to the other side of the equation. They were all made by means of the colour-top, and were verified by repetition at different times. It may be necessary to remark, in conclusion, with reference to the mode of registering visible colours in terms of three arbitrary standard colours, that it proceeds upon that theory of three primary elements in the sensation of colour, which treats the investigation of the laws of visible colour as a branch of human physiology, incapable of being deduced from the laws of light itself, as set forth in physical optics. It takes advantage of the methods of optics to study vision itself,—and its appeal is not to physical principles, but to our consciousness of our own sensations.—*Athenæum*, No. 1505.

FARADAY'S LINES OF FORCE.

A PAPER has been read to the British Association "on a Method of Drawing the Theoretical Forms of Faraday's Lines of Force without Calculation," by Mr. J. C. Maxwell. The method applies more particularly to those cases in which the lines are entirely parallel to one plane, such as the lines of electric currents in a thin plate, or those round a system of parallel electric currents. In such cases, if we know the forms of the lines of force in any two cases, we may combine them by simple addition of the functions on which the equations of the lines depend. Thus the system of lines in a uniform magnetic field is a series of parallel straight lines at equal intervals, and that for an infinite straight electric current perpendicular to the paper is a series of concentric circles whose radii are in geometric progression. Having drawn these two sets ot lines on two separate sheets of paper, and laid a third piece above, draw a third set of lines through the intersections of the first and second sets. This will be the system of lines in a uniform field disturbed by an electric current. The most interesting cases are those of uniform fields disturbed by a small magnet. If we draw a circle of any diameter with the magnet for centre, and join those points in which the circle cuts the lines of force, the straight lines so drawn will be parallel and equi-distant, and it is easily shown that they represent the actual lines of force in a paramagnetic, diamagnetic, or crystallized body, according to the nature of the original lines, the size of the circle, &c. No one can study Faraday's researches without wishing to see the forms of the lines of force. This method, therefore, by which they may be easily drawn, is recommended to the notice of electrical students. An application of Faraday's method to the mathematical theory of electricity and magnetism has been brought before the Cambridge Philosophical Society, for an abstract of which see the *Philosophical Magazine.*

REFRACTION IN STEREOSCOPIC IMAGES.

MR. CLAUDET has communicated to the British Association a paper "on various Phenomena of Refraction through Semi-Lenses producing Anomalies in the Illusion of Stereoscopic Images." The paper had for its object to explain the cause of the illusion of curvature given to pictures representing flat surfaces, when examined in the refracting or semi-lenticular stereoscope. The author showed that all vertical lines seen through prisms or semi-lenses are bent, presenting their concave side to the thin edge of the prism, and as the two photographic pictures are bent in the same manner, the inevitable result of their coalescence in the stereoscope is a concave surface. The only means to avoid this defect is to employ the centre of the lenses to examine the two pictures ; but as the centre does not refract laterally the two images, their coincidence cannot take place without placing the optical axes in such a position that they are nearly parallel, as if we were looking at the moon, or a very far object. This is an operation not very easy at the first attempt, but which a little practice will teach us to perform. Persons capable of using such a stereoscope will see the pictures more perfect, and all objects in their natural state. Mr. Claudet presented to the meeting a stereoscope made on this principle, and many of the members present could see perfectly well with it. The author explained the cause of a defect which is very often noticed in examining stereoscopic pictures, viz., that the subject seems in some cases to come out of the openings of the mountings, and in some others to recede from behind, —this last effect being more favourable and more artistic. Mr. Claudet recommended photographers when mounting their pictures to take care that the openings should have their correspondent vertical sides less distant than any two correspondent points of the first plane of the pictures, which could be easily done by means of a pair of compasses, measuring those respective distances. To illustrate the phenomenon of vertical lines, bent prisms forming by coalescence concave surfaces, Mr. Claudet stated that if holding in each hand one prism, the two prisms having their thin edges towards each other, we look at the window from the opposite end of the room, we see first two windows with their vertical lines bent in contrary directions ; but by inclining gradually the optical axes, we can converge them until the two images coalesce, and we see only one window ; as soon as they coincide the lateral curvature of the vertical lines ceases, and they are bent projectively from back to front ; we have then the illusion of a window concave towards the room, such as it would appear reflected by a concave mirror.

INVENTION OF THE STEREOSCOPE.

Sir David Brewster, in a letter to the *Times*, dated Nov. 1, 1856, states :—"Another candidate for stereoscopic discovery (or bathoscopic, as the author calls it, from βαθος, depth) has appeared in Canada. In the *Toronto Times* of October 8, 1856, sent me by Mr. George Maynard, he claims to be the first person who published anything on the peculiar phenomena of binocular vision and the principles of the stereoscope.

"'In the year 1838,' he says, (if I mistake not,) 'at a meeting of the British Association, the attention of philosophers on the continent of Europe was invited by Professor Wheatstone to some remarkable phenomena of vision with two eyes; and a small apparatus, the stereoscope, was presented in illustration of his experiments.

"'It did so happen, however, that in the year 1836 (two years previous to the period aforementioned) a protracted article, signed 'Theophilus,' and involving a detailed enunciation of binocular phenomena, with their bathoscopical results, was published by me in the *Royal Standard* daily paper at Toronto, and such is (in my opinion) the misapprehension generally existing on this interesting subject that (even after 20 years of additional information) I am encouraged to hope that the remarks then published, with a little amplification, will not prove unacceptable to the generality of your readers.'

"Such is the commencement of a long and very interesting article occupying a whole page of the newspaper, and showing, if the paper by 'Theophilus' contains the same truths, that Mr. Maynard was in 1836 possessed of the true principles of the stereoscope, and had produced relief by uniting objects at different distances on a plane surface. His observations on the vision of points are admirable and in entire harmony with the views which I have published."

RESEARCHES RESPECTING HEAT, LIGHT, ETC.

THE recent investigations of Mr. Joule, of Manchester, and Professors Thomson and Rankine, of Glasgow, relative to the mechanical equivalent of Heat, have already illustrated in a remarkable manner many of the most obscure points of physical science, and promise to be productive of results not inferior to any which have been reached since the days of Newton. About twelve years ago, Mr. Joule demonstrated that the mechanical power expended in overcoming the friction of any machine produces an amount of heat of equivalent value to the power expended, so that, if this heat could be employed again in an engine which worked without waste or loss, it would exactly reproduce the power which had been expended in generating it. It is obvious that as heat is producible by a machine without any waste of its own substance, or is producible in water by agitation without the quantity of water being diminished, heat cannot be a material substance, and both heat and light are produced by vibrations similar to those which produce sound. The steam generated in a boiler when condensed by cold water, as is done in a condensing-engine, produces a certain quantity of warm water; but a given quantity of steam thus condensed will not produce the same temperature in the water which has accomplished the condensation if such steam has been employed to work an engine, as it will produce if it has not been employed to generate power. For, as power is equivalent to heat, the steam which is employed to generate power would, unless there were a reduced temperature in the water which has accomplished the condensation, exhibit when the power was turned into heat a larger amount of heat than the steam contains, or the engine would be a heat-generating engine, which is impossible. The amount of power produced in a steam-engine, therefore, is measurable by the amount of heat which has disappeared from the hot well, or, in other words, which cannot be discovered in the water by which the condensation of the steam has been accomplished; and in a perfect engine, in which the whole heat was turned into power, there would be no rise in the temperature of the hot well at all over the temperature of the water admitted to perform the condensation. The greater the difference of temperature between the boiler and condenser, the more effectual will any given quantity of coals be in generating power; and it is because air admits of the use of a far higher temperature than is possible in the case of steam, that it realises a very superior economy. Steam-engines, the writer is persuaded, cannot last for another twenty years. There are constructive impediments to the employment of air-engines which, however, are not very difficult of supersession; and they will be surmounted speedily, so soon as practical engineers are thoroughly satisfied of the superior performance attainable by air-engines, and which, therefore, it is important widely to announce. Mechanical power being convertible into heat, electricity, and also into light, it becomes easy to estimate the mechanical value of those agents; and a key is thus afforded whereby these heretofore inscrutable departments of science may be brought under the dominion of mechanical laws. Professor Rankine ascribes the elasticity of gases to a centrifugal action of their particles; and Professor Thomson, by a very ingenious process, makes an estimate of the density of the ether, or atmosphere, filling the interstellar spaces, by determining first the mechanical value of a cubic mile of sunlight, and the velocity of the vibrations by which light is caused; and he knows then, by the usual laws of mechanics, that with the given velocity of motion, the density must be such as to produce the specified amount of mechanical power.—*Mr. Bourne, in the Illustrated London News*, No. 813.

MOTION OF THE MOON.

A PAPER has been read to the British Association, "on the Reasons for describing the Moon's Motion as a Motion about her Axis," by the Rev. Dr. Whewell. The moon's motion may be described, in one way among others, by saying that in each month she revolves about the earth nearly in one plane, turning always the same face to the earth. But were a body rigidly fastened to a rigid radius which revolved about the earth nearly in one plane, such a body would during that revolution turn always the same plane to the earth. Now, would such a body be described as revolving upon its axis during such a revolution? By many persons it would not be so described. But the moon is described by astronomers as revolving about her axis in the course of every month. What are the reasons for such a description? The reasons are briefly these:—1. The moon is not fastened to the earth rigidly, nor fastened at all. 2. The moon being thus detached, the reference of the moon to the earth as a centre of revolution is arbitrary. 3. The other celestial bodies which revolve about centres also revolve about their axes, and the rule regarding them as not revolving about their axes when they turn always the same face to the centre, would produce confusion: it would, for instance, compel one to say that the earth revolves upon her axis 365¼ times in a year, whereas with regard to the fixed stars she revolves 366¼ times. Also, when a body revolves about a centre turning always the same face to the centre, then is mechanical force required to make it so turn; but no mechanical force is required to make it remain parallel to itself while it revolves round a centre. 1. The moon is *not* fastened to the earth rigidly, as the ancients supposed, when they invented the crystalline spheres as the mechanism by which the heavenly bodies revolve, and by which they are connected with one another; and as the body representing the moon is fastened to the body representing the earth in machines made by man. The moon in nature is entirely detached from the sun, and the fact of her turning the same face to the earth does not at all form the machinery of her monthly revolution. Hence it is ascribed to a separate motion, her monthly revolution on her axis. 2. The reference of the moon to the earth is *arbitrary*. The moon revolves about the earth, but she revolves about the sun also. She revolves about the sun *more* than about the earth; for when she is between the sun and the earth, her face is concave to the sun and convex to the earth's orbit. There are, in some respects, stronger reasons for regarding her as fastened to the sun than as fastened to the earth. But in truth she is not fastened at all; and the simplest way is to regard her as quite detached, and to consider her motion by which she turns her face different ways as quite separate from the motion by which she revolves about any centre. 3. The other celestial bodies also revolve about their axes, and especially the earth. All persons agree in thus expressing the fact in the case of the earth; and as there are 365 days in the year, the earth revolves 365 times on her axis with reference to the sun. By doing this she revolves 366 times on her axis with reference to the fixed stars. 4. It may easily be shown experimentally that mechanical force is requisite in order that a body revolving about another may always turn the same face to the other. The following is one way of doing this:—Let a cup containing water be fastened at the extremity of an arm which revolves in a horizontal plane about a centre. The cup will, of course, always turn the same side to the centre, being forced to do so by the rigid connexion of the parts. But the water in the cup, not having any rigid connexion with the centre, will not turn the same side to the centre during the revolution of the cup. This will appear if a straw be made to float upon the surface of the water; for the straw will always point in the same direction with regard to surrounding objects, and not with regard to the centre. If the motion is very rapid or long continued, a slight deviation of the straw from its original position will be produced by the friction of the water against the sides of the cup.

This paper was followed by the reading of a contribution "on Phenomena recently discovered in the Moon," by Mr. J. Symons.—The title given to this communication by the author was a misdescription of its contents, as it treated of no recent discoveries of phenomena in the moon, but was simply a renewal of his assertion, that it tended to mislead ordinary persons, and was unsuited to the instruction of the young, to describe the moon as moving round her own axis with a uniform rotatory motion once in each month. The author stated that a learned Judge, while recently trying an infringement of a patent, had stated that correct terminology as to the several kinds of motion was much required, and would greatly tend to prevent litigation in such cases as the one then under trial. And the author bore witness from his own experience to the serious mistakes which prevailed in the popular mind on this subject of describing the moon's motion as one combined of a motion round the earth in a month, and, at the same time, a uniform rotation on an axis passing through her centre once in the same time. The author claimed Dr. Whewell as a convert to his opinion, as he stated that he had taken down his words, in which he stated that this was only a conventional mode of describing her motion, among many others that might with equal correctness be adopted, rather than an exact statement of facts.—[Dr. Whewell, No, no.]—The author reiterated that he had taken down his words, and proceeded to assert that the correct way of describing the motion in such a case as that of the moon was, when the body turned on an axis within herself, to speak of that as a motion round an axis; but when the motion was as in the present case, he maintained it to be round a line, not exactly passing through the earth, but near it: that would be the proper way to describe the motion. The author then produced a machine, consisting of a board, which he could turn round by machinery, and three wheels, which caused an upright arm, carrying a ball to represent the moon, either to revolve on the arm or to remain stationary as the ball went round the central one representing the earth. The upright arm, also carrying the moon, could be placed as a firm fixture to the revolving board, which caused it to revolve in a simple and obvious manner, always with the same face to the central ball representing the earth. This, the author asserted, truly represented the moon's motion, abstracting from a very slight, or insignificant motion, called her libration in longitude.

Towards the conclusion of his address, he stated, as a proof of how necessary it was to correct the statements in which philosophers sometimes indulged, that it was now asserted that there were not large assemblages of water upon the moon, whereas Newton had not only traced out her seas, but had actually calculated the heights of the lunar tides—[At this palpable and gross misconception, several gentlemen on the platform could no longer contain themselves, but burst out into exclamations causing interruption].

The Rev. Mr. Pritchard said that the gentleman asserted that the moon did not revolve uniformly on an axis within her once in a month: he maintained that she did. The gentleman asserted that the moon's librations were insignificant: he maintained, in opposition, that they were most important, and when correctly interpreted by one fitted by previous study for it, completely established the affirmative of the proposition which the learned gentleman denied.

Mr. Brooke, in the course of his observations on the controversy, said, he thought the views of Mr. Symons admitted of being disproved by many illustrations, but one appeared to him decisive. Mr. Brooke, stretching out his arm, placed a pen between his fingers so as to point with its sharp end to the ceiling. He then showed that, by revolving his entire arm once round, he could cause the point of the pen, in succession, to point to the right-hand wall, to the floor, to the left-hand wall, and, finally, to the ceiling, nearly as high as where it pointed when he began to revolve his arm; but, because he could not continue the revolution of his arm beyond that limit, he could carry the pointing of the pen no further round. He now moved his stretched-out hand round a vertical circle placed before him to represent the moon's orbit, and he showed that he could carry the pen any number of times round, if, without any revolving of his arm, he merely moved it round; but then the pen, instead of always pointing to the centre of the circle representing the earth, as the moon did, kept always fixedly pointing to one wall —say the right-hand one. But if, in endeavouring to imitate the moon always pointing the same face to the earth, he tried to do so with the pen, by revolving his arm, he could do so for one turn; but beyond that he could not continue to imitate the manner in which the moon kept the same face to the earth, because he could not continue the rotation of his arm, which was a correct representative of her axis. She does, therefore, revolve exactly once on her axis each month. The President of the Section said that he was in the habit of illustrating the truth very simply. If you walked round a central point of a room so as to keep your face continually pointed to that centre as the moon does to the earth, you find that, as you go round, your face turns once to each of the four walls of the room in succession during the once going round. Now, if you diminish the radius of the circle in which you walk to nothing at the centre, where the orbital motion has disappeared, the motion on the axis alone remains.—*Athenæum*, No. 1504, *abridged.*

THE SELF-REGISTERING ANEMOMETER OF KEW OBSERVATORY.

MR. WELSH has described to the British Association a model of this instrument, designed and constructed by Mr. R. Beckley, in which he has adopted Dr. Robinson's method of measuring the velocity of the wind by the rotation of a system of hemispherical cups,—the direction being indicated by a double-wheel fan, like the directing vane at the back of a windmill. A stout tubular support carries the whole of the external part of the instrument, including the measurer of velocity, the direction vane, and a rain-gauge. This support is so made that it can be easily adapted to the roof of any building upon which it may be necessary to mount it. All the rotatory parts of the anemometer run upon friction balls. The shaft of the apparatus for measuring the movement of the wind, by means of a diminishing train of wheels, is made to turn a cylinder upon which is wrapped a sheet of paper of the kind used for "metallic memorandum books," this paper having the property of receiving a trace from a style of brass. The sheet of paper is divided into two sections, upon one of which is recorded the motion of the wind, and upon the other the direction. As the cylinder is being turned by the action of the wind a clock carries a pencil along the cylinder at a uniform rate of 12 inches in the 24 hours. To the lower end of the direction shaft is attached a spiral of such a figure that equal angles correspond to equal increments of radius; the edge of this spiral consists of a thin slip of brass, which touches the paper and records the direction of the wind on a rectilinear scale. When the sheet of paper is unwrapped from the cylinder after 24 hours, the motion of the wind and the direction are both found projected in rectangular co-ordinates. The author also stated that as it was well known to be difficult, if not impossible, by any method at present in use, to judge of the true direction of the wind when in a ship moving swiftly at sea, the method suggested in the following extract of a letter will be found effectual:—"By means of a portable Robinson's anemometer, provided with a means of observing the total number of turns made by the rotating part in any given time, observe the *apparent* velocity of the wind and record it in knots per hour. By an anemoscope of any kind register the *apparent* direction of the wind. From the log-book take the rate and direction of the ship's motion. On a slate or other similar surface *scratch* a permanent compass circle. Set off from the centre of the circle, or the radius of the direction of the ship's head, by any convenient scale, the number of knots per hour the ship is going—from this point draw a pencil line parallel to the direction of the wind as observed by the anemoscope (*i. e.*, the *apparent* direction *to* which the wind is *going*)—set off on this line the number of knots per hour as shown by the anemometer—draw a line from the centre of the circle to this last point. The length of this line by the scale adopted gives the *true* velocity of the wind, and its direction (carried backwards) shows the point *from* which the wind is *coming*. A parallel ruler divided on the edge is all that is required besides the slate. It would be easy enough to contrive some mechanism to save the trouble of drawing lines, but it would not, I believe, be any real simplification, and would increase the expense. The train of indicating wheels might be so arranged that they at once indicate knots per hour, without reference to tables, and can be readily set to zero for a fresh observation.—*Athenæum*, No. 1504.

NEW SEISMOMETER.

THE new Seismometer (an instrument for determining the data concerning earthquakes), invented by M. Kreil, director of the Imperial Meteorological Institute, Vienna, is a pendulum oscillating in every direction, but unable to turn round on its point of suspension, and bearing at its extremity a cylinder, which, by means of mechanism within it, turns on its vertical axis once in twenty-four hours. Next to the pendulum stands a rod bearing a narrow elastic arm, which slightly presses the extremity of a lead-pencil against the surface of the cylinder. As long as the pendulum is quiet, the pencil traces an uninterrupted line on the surface of the cylinder; but as soon as it oscillates, this line becomes interrupted and irregular, and these irregularities serve to indicate the time of the commencement of an earthquake, together with its direction and intensity.—*Proceed. Imp. Acad. Sciences, Vienna.*

NEW THERMOMETERS.

PROF. PHILLIPS has communicated to the British Association, a paper, "on a new method of making Maximum Self-registering Thermometers." Thermometers constructed after this plan were first exhibited by Prof. Phillips, accompanied by a description, to the Oxford Meeting of the Association, in 1832. In consequence of a careful examination of the principle on which they were arranged by Mr. Welsh, attention was again called to the subject. The principle of the instrument is the employment of a little portion of the column of mercury, detached as a *marker*. This is capable of a great range of adaptation, and is independent of change, by time or chemical action, and as delicate in operation and as free from error as the best ordinary thermometer can be made. Mr. Welsh constructed some in a manner much superior to that formerly employed by Prof. Phillips, and reported in very favourable terms on the accuracy and permanency of the instrument. Thus encouraged, Mr. Casella had undertaken to adapt the thermometer to different purposes in meteorology and philosophical research, but without changing in any degree the essential character of the instrument. Among the examples on the table was one which was planned by Prof. Phillips for special researches on limited sources, or areas, of heat, with small bulb, fine bore, and *short detached marking column*. Thus made, the thermometer may be used in any position, vertical, inclined, or horizontal, and the *short detached marking column* will retain its place with such firmness that instruments may even be carried far or agitated much without losing the registration.

OXYGEN IN THE BLOOD.

DR. GEORGE HARLEY has communicated to the Royal Society a paper "on the Condition of the Oxygen absorbed into the Blood during Respiration;" which he concludes by expressing a hope that his experiments will be considered as at least serving to establish one important fact respecting which further evidence was wanted, namely, that the entire volume of the respired oxygen is not transmitted in an uncombined state (as Magnus believes) to the various organs and tissues of the body, but that a portion of it enters into chemical combination with some of the organic constituents of the blood.

EXPERIMENTS IN ELECTRO-PHYSIOLOGY. BY PROF. MATTEUCCI. (IN A LETTER TO DR. FARADAY).

May 1, 1856.

MY DEAR FRIEND,—I think I have already told you that for some time past I have been making Experiments in Electro-Physiology. Allow me now to communicate to you the results of my work.

I have lately succeeded in demonstrating and measuring the phenomenon which I have called *muscular respiration*. This respiration, which consists in the absorption of oxygen and the exhalation of carbonic acid and azote by living muscles, and of which I have determined the principal conditions and intensity compared with that of the general respiration of an animal, has been studied particularly on muscles in contraction. I have proved that this respiration *increases considerably* in the act of contraction, and have measured this increase.

A muscle which contracts, absorbs, while in contraction, a much greater quantity of oxygen, and exhales a much greater quantity of carbonic acid and azote, than does the same muscle in a state of repose. A part of the carbonic acid exhales in the air, the muscle imbibes the other part, which puts a stop to successive respiration and produces *asphyxy of the muscle.* Thus a muscle soon ceases to contract under the influence of an electro-magnetic machine when it is enclosed in a small space of air: this cessation takes place after a longer interval of time if the muscle is in the open air, and much more slowly still if there be a solution of potash at the bottom of the recipient in which the muscle is suspended. Muscles which have been kept long in vacuum or in hydrogen are nevertheless capable, though in a less degree, of exhaling carbonic acid while in contraction; this proves clearly that the oxygen which furnishes the carbonic acid exists in the muscle in a state of combination. According to the theories of Joule, Thomson, &c., the chemical action which is transformed, or which gives rise to heat, is also represented by a certain quantity of *vis viva*, or by an equivalent of mechanical work. I have therefore been able to measure the *theoretical work* due to the oxygen consumed, taking the numbers which I had found for muscular respiration during contraction, and in consequence the quantity of heat developed by this chemical action, and finally this *theoretical work* according to the dynamical equivalent of heat. I have compared this number with that which expresses the *real work* which is obtained by measuring the weight which a muscle in contraction can raise to a certain height, and the number of contractions which a muscle can perform in a given time. It results from this comparison, that the first number is somewhat greater than the second, and the heat developed by contraction ought to be admitted among the causes of this slight difference: these two numbers are therefore sufficiently in accordance with each other.

I completed these researches by some new studies on *induced contraction*, that is to say, on the phenomenon of the irritation of a nerve in contact with a muscle in contraction. A great number of experiments lately made on the discharge of the torpedo, and on the analogy between this discharge and muscular contraction, have led me to establish the existence of an electrical discharge in the act of muscular contraction. The general conclusion to be drawn from these researches is, therefore, that the chemical action which accompanies muscular contraction developes in living bodies, as in the pile or in a steam-engine, heat, electricity, and *vis viva*, according to the same mechanical laws.

Allow me to describe to you briefly the only one of these experiments which can be repeated in a lecture, and which proves the principal fact of these researches, although it is limited to prove that muscles in contraction develope a greater quantity of carbonic acid than those in repose. Take two wide-mouthed glass phials of equal size, 100 or 120 cub. centims.; pour 10 cub. centims. of lime-water (eau-de-chaux) into each of these phials. Prepare ten frogs in the manner *of Galvani*, that is, reducing them to a piece of spinal marrow, thighs and legs without the claws, which are cut in order to avoid contact with the liquid in the phials. The cork of one of these phials is provided with five hooks, either of copper or iron, on which five of the prepared frogs are fixed. Through the cork of the other phial are passed two iron wires, bent horizontally in the interior of the phial; the other five frogs are fixed by the spinal marrow to these wires. This preparation must be accomplished as rapidly as possible, and both the phials be ready at the same instant, and great care taken to avoid the contact of the frogs with the sides of the phials or the liquid. When all is in readiness, with a pile of two or three elements of Grove, and with an electro-magnetic machine such as is employed for medical purposes, the five frogs suspended on the two iron wires are made to contract. After the lapse of five or six minutes, during which time the passage of the current has been interrupted at intervals in order to keep up the force of the contractions, agitate gently the liquid, withdraw the frogs, close rapidly the phials, and agitate the liquid again. You will then see that the lime-water contained in the phial in which the frogs were contracted is much whiter and more turbid than the same liquid contained in the other phial in which the frogs were left in repose. It is almost superfluous to add, that I made the complete analysis of the air in contact with the frogs according to the methods generally employed.

Yours faithfully,

A. MATTEUCCI.

—*Contributed to the Philosophical Magazine*, No. 74.

MENTAL CALCULATION.

Two of the evening meetings of the Institution of Civil Engineers have been devoted to the hearing of addresses by Mr. George Bidder, the eminent engineer; conveying that process of reasoning, or action of the mind, which constitutes the power of Mental Calculation. The boyhood of Mr. George Bidder will be remembered among the few records we possess of this class of eminent mental calculators: his object in these communications was truthfully to submit the result of certain facts connected with his own training in Mental Arithmetic; in short, to detail the progress, as it were, of an experiment worked completely out upon himself, and to give a faithful record of the result.

Mr. Bidder is convinced that Mental Calculation can be taught to children, and be acquired with greater facility and less irksomeness than ordinary arithmetic. Still, the eminent mental calculators have been extremely few during the last two centuries, among whom Jedediah Buxton and Zerah Colborne were the most remarkable; but even their powers have not been usefully employed, in consequence of their not having subsequently had the opportunity of receiving a mathematical education. It has been commonly thought that Mental Calculation is an art naturally engrafted upon peculiarly constituted minds; it has also been attributed to the possession of great powers of memory; and it has been generally thought that Mr. Bidder himself has been indebted to unusual powers of memory and a natural mathematical turn of mind for the celebrity he has acquired. Now, Mr. Bidder emphatically declares this not to have been the case; he has sought every opportunity of comparing himself with boys and men who possessed this faculty, and, except so far as being carefully trained and practised in the cultivation and use of figures, he has not found that his memory was more than ordinarily retentive. In fact, whilst at school and at college, he had some difficulty in maintaining a decently respectable position in the mathematical class.

Mr. Bidder enunciates, as a principle, that there is not any royal or short road to Mental Calculation: the processes are, like all others in arithmetical computation, to be performed seriatim, as, whatever may be the number of figures employed in a calculation, they are only so many symbols, to be dealt with precisely as they would be in algebraic formulæ, with which the calculations may be considered as identical. In point of fact, many of the processes of Mental Calculation, if produced on paper, would appear most complex and complicated. They can, however, be accomplished mentally, in consequence of the faculty of occupying the mind simultaneously with the double task of "computing" and "registering." The first—computing—is executive or reasoning, and is that portion of the process which, whilst it is the most active, is not that which causes the greatest strain on the mind. The result is recorded by the second faculty, registering, which is the real strain upon the mind, and that by which alone the power of Mental Computation is limited.

Experience has shown that, up to a certain point, the power of registering is as rapid as that of thought; but the difficulty increases, in a very high ratio, in reference to the number and extent of impressions to be registered, until a point is reached, the registering of which in the mind and by writing are exactly balanced. Below that point, mental registration is preferable; above it, that by writing will be as quick, and more certain. Therefore, the mental process, as compared with the operation of writing, is as the speed of lightning to that of an express train; and, if the power of registration could be maintained at all times upon a par with the executive faculty, there would be no difficulty in computing with immense rapidity a table of logarithms up to ten places of figures.

All the rules employed by Mr. Bidder were invented by him, and are only methods of so arranging calculation as to facilitate the power of registration; in fact, he thus arrived at a sort of natural algebra, using actual numbers in the place of symbols. He believes it was in about the sixth year of his age that he began to deal with numbers; he had not then learned to read, and certainly long after that time he was taught the symbolical numbers from the face of a watch. His earliest recollection is that of counting up to 10, then up to 100, and afterwards to 1000; then, by intuitive process, he taught himself the method of abbreviating the labour of counting—arriving, in fact, at the natural multiplication of numbers into each other, attributing to each a separate and individual value.

In this manner the actual value of every number, up to 1000, was impressed upon the memory, and he then proceeded onwards, seriatim, up to a million. It was his practice to count numbers practically by peas, marbles, or shots, to compose rectangles of various values, and, by counting them, the multiplication table was ultimately the result of actual experience and test; and thus he had attained an intimate acquaintance with numbers multiplied with each other, by a tangible process, divested of that formidable character under which it was generally brought before the young student.

In this way he learned to multiply up to two places of figures before he knew the symbolical characters of the figures or the meaning of the word "multiply," as, instead of the term "multiplying 27 by 73," he only understood the expression "27 times 73."

All the varieties of numbers up to a million being represented by six different designations, or varieties of numbers, viz., units, tens, hundreds, thousands, tens of thousands, and hundreds of thousands, their permutations were only eighteen in number. A boy, therefore, who knows his multiplication table up to 10 times 10 registered 50 facts in his mind, and with the permutations above mentioned has only to store 68 facts. The ordinary multiplication table of 12 times 12 gives him 72 facts to store, or 4 additional facts. The machinery, therefore, necessary to enable him to multiply to 6 places of figures consists of 4 facts less than that required to enable him to carry the multiplication table in his mind.

The application of this, when fairly acquired, may be thus illustrated; for example, multiplying 173 by 397, the following process is performed mentally:—

100 × 397 = 39,700						
70 × 300 = 21,000 = 60,700						
70 × 90	... = 6,300 = 67,000					
70 × 7	...	... = 490 = 67,490				
3 × 300	...	...	... = 900 = 68,390			
3 × 90	...	...	...	... = 270 = 68,660		
3 × 7	...	..	...	..	... = 21 = 68,681	

The last result in each operation being alone registered by the memory, all previous results being obliterated.

To show the aptitude of the mind by practice, he will know, at a glance,

That ... ... 400 × 173 = 69,200
And then ... ... 3 × 173 = 519

The difference being 68,681, as above.

In Addition and Subtraction the same principle as already explained for Multiplication is adhered to—viz., that of commencing with the left-hand side, or the large numbers, and adding successively, keeping one result only in the mind.

Division is, as in ordinary arithmetic, much more difficult than Multiplication, as it must be a tentative process, and is only carried out by a series, more or less, of guesses; but no doubt, in this respect, the training arrived at by Mental Arithmetic gives the power of guessing to a greater extent than is usually attained, and affords a corresponding facility in the process. Supposing, for instance, it is necessary to divide 25,696 by 176, the following will be the process:—100 must be the first figure of the factor: 100 times 176 are known at once to be 17,600: subtracting that from 25,696, there remains 8096. It is perceived that 40 is the next number in the factor; 40 times 176=7040: there then remains 1056; that, it is immediately perceived, gives a remaining factor of 6, making in all 146. Thus only one result is retained in the mind at a time; but, as contrasted with multiplication, it is necessary to keep registered in the mind two results which are always changing, viz., the remainder of the number to be divided, and the numbers of the factor, as they are determined; but if it is known, as in the present instance, that 176 is the exact factor, without any remainder, having got the first factor—100—which is perceived at a glance, it is known that there are only four numbers which, multiplied by 76, can produce a result terminating in 96—viz., 21, 46, 71, and 96; and therefore the immediate inference is that it must be 46, as 121 must be too little, and 171 must be too much, therefore 146 must be the factor. Thus, the only facility afforded by Mental Calculation is the greater power of guessing at every step towards the result.

Mr. Bidder then proceeded to make a few remarks on the Rule of Three, applied to money, weight, measure, and time—then on the Square and Cube Roots, Compound Interest, and Prime Numbers, with instances of their application to subjects connected with the profession of civil engineering; concluding with what would appear to be the true course of education in teaching arithmetic. Of the latter we quote a short *résumé*.

The first step that Mr. Bidder recommends, even before any knowledge of figures is symbolically acquired, is that the process of counting up to ten should be mastered, then up to 100, and subsequently to 1000; then the multiplication table, up to 10 times 10, should be taught practically, by the use of peas, marbles, or shots, or any bodies of uniform dimensions, by placing them in rectangles or squares.

Having thus induced the student to teach himself the multiplication table, nothing will be more easy than to teach him to multiply 10 by 17, which will be 10 × 10 + 10 × 7; having accomplished this, the multiplication of 17 × 13 easily follows, being 10 × 17 + 3 × 10 + 3 × 7. This being executed it only remains for him to practise multiplication up to two places of figures. Concurrently with this should be taught the permutations of 100, 1000, &c., into each other, and thus will be laid the basis of Mental Calculation, for whatever extent the individual may desire to carry it to; but the early training should be such as to enable the student to rely upon his own resources for framing his rules for any other branch of arithmetic. In order to do this, however, his mind must be stored with a certain number of facts, which must be completely at his command; and advantage should be taken of the mode of giving him an insight into natural algebra and geometry. With this view the training should be extended, and there would be no difficulty in conveying to young minds the knowledge of certain leading facts connected with the sciences, long before they are capable of comprehending the beautiful trains of reasoning by which their truths were established. There is no difficulty in impressing, permanently, an appreciation of the relative proportion of the diameter to the circumference of a circle; of the beautiful property of the square of the hypothenuse of a right-angled triangle being equal to the squares of the two sides containing the right angle, or of the equality of the areas of triangles on the same base, contained between the same parallel, and many others which must occur to all geometricians.

The same with respect to the properties of several series of numbers—for instance, $1+3+5$, &c., or $1+2+3$, &c., or $(1)+(1\times 6)+(1+3\times 6)+(1+6\times 6)$, &c.

Such is a brief outline of Mr. Bidder's valuable contribution. The paper, *in extenso*, has been edited and published by Mr. Charles Manby, F.R.S., Secretary to the Institution of Civil Engineers.

ON ACOUSTICS AS APPLIED TO PUBLIC BUILDINGS.

Professor Henry has communicated to the American Association for the Advancement of Science a paper discussing the conditions producing echo and resonance. Under the latter head, he remarked that the material of the wall will affect the duration of a resonance. A series of experiments was made with a tuning-fork; first, to show that the motions excited by setting the fork on the back of a solid body are similar to those excited by the impulses of sound coming through the air against that body. Next, to discover what those motions are, a fork suspended by a cambric thread vibrated for 252 seconds, as was determined by holding under it a cavity which would resound in unison with the fork, and listening to it with an ear-trumpet. Placed on a thin pine board, the fork gave a loud sound, which continued less than ten seconds, the motive power of the fork being communicated to so large a mass of wood, and through that rapidly to the air. Placed on a slab of marble, the sound was feeble, but lasted 115 seconds. The fork was now placed upon a cube of India-rubber lying on the marble slab. The sound was very feeble, but continued less than 40 seconds. The question, What became of the motive power in this case, as it produced so little sound? was answered by a set of experiments, proving that the sound was (so to speak) converted into heat. The amount of heat evolved in the rubber was so small as to be detected only by a delicate galvanometer. Joule has, however, shown that the mechanical energy generated by a pound weight falling through 750 feet would, when converted into heat, elevate the temperature of a pound of water only one degree. On a brick wall the duration of the vibration was 88 seconds; on lath and plaster there was a louder sound, of only 18 seconds. Experiments were made upon the reflection of sound. Parabolic mirrors were tested by lights placed in the focus, and a watch being substituted for the light, the reflected sound and the position of its focus examined by an ear-trumpet.

Electrical Science.

LAW OF ELECTRICAL AND MAGNETIC FORCE.

SIR W. S. HARRIS prefaces the exposition of the views he himself has adopted, after a lifetime of experimental research on the subject, by stating that the discovery of the beautiful and comprehensive law of universal gravitation by Newton has predisposed all physical inquirers to entertain the notion that every other force associated with ordinary matter is subject to a similar law. The author goes on to illustrate the law of the inverse square of the distance as applicable to forces emanating from one central point and to other emanations from a centre, and to point out how far this may safely be relied upon as applicable to the electrical and magnetic forces of attraction and repulsion; and states that the object of the present communication is to investigate the physical condition under which these forces manifest themselves,—what are the general laws of the operation of such forces,—how far we may safely consider them as central forces, such as gravity, or whether they are to be considered more in the light of parallel forces, distinctive in their character and in all their relations to common matter, and in the elementary conditions of their character. He then points out one, in particular, essentially distinctive character of these forces. In gravitation, the attracted body, as far as we can observe, remains in the same physical condition before and during all the changes of distance and force to which the bodies are mutually subjected. But in the electrical and magnetic phenomena of attraction and of repulsion, supposing it in a distinctive sense to exist, the very first step is, that the body acted upon has its physical condition changed; and this change again, by a kind of reflex influence, affects what has been the instant before the physical condition of the body producing the change; and thus during the action and its changes, new physical conditions of both have to be investigated and taken into consideration, if we wish truly to interpret the facts. The author then proceeds to illustrate the truth and importance of these general views, and concludes his memoir by showing with what caution the results of the experiments of Coulomb, with the proof plane and balance of torsion, although in themselves statements of most certain facts, which do and must manifest themselves, should be applied as they have been by mathematicians to establish deductions from theories, the very basis of which assumes the bodies to be in such very different physical conditions from those which, when we duly consider them, obtain in nature during the progress of these very phenomena.—*Proceedings of the British Association*, No. 1504.

HEARDER'S INDUCTION COIL.

AT a meeting of the Plymouth Institution, Mr. J. N. Hearder, of Plymouth, lately brought forward his modification of the Induction Coil Machine, possessed of very great power, whilst the length of wire was not more than one-third the quantity employed by M. Ruhmkorff, of Paris. Since that time Mr. Hearder has introduced other improvements in the machine, and has now produced one containing one-sixth less in length of wire than the first one, but possessing double the power. It has been exhibited at the Royal Cornwall Polytechnic Society, and has received their first silver medal. Mr. Hearder pointed out some of the peculiarities of the machine, and stated that he had been enabled by its use to develop an entirely new law of electrical action, which was made the subject of distinct communication to the Society. He considers that the mode of insulation adopted by M. Ruhmkorff must be very defective, since, according to his calculation, it ought to furnish sparks between the terminals five or six times as long as those usually afforded by the instrument.—*Athenæum*, No. 1512.

THE ELECTRIC SPARK.

At the Royal Institution, the instantaneous duration of an Electric Spark, and the means ingeniously contrived by Professor Wheatstone to measure it, were lately illustrated by the original apparatus employed by the Professor; from which it was ascertained that the duration of the spark does not exceed the twenty-five thousandth part of a second. A cannon-ball, if illumined in its flight by a flash of lightning, would, in consequence of the momentary duration of the light, appear to be stationary; and even the wings of an insect that moves ten thousand times in a second, would seem at rest.

PERPETUAL MOTION.

Mr. W. R. Grove, F.R.S., has read to the Royal Institution a paper containing certain important inferences from the Negation of Perpetual Motion. The lecture is reported *in extenso* in the printed *Proceedings* of the Institution: we have only space to quote certain experiments made by Mr. Grove, and believed by him to be new. Carnot's theory upon the subject is that the mechanical force is produced by the transfer of heat, and that there is no ultimate cost or expenditure of heat in producing it. One of the greatest difficulties which had presented itself to Mr. Grove's mind, with reference to this theory of Carnot, has been one of analogy, derived from the received theories of electricity. Many electrical cases might be cited in which no electricity is supposed to be lost, though a certain mechanical effect is produced by the electricity; if, for instance, a ball vibrates between a positively and negatively electrified substance, none of our electrical theories lead us to believe that any difference in the actual amount of electricity transferred would be occasioned by the ball being attached to a lever which would strike a wheel or produce any other mechanical effect.

In preparing the evening's communication an experiment had occurred to him, which, though performed with imperfect apparatus, and therefore requiring verification, does, as far as it goes, support the view derived from the negation of perpetual motion, viz., that when electricity performs any mechanical work which does not return to the machine, electrical power is lost. The experiment is made in the following manner: A Leyden jar of one square foot coated surface has its interior connected with a Cuthbertson's electrometer, between which and the outer coating of the jar are a pair of discharging balls fixed at a certain distance (about ½ an inch apart). Between the Leyden jar and the prime conductor is inserted a small unit jar of nine square inches surface, the knobs of which are 0·2 inch apart.

The balance of the electrometer is now fixed by a stiff wire inserted between the attracting knobs, and the Leyden jar charged by discharges from the unit jar. After a certain number of these (22 in the experiment performed in the theatre on this occasion), the discharge of the large jar takes place across the ½-interval; this may be viewed as the expression of electrical power received from the unit jar. The experiment is now repeated, the wire between the balls having been removed, and therefore the "tip," or the raising of the weight, is performed by the electrical repulsion and attraction of the two pairs of balls; at 22 discharges of the unit jar the balance is subverted, and one knob drops upon the other, but *no discharge takes place*, showing that some electricity has been lost, or converted into the mechanical power which raises the balance. By another mode of expression the electricity may be supposed to be masked or analogous to latent heat, and would be restored if the ball were brought back, without discharge, by extraneous force.

This experiment has succeeded in so large an average of cases, and so responds to theory, that notwithstanding the imperfection of the apparatus, Mr. Grove places much reliance on it; indeed it is difficult to see, if the discharges or other electrical effects were the same in both cases, why the raising the ball, being extra and the ball being capable by its fall of producing electricity or other force, force would not thus be got out of nothing, or perpetual motion attained.

The experiment is believed to be new, and to be suggestive of others of a similar character, which may be indefinitely varied. Thus, two balls made to diverge by electricity, should not give to an electrometer the same amount of electricity as if they were, whilst electrified, kept forcibly together, an experiment which may be tried by Coulomb's torsion balance.*

There is an advantage in electrical experiments of this class, as compared with those on heat, viz., that though there is no perfect

* Another mode of showing the same effect is the following. On the top of an ordinary gold-leaf electroscope place two brass plates, such as those commonly used for a condenser, connect them by a long fine wire, and electrify them by a rubbed rod of glass or sealing-wax, so that the gold leaves diverge

as it is raised, and again diverge as it is depressed. It should be recollected that the plates are electrified by the same electricity, and are always metallically connected by the fine wire, in which respect this differs from ordinary induction experiments. It may be said that here the mechanical force is given by the hand; but this is only in part, the repellent effect of electricity does part of the work, and would be therefore expended; it is analogically as though a man were to add his force to the piston-rod of a steam-engine, which would not prevent the loss of heat by the dilating steam.

insulation for electricity, yet our means of insulation are immeasurably superior to any attainable for heat.

Similar reasoning might be applied to other forces; and many cases bearing on this subject have been considered by Mr. Grove in his essay on the *Correlation of Physical Forces.*

Certain objections to these views were then discussed, and especially some apparently formidable ones presented by M. Matteucci in a paper published by him some time ago.*

This distinguished philosopher cites the fact, that a voltaic battery decomposing water in a voltameter, while the same current is employed at the same time to make an electro-magnet, nevertheless gives in the voltameter an equivalent of gas, or decomposed substance, for each equivalent of chemical decomposition in the cells, and will give the same ratios if the electro-magnet be removed. In answer to this objection it may be said, that in the circumstances under which this experiment is ordinarily performed, several cells of the battery are used, and so there is a far greater amount of force generated in the cells than is indicated by the effect in the voltameter. If, moreover, the magnet is not interposed, still the magnetic force is equally existent through the whole circuit; for instance, the wires joining the plates will attract iron filings, deflect magnetic needles, &c. By the iron-core a small portion of the force is absorbed while it is being made a magnet, but this ceases to be absorbed when the magnet is made; this is proved by the recent observations of Mr. Latimer Clark, which were fully entered into and extended by Dr. Faraday, in a lecture at the Institution (Jan. 20, 1854).† It is like the case of a pulley-and-weight, which latter exhausts force while it is being raised, but when raised the force is free, and may be used for other purposes.

If a battery of one cell, just capable of decomposing water and no more, be employed, this will cease to decompose while making a magnet. There must, in every case, be preponderating chemical affinity in the battery cells, either by the nature of its elements or by the reduplication of series, to effect decomposition in the voltameter; and if the point is just reached at which this is effected, and the power is then reduced by any resistance, decomposition ceases. Were it otherwise, were the decomposition in the voltameter the exponent of the entire force of the generating cells, and these could independently produce magnetic force, this latter force would be got from nothing, and perpetual motion be obtained.

In another case, cited by M. Matteucci, viz., that a piece of zinc dissolved in dilute sulphuric acid gives somewhat less heat than when the zinc has a wire of platinum attached to it, and is dissolved by the same quantity of acid, the argument is deduced, that as there is more electricity in the second than in the first case, there should be less heat; but, as according to our received theories, the heat is a product of the electric current, and in consequence of the impurity of zinc, electricity is generated in the first case molecularly in what is called local action, though not thrown into a general direction, there should be more of both heat and electricity in the second than in the first case, as the heat and electricity due to the voltaic combination of zinc and platinum are added to that excited on the surface of the zinc, and the zinc should be, as in fact it is, more rapidly dissolved. Other instances are given by M. Matteucci, and many additional cases of a similar description might be suggested. But although it is difficult, perhaps impossible, to restrict the action of any one force to the production of one other force, and one only, yet if the whole of one force, say chemical action, be supposed to be employed in producing its full equivalent of another force, say heat, then as this heat is capable in its turn of reproducing chemical action, and in

we could, by adding this to the total heat, get more than the original chemical action, and thus create force or obtain perpetual motion.

The impossibility of perpetual motion thus becomes a valuable test

* *Archives des Sciences Physiques*, vol. iv. p. 380.
† *Proceedings of the Royal Institution*, vol. i. p. 345.

of the approach that in any experiment we may have made to elimi nating the whole power which a given natural force is capable of producing; it also serves, when any new natural phenomenon is discovered, to enable us to ascertain how far this can be brought into relation with those previously known. Thus when Moser discovered that dissimilar metals would impress each other respectively with a faint image of their superficial inequalities,—that, for instance, a copper coin placed on a polished silver plate, even in the dark, would, after a short time, leave on the silver plate an impression of its own device, it occurred to Mr. Grove that as this experiment showed a physical radiation taking place between the metals, it would afford a reason for the effects produced in Volta's contact experiment, without supposing a force without consumption or change in the matter evolving it. This led him to try the effect of closely approximating disks of zinc and copper without bringing them into metallic contact; and it was found that disks thus approximated, and then quickly separated, effected the electroscope just as though they had been brought into contact. Without giving any opinion as to what may be the nature of the radiation in Moser's phenomena, this experiment removes the difficulty presented by that of Volta to the chemical theory of electricity.

The present scope of the argument from the negation of perpetual motion leads the mind to regard the so-called imponderables as modes of motion, and not as different kinds or species of matter. The recent progress of science is continually tending to get rid of the hypotheses of fluids, of occult qualities, or latent entities, which might have been necessary in an earlier stage of scientific inquiry, and from which it is now extremely difficult to emancipate the mind; but if we can, as it is to be hoped we shall ultimately, arrive at a general dynamic theory, by which the known laws of motion of masses can be applied to molecules, or the minute structural parts of matter, it seems scarcely conceivable that the mind of man can further simplify the means of comprehending natural phenomena.

CAN OPPOSITE ELECTRICAL CURRENTS SIMULTANEOUSLY EXIST IN THE SAME CONDUCTING WIRE?

PROF. G. BELLI, in *Il Nuovo Cimento*, vol. ii., states that the galvanometer, by means of which many physicists have endeavoured to solve the above question, is not adapted to furnish its solution. This has been already pointed out by M. Soret, in a particular case, upon the foundation of some considerations exactly analogous to those now advanced in a much more general manner by M. Belli. The latter shows that,

In any system of conducting wires isolated from the ground, or communicating therewith by one or several points, and submitted to the simultaneous action of several batteries acting with any force and in any direction, the galvanometric effects which must be presented by any one of these wires are precisely the same, whether we regard the currents produced by the differences as independent or not, that is to say, either according to one or the other of the two following theories :—

1. That each battery determines its particular system of currents, and that each wire is traversed simultaneously by all the unaltered partial currents, on condition that the currents of each battery taken separately are subjected to the laws of Ohm, and submitted not only to the resistance of the battery which produces it, but also to that of all the other batteries.

2. That in each wire we have a single current furnished by the composition of the forces with which the different batteries set electricity in motion.

M. Belli has taken up a certain number of particular cases, and shown that the facts constantly agree with the two theories (at least if we admit the conditions enunciated above), and that consequently we must seek for some other method of determining which of the two hypotheses is the true one.

CURRENT ELECTRICITY IN PLANTS DURING VEGETATION.

MR. H. F. BAXTER, in reference to the manifestations of electrical action in the organic compared to that which appears in the inorganic world, from a series of experiments,* arrives at the following conclusion, viz. :—That *during* those *actions* which are termed *organic*, such as *secretion, absorption* (*lacteal*), and *nutrition*, there is then manifested the same power as is observed during ordinary *chemical actions*—a manifestation of electrical action. If we wish to have a clear view as to the resemblance between these actions—between the *organic* and the ordinary *chemical* actions—we must refer to the changes which occur in the *decomposing cell* of an ordinary voltaic battery, or to those which occur in a simple voltaic circle. And here we cannot refer to a more beautiful experiment than the one recorded by that eminent philosopher Wollaston for the sake of illustration. The difficulty which might exist in some minds of perceiving the resemblance may naturally arise from the circumstance, that in the ordinary voltaic circle we have metals, and it requires, consequently, some mental effort to perceive clearly the resemblance which can exist between those actions (*secretion*) which occur, for instance, in the mucous membrane, and those which occur in the simple voltaic circuit. Although in the ordinary simple voltaic circle one of the metals is usually acted upon chemically, we should bear in mind that they serve principally as *conductors*, and that they are not *essential* for the development of the power. Again, the resemblance which occurs between those actions which take place when two fluids (an *acid* and an *alkaline*) are separated by a membrane and those which occur during secretion, however similar in their nature, nevertheless, in some respects differ : take for instance the secretion in the kidney or liver ; here we have the fluid (blood) on one side only, whilst the secreted product passes through ; in the former case, with the acid and alkaline solutions, we have *combination* between the two fluids ; in the latter case, during secretion, a *separation*—not a mere *transudation*, however, but a *secreted* product ; nevertheless, during the formation of

* See *Edinburgh New Philosophical Journal*, No. 7 : also, the papers published in the *Philosophical Transactions* for 1848 and 1852 ; and in the *Philosophical Magazine* for September, 1835, and January, 1855.

this secreted product and its separation from the blood, the same effects are produced, the same actions occur upon the needle of the galvanometer as would occur if we cause the *separation* of an *acid* from an *alkali* when in combination with each other—in short, a *decomposition ;* and this is what actually takes place either in the *decomposing* cell of a voltaic battery or in that beautiful experiment of Wollaston in the simple voltaic circle. And as we say that the power in the voltaic circle is brought about by *chemical** means, so may we say that the same power is brought about in the animal body by *organic* means. But it may be asked, what do we understand by *organic* means? In what do they differ from *chemical* means? What is the real difference between *organic* action and *chemical* action? And to these questions we have no hesitation in saying that we believe them to be both *polar* in their character; and as we speak of *chemical polarity* so may we speak of *organic polarity,* and consider that *organic* force and *chemical* force are both polar,† and so far identical.

MEASUREMENT OF THE SPEED OF A RAILWAY TRAIN BY MEANS OF ELECTRO-MAGNETISM. BY W. C. M'REA.

THE wheels of a car rotate a certain number of times in going over a given space of road; for example, supposing a car-wheel to be eight feet in circumference, it will rotate 660 times in going the distance of a mile. Now, if the car were so constructed that the body would always remain at a given distance from the axle, which is prevented by the motion given it by the springs, it would not be difficult to bring the wheel at each revolution so to bear upon a lever, as to rotate a wheel inside the car, which might have as many cogs as the car-wheel rotates times in going a mile. Or, by a series of clock-work wheels, the indicating wheel might contain a fractional

* The dispute in reference to the *origin* of the power in the voltaic circle, whether by *contact* or *chemical change,* will make no difference to our argument. As far as we can make out, the dispute, in most instances, arises more from the meaning of the terms employed and the extent of their meaning, than from any real difference of opinion.

† We have spoken of organic polarity in connexion with chemical polarity, inasmuch as we are able to prove, by *experiment,* the resemblance between these two powers. Other polar phenomena may also occur in the organic world, which might differ as much from chemical polar phenomena as magnetic polar phenomena do from the latter. In other words, the organic *form* of force might differ from the chemical *form* as much as the magnetic *form* does from that of the latter, or from *that* of heat, light, and electricity; nevertheless they are mutually connected and correlated. That the *force* manifested during organic action is *polar* we may consider as established upon *experimental* evidence.

We might refer to several authorities who have suggested the idea, or even pointed out the polar character of some of the organic actions; to Todd and Bowman's *Physiological Anatomy*, vol. i. p. 237, *et seq.*, and especially to Dr. Carpenter's valuable paper on the Mutual Relations of the Vital and Physical Forces, in *Phil. Trans.*, 1850, p. 727, for further arguments in support of the same idea. Dr. Todd, however, appears to us to have been the first to give the most precise and definite idea in reference to *nervous polarity* that we are aware of (*vide* Art. on the Physiology of the Nervous System in the *Cyc. of Anat. and Phys.*); and also to a small work, entitled the *Anatomy of the Brain and Spinal Cord,* by the same author.

number of cogs in proportion to the number of times which the car-wheel would rotate in a given distance.

The difficulty occasioned by the unsteady motion of the car, owing to the springs, may be overcome by the use of a magnet, battery, and galvanic circuit; the latter to be so arranged as to be broken at each revolution of the car-wheel or axle. So by this means the operation of the magnetic contrivance would be to move the speed-indicator the distance of one cog.

A contrivance of this kind may be so constructed as not to require winding, in order to have it in readiness for use.

The indicator may be so constructed as to have an index placed over it, in such a position that the hand on the indicator should move it a sufficient distance to show at each successive rotation the number of miles already travelled.

The kind of battery most suitable for such a contrivance would be that of the "sand-battery," which, if properly constructed, may be made to act with as much certainty as any other, and at far less expense. This battery should be constructed of sand of such quality as is used by the manufacturers of glass, that is, free from dirt of any kind. The battery-cup may be that of the ordinary kind, as used in Groves's battery; or if larger glass or porcelain jars can be obtained, they would doubtless be better, affording an opportunity for the use of larger plates of zinc and copper; these should be placed about an inch apart, and the sand packed tightly around them. The zinc should be amalgamated, and the copper rubbed with a piece of emery-paper before placing in the cup; the sand should then be well moistened with sulphuric acid, diluted in the usual proportion for battery purposes. Intensity may of course be increased by increase of acid. A battery of this kind would stand for some weeks, only requiring the addition of a little acid each day, according as the strength of that first put in became exhausted. A series of cups of this kind could be carried on a train without the difficulties which would arise from that of almost any other battery. —*Journal of the Franklin Institute.*

ELECTRIC CLOCKS.

MR. KAMMERER has exhibited and explained at Manchester his *Horologes Electriques*, with much success. There were three electric clocks, of varied external appearance, placed in different parts of the room, and these were governed by one ordinary pendulum clock. The common clock has an addition made to it (which we understand can be added to any clock) whereby it is brought into contact with the two poles of a galvanic battery. The wires from the battery communicate with a drum, moved by the clockwork; and every fifteen seconds the current is changed, the positive and the negative being transmitted alternately. The going of this clock regulates the motion of the others. A wire is continued from the drum to the electric clock, which is of very simple construction. The apparatus of one of them was fixed to a dial of plate-glass, so that the movement could be easily observed. There are two pairs of small straight electro-magnets, each pair having their ends opposite to the other pair, with about half an inch space between. Within this space there hangs a vertical steel bar, which also may be made of plate-glass, suspended from a spindle at the top. The rod has two slight projections on each side, parallel to the ends of the wire-coiled magnets. When the electric current comes on the wire from the positive end of the battery (through the drum of the regulator-clock), the positive magnets attract the bar to it, the distance being perhaps the sixteenth of an inch. When, at the end of fifteen seconds, the negative pole operates, repulsion takes effect, and the bar moves to the opposite side. This oscillating bar gives motion to a wheel, which turns the minute and hour hands. This is effected rather curiously : it is something like the common crutch or anchor escapement, only that, instead of the wheel moving the escapement, the escapement moves the wheel. The teeth of the wheel are cut obliquely, or sloped on one side, so that as the pallets of the anchor come in contact with the sloping sides of the cogs of the scape wheel they force it round. The wheel moves one cog every 15 seconds (but could be made to move every second or half second if required), the movement being imparted on each side alternately. It was observed that the three clocks beat simultaneously, in fact so precisely, that the triple sound was mistaken by several as proceeding from one clock. It was stated by the inventor, that if the galvanic battery were attached to any particular standard clock, any number of clocks, placed in whatever part of the city (or the kingdom), communicating with this by a wire, would indicate precisely the same time. The precision with which the instruments performed was the subject of general remark. We understand that in a prior invention, electricity was only used to impart the motion in one direction, a spring being depended upon for the opposing motion. Practice showed, that when the electric current was weak, the spring was too strong, and this sometimes led to inaccuracy. M. Kammerer obviates this by employing the current, positive and negative, for both motions. We learn that many hundreds of these clocks are in use upon the railways and in the public offices in Belgium, and that M. Kammerer is under contract to supply a large order in Russia. One of the clocks was fitted in a street lamp, and for this purpose they seem very suitable, as no additional cost would be incurred for illumination, while their exposure in large thoroughfares would be a public convenience. They also appear to be admirably adapted for warehouses, or other large establishments, where one battery could be employed for impelling the instruments placed in the various rooms.—*Manchester Guardian.*

HEAT INDICATORS AND ELECTRIC CONTACT.

MESSRS. A. SYMONS and A. BURGESS, of London, have patented certain instruments for ascertaining and indicating Heat, and also in the parts for making and breaking contact in Electric Circuits, used therewith :

Relating first to the combination of particular metals to be employed as the part or parts sensitive to heat of such instruments, motion being communicated to apparatus connected with a suitable scale or dial, to afford visible indication of the gradations of temperature, and to actuate apparatus whereby an audible signal or alarm will be created, being an instrument applicable for making and breaking the contact of electric circuits used for this purpose. The improvements consist in combining a plate or strip of gold with a plate or strip of zinc, soldered together throughout their length, which compound strip of metal is in a curved or other form, adapted for giving motion to the other parts of the indicator, by reason of the alteration of its form, caused by the difference of expansion of those metals at or in different temperatures. Another combination of metals for this purpose consists of a strip or piece of steel, suitably united with a strip or piece of gold, and adapted to, and in suitable connexion with the hand or index of the instrument. The improvements in the points of contact for establishing or breaking the electric circuit in instruments for indicating heat consist, first, in placing one of the points of contact so as to bear in and rub along or across a grooved surface, when affected by the movement of the compound metal instrument before described, which groove is formed of agate, or some similar non-conducting material, and whereby the contact point will be cleaned before it arrives at the other conducting part, where the circuit will be established. The rubbing of the conducting point, or the conducting surface, will also tend to clear that surface, and render the electric circuit perfect. The contact point receives its rubbing motion from the before-mentioned compound metal strip, with which it is placed in connexion, and may be so arranged that the dial of the instrument may indicate the temperature at which the alarum was discharged. The electric circuit is so arranged in connexion with an alarum apparatus, that when the instrument indicates a given temperature, it will be discharged and give audible notice.

ELECTROGRAPHY; OR, A NEW ART OF ENGRAVING IN RELIEF ON METAL. DISCOVERED BY JOSEPH DEVINCENZI, PARIS.

THE details of this discovery are contained in a memoir presented by the Author to the Paris Academy of Sciences, on which that body made a formal Report at the sitting which took place on the 31st of December, 1855.

The following is the substance of M. Devincenzi's memoir. After a brief dissertation on the origin of printing, the employment of wood-blocks, and the subsequent inventions of copper-plate engraving and lithography, the author observes:—

Having devoted myself, for several years, to a series of researches and experiments in the art of printing, I decided on submitting to the examination of the Academy of the Sciences of the Institute, an electro-chemical process of engraving in relief, to which I have given the name of Electrography. This process is destined, if I do not deceive myself, entirely to supersede xylography (wood-engraving), and even in a great degree lithography and copperplate engraving.

M. Devincenzi then refers to the ordinary processes employed to obtain relief-engraving on metal by means of acids, on the same system as in line-engraving, and by other methods, and proceeds to describe in what Electrography consists—

This art (he says) has for its principal object to convert into an engraving in relief all drawings made with a greasy, a bituminous, or a resinous body upon a metallic plate. Amongst all metals, zinc is the most proper for this kind of engraving, and its low price renders it still more desirable. The kind employed is the laminated zinc of commerce, the surface of which is grained with sifted sand, in the same manner as the stones are grained in lithography. You may draw on these plates, either with a crayon, with lithographic ink, or with any other substance employed in lithography. The plate, once drawn upon, is then prepared in the same way as if it were intended to be used for a lithographic impression; indeed, zinc plates have often been employed instead of stones, and it is to Senefelder himself, the inventor of the lithographic art, that this application is due. The effect of the preparation is:—first, to render the crayon or drawing-ink insoluble in water, and to fix them on the plate; and next, to change the affinity of the metal. Zinc, in its natural state, has a great affinity for greasy substances, and for this very reason can be easily drawn upon. But once prepared, this affinity is altered: after the preparation the zinc has a greater affinity for gum and water than for greasy substances. The slightest humidity on its surface suffices to repel the latter. I give this preparation to the zinc plate by plunging it for a minute into a simple decoction of gall-nut, and afterwards wash the plate with clear water, and then cover it again with a solution of gum-arabic. The decoction of gall-nut is made with the gall broken into good-sized lumps, in the proportion of 125 *grammes* (something less than ¼ lb.) in a *litre* (about 1¾ pint), reduced by boiling to half the quantity. The zinc plates, that are used in lithographic fashion, are generally prepared with the same decoction of gall-nut; but in imitating the preparation of the stones, nitric acid is added, and often hydrochloric acid. These acids I entirely do away with. It is known how delicate the operation is of preparing stones for lithography, on account of these acids, for the preparation very often injures the half-tints by the action which the acids exercise both on the ink and the stone. On the other hand, the simple decoction of gall-nut, while it makes an excellent preparation, exercises no ulterior action upon the drawing or the plate.

This experiment may be safely repeated. The drawing being made with lithographic chalk or ink upon a zinc plate, the latter may be left for hours or even days in the gall-nut decoction without any alteration being produced either in the lines or the surface of the plate. In lithography, on the contrary, by prolonging the acidulation, both the drawing and the surface of the stone are destroyed. The unalterability of the drawing by the preparation is a very remarkable feature in this species of engraving, for after its application the drawing remains exactly the same as when it came from the artist's hand. The plate thus prepared with the gall-nut decoction and afterwards gummed, is then immediately cleared of the gum with water, and I wash the drawing with essence of turpentine. In this state, scarcely anything is visible on the plate; but every part of the drawing has a strong affinity for greasy substances, and all the other parts of the plate repel them. If one wished to print lithographically, it would be sufficient to damp the plate and pass a roller over it charged with printing-ink, in order to obtain proofs. By my process of engraving, instead of printing-ink, I apply in the same manner, by means of a roller, a varnish which, on account of the different affinities of the plate, perfectly replaces the chalk or draughtman's ink, and is as easily applied as printing-ink upon a lithographic drawing, and it takes up no more time to lay on the varnish than to pull a lithographic proof. This varnish is composed of asphaltum of linseed-oil boiled with *litharge*, and of essence of turpentine. When the varnish is dry, the plate of zinc is placed in metallic connexion with a copper plate of equal size. Over the plate which has the drawing a very weak solution of sulphuric acid is passed with a brush in order to cleanse it, and the two plates are then plunged horizontally and facing each other, at a distance of five *millimètres* (somewhere about ¼ inch), into a solution of sulphate of copper of fifteen degrees. The sulphuric acid from the decomposition of the sulphate of copper dissolves all the parts of the zinc plate which are not covered by the varnish, and this substance not being decomposed by contact with the sulphate of copper, does not experience the least alteration. On account of the great affinity which the sulphuric acid has for the zinc, in comparison with the slight affinity which it has for the copper, the employment of this salt and the approximation of the plates give rise to a very energetic electro-chemical action, and at the end of a few minutes the plate is engraved. During the operation the zinc plate is frequently withdrawn and washed with pure water, in order to get rid of the parts of the sulphate of zinc and of metallic copper which adhere to its surface. To prove the unalterability of my varnish, you may make a drawing on a porcelain plate and fill it with the solution of the sulphate of copper: the drawing will undergo no change. The voltaic pile has for some time been employed to engrave on copper, but no one before I made the experiment has attempted relief-engraving by electro-chemical means. Nevertheless, it has often been observed that by the aid of electricity very deep lines could be cut in copper-plates without widening the strokes,—for while the chemical action alone bites on all sides, an energetic electro-chemical action only takes effect on the depth. This superiority of galvanic electricity over the simple action of acids renders possible that kind of engraving in relief which requires great depth.

After recognising the assistance rendered to this new invention by the processes of lithography and the science of electro-metallurgy, M. Devincenzi goes on to illustrate its importance. This is chiefly shown by the facilities which it offers for producing, like ordinary types, an almost unlimited number of impressions. M. Devincenzi observes that lithographic presses and copper-plates throw off variously two, three, four, or five hundred copies in a day: with his electrographic plates he has hitherto not attempted to produce more than three thousand within the same space, but considering the properties of zinc, and analogous facts, he is of opinion that any number of copies could be printed. Zinc, he says, is as hard as copper, and with copper stereotypes millions of impressions may be struck off, nor is there any reason for supposing that zinc stereotypes would prove less serviceable. In its relation to wood-engraving, M. Devincenzi demonstrates a manifest advantage on the side of electrography, as regards the more direct application of the latter. In the art of xylography recourse is had both to the engraver and the draughtsman. In electrography the work of the draughtsman is not more difficult, while that of the engraver disappears, and the extraordinary degree of perfection which can be obtained, together with the surprising celerity with which it can meet the various exigencies of the moment, cannot fail to add to its importance. Finally, electrography offers precisely the same facilities in its execution as lithography, and exceeds it illimitably in its power of production; and comparing it with line engraving, electrography has all the advantages of a far more facile execution, of a greater variety of style, resulting from the use of crayons, of a typographical use of the press, and of a faithful reproduction of the artist's labour.

We append to this notice of M. Devincenzi's invention an extract from the Report made by the Committee appointed by the Academy of Sciences to inquire into its merits and test its practical applicability. The members of the committee, MM. Chevreul, Séguier, and Becquerel, the last its reporter, say:—

Your Committee, desirous itself of verifying all the operations which have been described, requested our excellent artist, M. Chatillon, to be kind enough to draw upon a grained zinc plate some well-finished subject, in order to satisfy us that the most delicate touches, as well as the half-tints, were reproduced by this mode of engraving. He acceded to our wish, and drew the portrait of Perugino, after Raffaelle, making in it touches so extremely fine as to serve as marks of recognition (*lignes de repère*). We submitted the plate of M. Devincenzi, in our own presence, to all the preparations described, and the printing from it was afterwards made by M. Plon, whom we had named to him. All the proofs obtained were a perfect reproduction of the drawing, and acknowledged to be such as well by M. Chatillon as by ourselves; the marks of recognition, scarcely visible in the drawing, were also there. . . . . The process of engraving in relief, of which we now report, fulfils then the object proposed by M. Devincenzi,—that of superseding engraving on wood by engraving on zinc. In the former, a draughtsman and an engraver are necessary; in the latter a draughtsman only. In comparing this process with that of lithography, either on stone or zinc, we find this great advantage—that the printing by the electrography is very considerable as to numbers, and costs very little, while the other mode is very limited and dear.

The Report of the Committee was adopted.—*Athenæum*, No. 1480.

ELECTRO-TELEGRAPHIC APPARATUS.

DR. WILDMAN WHITEHOUSE has patented certain improvements in Electro-Telegraphic Apparatus relating:—1. To the apparatus employed in obtaining electric currents by induction, and which may be termed induction coils, and consists in placing the secondary coil nearest the iron, and the primary coil which is connected with the battery outside the other or secondary coil. 2. To improvements in the instruments or relays used for receiving alternating currents, either from a distinct station or on home circuit, so as to call into play a local battery of any required form or strength. 3. To combining a dead beat magnetic needle instrument, with a relay fitted to receive alternating currents. 4. To the adaptation of an ordinary step-by-step action dial instrument of a peculiar releasing or retrograde movement.

Dr. Whitehouse has read to the British Association, a paper "on an Instrument for determining the Value of Intermittent, or Alternating Electric Currents, for Telegraphic Purposes." The author showed the Section that the effect of a weak electric current, say after it had traversed 100 miles of wire on an ordinary magnetic needle, was altogether inappreciable; and even the effect of strong currents at short intermitted periods caused the needles so to vibrate as to render the observing of the arcs quite impossible; but by transmitting a very feeble current in such a way as to excite a powerful coil and produce an electro-magnet by soft pieces of iron in the axes of the coils, he showed that, by a strongly-framed and accurately constructed steel-yard, he was able actually to weigh the feeblest currents, and to compare them with even the most powerful current transmitted through short distances. The exhibition of the apparatus, which worked admirably, and, as it were, weighed the force of each current as transmitted during the ordinary rapid working of the telegraph, seemed to afford much satisfaction to the Section.

Mr. J. Jones, of St. Asaph, Flint, has obtained provisional protection for improvements in telegraphs, by which a facsimile of the message is recorded simultaneously on the transmitting and receiving instruments, so that the sender may know immediately, and without the trouble of repeating, whether his message has reached its destination correctly.

Mr. Thomas Allan, of London, C.E., has prepared a telegraphic wire of iron insulated with a new flexible material, sufficiently strong, it is said, to afford full protection, the whole weighing in some cases as little as one-tenth of the common wire, though having a conducting power three or even five-fold greater, while the relative proportion of strength in the wire is increased to a considerable degree.

Mr. William Brown, of Australia, has made an offer to the Government to erect an electric telegraph from Mount Louis to Hobart Town, thence to Launceston and George Town, and to complete the whole within nine months from signing the contract, for 16,000*l*.

Mr. L. D. B. Gordon has patented an improvement in electric telegraphs when insulated wires are laid under water or in the earth. This invention consists chiefly in using two insulated wires, placed close to each other, and imbedded in insulated material, as one electric circuit in which the battery and receiving instrument are inserted without using the earth as part of the circuit. The two conducting wires will be charged equally at any given point—the one with positive and the other with negative electricity; and since both are in equal proximity to the surrounding water or earth, no electric charge can take place between the wires and the earth; nor will any induced current be produced in additional conducting wires that are imbedded in the same conducting mass, provided they are placed equidistant from two wires forming the electric circuit. The same cable may, therefore, contain one or more sets of insulated wires close to each other, which may be used simultaneously as circuits without the interference of one with the other.

Professor Giovanni Caselli, of Florence, says *Galignani's Messenger*, has invented an apparatus by which the telegraph wire will transmit to any distance an exact facsimile of any writing or design, when made to communicate with a similar apparatus at the other station. The transmission of telegraphic despatches by single letters will thus, it is added, be entirely superseded; and the original writing put into the apparatus will be reproduced in an instant, with the signature of the correspondent as if written by himself. It is hopeful, ever and anon, to have such inventions turning up again; but it is a mistake to consider this invention as a new (though it may be an improved) one.

The Hughes Printing Telegraph Instrument, says the *New York Commercial Register*, is now finished, and will be placed upon the line between this city and Philadelphia. This invention, it adds, may be called a printing-press and telegraph instrument combined, for it prints all messages in plain Roman capitals, with unerring correctness, and at an almost incredible rate of speed, averaging in the ordinary despatch of business from 20,000 to 25,000 letters per hour. It also demonstrates the practicability of sending and receiving messages in opposite directions over the same wire at the same time.

Mr. S. Statham has patented certain improvements in electric telegraph cables. The patentee takes a core of gutta-percha, or other insulating material, containing therein one or more metallic wires, strips, or plates, and places over such core strands of hemp, or cord, employing various modifications. And he encases the core covered by one or other, or all of the materials just named, in an outer casing or tube of gutta-percha, or any of its known compounds, or either of these combined with metallic or other substances. By these or similar means the patentee is enabled to produce a light, flexible, and strong cable, especially suited for submarine purposes, in which the weight may be regulated by the employment of metal wires, strands, or plates, or fibrous materials between the insulated wire or wires and the outer coating, as well as by the employment of gutta percha or any of its known compounds, or by combining with either of these, more or less, some suitable substances heavier than gutta-percha itself, with the gutta-percha or gutta-percha compounds employed for the outer casing.

In course of some experiments with a telegraph invented by a Mr. Duncker, two distinct messages are said to have been sent by the same wire, and read off in an incredibly short space of time. Mr. Duncker has successfully tried his invention on a Prussian government line, and on a subterraneous line of 160 miles in England. The invention is said to be applicable to existing arrangements. It is calculated that the adoption of it would enable the telegraph companies to transmit messages at one-fourth of the usual rates, and with more chance of despatch. As remarked by the *Gateshead Observer*, it would be more correct, perhaps, to say, that while the wire transmits one message, the earth transmits the other; but, practically, one wire is made to do the work of two.

Mr. D. L. Price has patented certain improvements, in the first place having reference to the connexions between the carriages in the electric circuit between distant points of a railway train. For this purpose the patentee employs a coiled spring, similar to a clock-spring, but which has a tendency to recoil and draw itself within a small circular case fixed to the carriage. Another part of the improvements consists in forming the immediate points of junctions of the connexions between rail carriages, so as to have a double locking or hold the one part with the other when united. The improvements in the telegraph instruments and conducting parts connected therewith are such that the patentee is enabled to work a bell and needle telegraph by means of one wire, that is to say, one out and one return current, for which purpose he arranges two precisely similar batteries at distant points, both to act as local, and which may both be put into action from either end of a railway train or station. To produce audible signals he employs the centrifugal bell-hammer, actuated by a train of wheels, but detached and set in motion by the electric current.

THE NEW TELEGRAPH WIRES TO INDIA.

MR. THOMAS ALLAN, C.E., has overcome certain formidable difficulties in the way of extensive telegraphic enterprises. Thus, it is obvious that where a frail line of communication has to be carried over the abrupt inequalities of the surface of our globe, creeping over the summits of mountains, and lying along the deep shelves in the bed of the ocean, too much care cannot be devoted to its composition and texture. The wire prepared by Mr. Allan possesses advantages superior to those of any other conductor at present in use, and in the main requisities of conductibility, strength, lightness, and cheapness, its superiority is incontestible. The submarine wires commonly employed are of copper, insulated with gutta-percha, and encased in iron. Mr. Allan's wire is one of iron, insulated with a new flexible material, sufficiently strong to afford a full protection from all the contingencies to which such a conductor is ordinarily liable. The differences between the two are at first sight rather startling. Weighing in some cases as little as one-tenth of the common wire, we obtain a conducting power three or even five-fold greater, while the relative proportion of the strength of the wire to its weight, is increased to a considerable degree. Add to these facts the diminished cost of construction, and the greater ease with which it can be laid down.—*Caledonian Mercury*.

THE ATLANTIC TELEGRAPH.

THE great project of the union of the Old and New Worlds has been commenced within the past year by the Atlantic Telegraph Company.

The discovery by Maury of the "telegraph plateau," a soft and almost uniformly level bed of 1300 miles extent in the direct line between Ireland and Newfoundland, and the adoption of a wire rope covering for the cable, at once light and flexible, and of such strength "that it will bear in water over six miles of its own length," "suspended vertically," have reduced the labour, anxiety, and danger of this part of the work so greatly as to lead to the expression amongst practical men of the opinion "that this cable will be found to be attended with less risk in the process of submersion than any one that has yet been laid down."

The Telegraph Company having placed ten subterranean gutta-percha insulated conductors of over 2000 miles each at the service of the experimenters during the hours of the night of 2nd of October, Professor Morse, from America, who appears to have come over for the purpose, and Dr. Whitehouse and Mr. Bright, experimented with the lines in connexion, and, according to Mr. Morse's Report, with perfect success, so as to establish the complete practicability of telegraphing between Europe and America, *viâ* the Atlantic Ocean, and thus disproving or dispelling Professor Faraday's fears of the impracticability of such a mode of communication. Signals were telegraphed from one end of the 2000 miles to the other, at the maximum rate of 270 per minute upon the telegraphic register, a speed commercially advantageous.*

The great undertaking was begun by throwing eighty-five miles of telegraphic cable across the Gulf of St. Lawrence to the Island of Newfoundland, which lies in the way of the projected line. At first it was contemplated that the line should go by Labrador, Greenland, Iceland, and the Ferroe Isles, and so to Europe by successive stages; but to such a round-about journey there were insurmountable objec-

* On Oct. 9, a public dinner was given to Prof. Morse, in acknowledgment of his services in the development of the electric telegraph, and likewise with a view of expressing an opinion of the importance of a submarine communication with America. The chair was taken by Mr. W. Fothergill Cooke, one of the Directors of the Electric Telegraph Company. In proposing the health of Professor Morse, the chairman stated his opinion that the system introduced by the Professor was the best, it being the most simple, permanent, and certain.

tions. Ice has especially to be guarded against, and ground where anchors may catch in the line must be avoided; consequently, very deep water is a desideratum, and this presents itself at once at Newfoundland. 1900 miles of ocean must then be crossed, and facilities for the undertaking exist, it is said, such as no equal extent of the globe can parallel. The cable, to allow for the inequalities of the ground and other exigencies, will be 3000 miles long. The wires will be isolated in gutta-percha coatings ; and all the improvements which modern science can afford will be applied to give durability, strength, and efficacy to the cable. Two ships will proceed to the mid-ocean, each carrying one-half of the line. Uniting the ends of the cable, the ships will then separate and continue to pay it out until they reach their respective destinations. It is to sailing vessels towed only by steamers, it seems, that the loss of so many submarine telegraphic cables is attributable. The *Cork Reporter* states that "Dr. Whitehouse, one of the highest authorities on this branch of science, has demonstrated by more than 4000 experiments that so far from the great length of line requiring a proportionally great circumference or diameter of wire, the very contrary is the case,"—a conclusion entirely at variance with that of Dr. Faraday. Dr. Whitehouse is also said to have invented an apparatus by means of which, should the line be damaged, the exact point of interruption can be accurately ascertained.

Dr. Whitehouse thus describes the cable:—

Every one, I believe, on first thinking of the subject, has expected to see something indicative of enormous strength and of great size, and can hardly realize the idea of our attempting so great a work with such apparently slender means. And yet this cable is the result of many months of thought, experiment, and trial, and hundreds of specimens have been made—comprising every variety of form, and size, and structure—and most severely tested as to their powers and capabilities, and it has resulted in the adoption of this, which we know to possess all the properties required, and these in a far higher degree than any cable that has yet been laid. Its flexibility is such as to make it as manageable as a small line. You may tie it in a knot about your arm without injury. Its weight is but 18 cwt. to the mile, and its strength such that it will bear in water over six miles of its own length if suspended vertically. Its specific gravity is such that there can be no question about its sinking to the bottom, for it is heavier than those shells which have been brought up by sounding. The strands of slender iron wire by which it is surrounded will, it is true, suffer corrosion or decomposition in a short time; but in doing so, the material of which they consist will enter into chemical union with the soft mud in which the cable is imbedded, and will thus form a concrete mass of calcareous or siliceous substance, affording the very best possible protection for the cable. We must all have seen instances of this sort of incrustation having taken place around iron which has been long submerged. The gutta-percha and copper wire forming the electric part of this cable are, as far as we know, indestructible under water. The Dover cable is as good this day as it was the first day it was laid. The insulation of this cable is more perfect than that of any previously made.

In the *Spectator*, the difficulties still to be surmounted are thus explained:—

The cable, which is to join together the continents of Europe and America, is already stretched a long way across the dividing space. One end of it is attached to the station at New York; it passes thence over land and under water to Cape Race, and for four hundred miles traverses the coast of Newfoundland; so that fourteen hundred miles of the difficulty have been surmounted. Professor Morse is the inventor of the simplest of all possible means of transmitting messages by electricity. Without any instrument whatever, a person holding the two ends of the telegraph-wire in his hands might transmit a message which would record itself on paper at the distant station. In practice, indeed, this extremely simple mode is not adopted, and an apparatus moved by clockwork is required at the receiving-station to move along the strip of paper whereon the message is impressed, and there is an electro-magnet to make the impressions. This plan has now generally superseded on the Continent all other systems of telegraphic communication. As regards the wire-connexion between the two countries, there seems no doubt that it can be made; but that mechanical difficulty overcome, there will remain the question whether telegraphic signals can be transmitted through a submerged wire of that length, however carefully it may be insulated. On this point electricians and mathematicians are at variance. It is not a simple question whether an electric current can be transmitted, but whether the wire can be discharged, after transmission, quickly enough for the repetition of telegraphic signals. This difficulty first presented itself in the telegraph from Harwich to the Hague. It was found that the water surrounding the wires prevented them from transmitting distinctive signals, the action of each one being prolonged so as to interfere and blend with the signal preceding. The difficulty was quite unexpected. Faraday brought his wonderful power of investigation to bear on the subject, and ascertained that the conducting property of sea-water on the outside of the gutta-percha has the effect of converting the coated wire into an elongated Leyden jar, and causes it to retain a portion of the charge, in the same manner as an ordinary Leyden jar retains a part of the electricity after it has been discharged. This difficulty, which seemed to present an effectual bar to the use of Professor Morse's instruments—in which the electric current traverses continuously in the same direction—was overcome by reversing the direction of the current after each signal, by which process the wire was prepared to transmit another. That plan has answered from London to the Hague, but doubt is entertained whether the remedy will apply across the Atlantic. Experiments, so far as they can be made, show that the obstacle may be overcome; theoretical philosophers, armed with arrays of figures, contend that the thing is impossible; but, as facts are against them, there seems no reason to despair that practice will get the better of theory in the establishment of a working telegraph to America. The people of the United States will then realize what Professor Morse declares to be their ambition—they will know what is done in England *before it takes place!* for an event happening in London at noon, will be published in New York on the morning of the same day—of the month.

See also, at page 121, Dr. Whitehouse's inquiry, read to the British Association,—whether the Law of Squares is applicable to the Transmission of Signals in Submarine Currents.

By means of the ingenious apparatus devised by Dr. Whitehouse, at every sounding of the Atlantic, specimens of the bottom were brought up, which, when examined with the microscope, presented various kinds of Foraminiferæ, with a few good specimens of Diatomaceæ among them. Are these Infusoria brought down by the Gulf Stream and after death merely deposited where we find them? or do they really live at these enormous depths? One or two shells have been seen which we believe to contain undecomposed animal tissue.—See the specimens of these Infusoria engraved in the *Illustrated London News* for Dec. 6, 1856; with a profile of the bottom of the Atlantic, and a piece and section of the cable.

A prospectus estimates that the net receipts will annually amount to 40 per cent. of the capital subscribed. Mr. Morse calculates that 14,400 words may be daily transmitted, or about 480 messages, and that arrangements may be made for doubling the number. The London messages sent between 10 A.M. and 3 P.M. will reach New

York of course at earlier periods of what may be called the same business day on which they are sent, so that a message despatched at 10 A.M. on a Saturday, for instance, may reach an office in New York *before* 10 A.M. on that day, or, figuratively speaking, may be sent in "no time," and some little perhaps to spare over and above. The Americans will not be able to return the compliment in precisely the same way, but will also have it in their power to accommodate their London correspondents otherwise. All doubt and difficulty as to the practicability of laying and working the telegraph have disappeared, it seems, so that men of skill and experience, such as Mr. Morse, in telegraphing, and Lieut. Maury in nautical surveys and sea affairs in general, are quite confident of success. Lieut. Maury has invented a method whereby the cable will be secured, even though a storm may oblige the ship from which it is payed out to cut and run. Lastly, the British Government have offered to aid in the work, and to assure the company in 4 per cent. on their capital for Government messages.

THE ELECTRIC TELEGRAPH IN JAVA.

THE Electro-magnetic Telegraph has been introduced into Java, and a line of wires completed between Batavia and Buitenzorg, the first intelligence by it having been transmitted to the Governor-General on the 22nd October, in the space of four minutes. The line is to be immediately extended to Samarang and Sourabaya, and afterwards in other points in different directions, such as Anjer, Cheribon, Pekalongan, Rembang, and Banuwangie. The natives are very much astonished and rather frightened at the invention, which they call *bichara angin* (wind-speech).—*Smith and Elder's Homeward Mail.*

LIEUTENANT MAURY, in Report on the Telegraph, says:—We have learned in the course of these investigations, that all the obstacles interposed by the sea to the laying of submarine telegraphs lie between the surface and the depth of a few hundred fathoms below, and that these are not to be mastered by force nor overcome by the tensible strength of wire-drawn ropes, but that, with a little artifice, they will yield to a mere thread. It is the case of the man-of-war and the little nautilus in the hurricane; the one, weak in its strength, is dashed to pieces; the other, strong in its weakness, resists the utmost violence of the storm, and rides on safely through it as though there were no ragings in the sea. Therefore, it may now be considered as a settled principle in submarine telegraphs, that the true character of a cable for the deep sea is not that of an iron rope as large as a man's arm, but a single copper wire or a fascicle of wires, coated with gutta percha, pliant and supple, and not larger than a lady's finger.

Chemical Science.

CHEMICAL DISCOVERY AND THE ARTS OF LIFE.

DR. DAUBENY, President of the British Association for the Advancement of Science, in his opening address to the Meeting held in August, 1856, at Cheltenham, chose for his subject, "The Progress of Physical Science within the last Twenty Years." After some introductory observations, the learned president commenced his review with the Science of Chemistry, the subject with which, he said, he was most familiar. He first reminded his auditory that at a period not much more remote than the date at which that Association sat in the city of Bristol, twenty years ago, all that could be quoted as really worthy the name of chemical science was comprehended within the limits of the mineral kingdom. Passing to the practical results bearing on the arts of life which have either been actually deduced, or might be anticipated to accrue from chemical discovery, the President remarked :—"Of these, perhaps the most important is the possibility of forming by art those compounds which had been formerly supposed to be only producible by natural processes, under the influence of the vital principle. The last two years have added materially to the catalogue of such bodies artificially produced, as in the formation of several species of alcohol from coal-gas by Berthelot, that of oil of mustard by the same chemist, and the generation of taurine, a principle elaborated in the liver, by Strecker. And if the above discoveries should strike you at first sight rather as curious than practically useful, I would remark that they afford reasonable ground for hope that the production of some of those principles of high medicinal or economical value which nature has sparingly provided, or at least limited to certain districts or climates, may lie within the compass of the chemist's skill. If quinine, for instance, to which the Peruvian bark owes its efficacy, be, as would appear from recent researches, a modified condition of ammonia, why may not a Holman be able to produce it for us from its elements, as he has already done so many other alkaloids of similar constitution? And thus, while the progress of civilization and the development of the chemical arts are accelerating the consumption of those articles which kind nature has either been storing up for the uses of man during a vast succession of antecedent ages, or else is at present elaborating for us in that limited area within which alone the conditions would seem to be such as to admit of their production, we are encouraged to hope that science may make good the loss she has contributed to create, by herself inventing artificial modes of obtaining these necessary materials."

Referring to the discussions which have taken place for some time past between Baron Liebig and certain experimental agriculturists in England, with regard to the principles that ought to regulate the manuring of land, Dr. Daubeny proceeded :—"In so far as concerns the relative advantages of mineral and ammoniacal manures, I presume there is but little room for controversy; for although most soils may contain a sufficiency of the inorganic constituents required by the crop, it by no means follows that the latter are always in an available condition; and hence it may well happen that, in most cases in which land has been long under cultivation, the former class of manures becomes, as Baron Liebig asserts, a matter of paramount necessity. Now, that the same necessity exists for the addition of ammoniacal manures can hardly be contended, when we reflect that, at the first commencement of vegetable life, every existing species of plant must have obtained its nourishment solely from the gaseous constituents of the atmosphere, and from the mineral contents of the rock in which it vegetated. The only divergence of opinion, therefore, that can arise, relates to the degrees of their respective utility in the existing state of our agriculture, and to the soundness of Baron Liebig's position, that a plant rooted in a soil well charged with all the requisite mineral ingredients, and in all other respects in a condition calculated to allow of healthy vegetation, may, sooner or later, be able to draw from the atmosphere whatever else is required for its full development. And does not, I would ask, this latter position derive some support from the luxuriant vegetation of the tropics, where art certainly contributes nothing towards the result? And is it not also favoured by such experiments as those carried on at Lois Weedon, in Northamptonshire, where the most luxuriant wheat crops have been obtained for a number of consecutive years without manure of any kind, simply by following out the Tullian system of stirring up and pulverizing the soil? How, too, are we to explain that capacity of subsisting without any artificial supply of ammonia, which Mr. Lawes is led by his experiments to attribute to turnips and other plants of similar organization, unless we assume that the power residing in the leaves of absorbing ammonia from the air may render plants, in some cases at least, independent of any extraneous aid? . . . Still the practical question remains whether, admitting the theoretical truth of Baron Liebig's position, a larger expenditure of capital will not be required for bringing a given farm into a condition to dispense with ammoniacal manures than for procuring those materials which contain that ingredient ready for use.

Having awarded a meed of praise to the researches carried on in our own country, and especially those conducted under the auspices of the Highland Society by Dr. Anderson—at our own Agricultural College by Professor Voelcker, and through the aid of the Royal Agricultural Society by their consulting Chemist, Mr. Way, the President next approached the departments of botany and vegetable physiology, and described some of the services rendered to botanical science by the late Professor Forbes, Dr. J. Hooker, and Dr. Thomson.

CHEMISTRY AND THE WAR DEPARTMENT.

Professor Abel, of the Royal Arsenal, Woolwich, has read to the Chemical Society a lecture upon the Applications of Chemistry to the War Department. Allusion was made to a recent improvement necessitated by the pressure of the war—namely, a chemical examination of all stores admitted into the Arsenal, whereby a substitution of pure goods for the adulterated articles formerly supplied had resulted. It appears that oxide of zinc from Liege forms the best white pigment employed. Pattinson's oxychloride of lead is preferable to ordinary white lead. Sulphate of baryta is largely used for adulterating white and coloured paints. There is great difficulty in transporting gunpowder in a dry condition; some of the powder in the Crimea having become damp in its transit, had to be removed from the barrels with pickaxes. The powder is now packed in uncleansed canvas bags contained in barrels. The bags subsequently serve many useful purposes. Wooden barrack buildings are rendered fire-proof, or nearly so, by successive applications of soluble glass and lime wash. Minie rifle bullets are made by moulding, from perfectly pure, and consequently very soft lead, obtained by Pattinson's process. A million and a half of these bullets have been produced per week by two of Mr. Anderson's machines. The shrapnell shell bullets are cast from an alloy of lead and antimony. The crude alloy is obtained from Hamburg, and is cheaper than either lead or antimony. The English mix chlorate of potash, the French nitrate of potash, with the fulminating mercury used for filling percussion caps. The English caps are less liable to corrosion than are the French. The substitution, in the percussion cap department, of methylated spirit for pure spirit, has prevented that imbibition of alcohol by the work-people which it was formerly impossible to prevent. English gunpowder is as a rule denser and more uniform in its composition and effects than foreign gunpowder, and keeps much better. From the more porous condition of the foreign powder, the whole of the charge is invariably consumed; whereas, with the English powder, portions of the unconsumed charge frequently escape from the aperture of the gun, and are occasionally blown back upon the gunners by the force of the wind. The French method of purifying nitre by washing has been substituted for the English process of crystallization and fusion, with great advantage. In the casting of bronze guns, the great difficulty is to prevent the separation of the different metals forming the alloy, whereby the guns are not uniform in composition, are in parts crystalline, and even present cavities in their structure. Some of the guns are now cast with a core, to facilitate rapid cooling, and thereby prevent the decomposition of the alloy. Professor Abel explained several varieties of the simple detonating tubes now used for firing ordnance, and alluded to various ingenious contrivances introduced by Captain Boxer.—*Literary Gazette.*

ALUMINIUM.

The Rev. J. Barlow has read to the Royal Institution a paper "on Aluminium." The presence of M. St. Clair Deville excited great interest, that gentleman having come from Paris for the express purpose of bringing specimens of aluminium, as well as materials and apparatus for the experiments of the evening. Furnished with funds by the liberality of the Emperor of the French, M. Deville has succeeded in producing in available quantities the metal which had remained a mere scientific curiosity since Wöhler established the fact of its existence in 1827. It was the object of this discourse, first, to render intelligible the difficulties of obtaining this metal, by comparing the process of its reduction with that of other metals; and secondly, to demonstrate its properties, and to suggest a few of the purposes to which it may be applied.—1. Gold, the type of the ancient metals, is found adhering to silica: the ore of aluminium consists of the oxide of that metal, chemically combined with silex. Gold is separated from its ore by the rudest mechanical process. The separation of aluminium is the result of consummate science. Again, the common ores of tin, lead, iron, &c., are brought by artificial means (if they do not thus occur in nature) to the condition of chemical combinations of these metals with oxygen. When heated in the furnace, these oxides part with their oxygen to maintain the combustion of the fuel, and it is thus that the metal is separated. But alumina, the oxide of aluminium, will not surrender its oxygen to any known fuel, at any known temperature. Again, being infusible, alumina cannot be decomposed by electrolysis, like potass or soda; and, lastly, alumina will not at any known temperature yield its oxygen to those powerful de-oxidizers, the vapours of potassium and sodium, therein differing from lime, baryta, strontia, &c. The first access to aluminium was opened by Oersted, who, by an ingenious concentration of chemical force, converted the oxide into a fusible and volatile, and therefore less refractory, substance, the chloride of aluminium. Wöhler availed himself of the properties of this chloride to effect a decomposition of its vapour by the vapour of potassium. By this process aluminium was obtained in minute quantities. M. Deville has not only simplified this process, but has made such improvements in the manufacture of sodium (the metal which he employs as the reducing agent) as to have enormously diminished its cost.

An unexpected source of aluminium has been since opened. Dr. Percy, upwards of a year ago, found a substitute for chloride of aluminium in cryolite (which is a fluoride of aluminium and of sodium). Specimens of this mineral and a geological diagram of Arksut Fiord, in Greenland (the only place where it has yet been found), were exhibited by Mr. J. W. Tayler, mineralogist to the Greenland Mining Association.

2. The physical properties of aluminium. It is ductile, malleable, an excellent conductor of heat and of electricity; its specific heat is great, its specific gravity very low (2·25); it is also very sonorous. But the chemical properties of this metal are yet more remarkable. Considering the great difficulty of detaching aluminium from the oxygen with which it is found combined, it might have been expected that, immediately on its coming into contact with the oxygen

of the air, it would attract that element with the utmost avidity. So far from this being the case, aluminium is scarcely acted on by any of the strong acids (except hydrochloric acid) in the cold,—neither is it attacked by sulphur. Dr. Percy has obtained interesting alloys of this metal;—of these several were exhibited, namely, with copper, tin, and gold,—one with copper at 5 per cent. of aluminium deserves notice: it laminates well and "dips" of a fine golden colour,—the dipping liquid was nitric acid. As to the uses of aluminium, this metal is at present too costly to be employed for many purposes for which it is singularly adapted. It is, however, adopted as the material of weights for the determination of small quantities. The lightness of this metal, and its freedom from all liability to rust or tarnish, recommends it to the surgeon and the dentist: pianoforte strings are said to have been made of it;—while its property of conducting heat, its high specific heat, and the resistance it offers to corroding agents, indicate it as perhaps the best-known metal for culinary vessels. But as soon as it is sufficiently cheap it will, doubtless, be employed in covering iron surfaces (such as rails, pipes, &c.) which are exposed to the atmosphere. It has been found from experiment that a clean iron surface will receive an adhering plating of aluminium.

This light and elegant metal begins, it appears, to come into more general use, at least in France. The eagles which surmount the colours of the army, hitherto made of copper gilt by galvanism, are now made of aluminium, thus lightening the weight of the flag by nearly 2¾lbs. Aluminium is more sonorous than bronze, and is consequently brought into use for musical instruments. Spoons and forks, drinking-cups, &c., have also been formed of it. The weight of the new metal is about one-fourth that of silver. Fine silver being worth 225f. the kilogramme, and aluminium 300f., a piece of the latter equal in size to a kilogramme of silver will only be worth 75f. instead of 225f. Thus an article which in silver would cost 50f. would be only 16f. in aluminium.

ALLOYS OF ALUMINIUM.

SEVERAL British and French chemists are engaged in experimenting on the alloys which this new metal is capable of forming. Dr. Percy observes that its lightness (sp. gr. 2·25), and its freedom from all liability to rust or tarnish, recommend it to the surgeon and the dentist, and as an excellent material for culinary utensils. It is not acted on by sulphur nor by any of the strong acids except the hydrochloric in the cold state. When means are found of procuring it at a cheaper rate, it will form an admirable plating for iron works exposed to the atmosphere. It unites with most of the metals, and an alloy of ten parts of aluminium with ninety of iron, according to M. Debray, has a hardness superior to bronze, and when heated, works with greater ease than soft iron.

UM FROM CRYOLITE.

out their brig Sonderjylland, Captain Brocksdorf, to Arksuk Fiord, in latitude 61 deg. 20 min. on the west coast of Greenland, for the purpose of bringing back minerals, and especially cryolite, for the obtaining of which peculiar privileges had at different times been granted by the King of Denmark to individual and associated miners; and that Messrs. Hald and Co. have received intelligence from Messrs. C. F. Fistgen and Co., to whom the brig was consigned at Copenhagen, of her safe arrival in that city on the 21st of September, after a voyage of only twelve days (the shortest on record), with a full load of cryolite. This is the first cargo of cryolite received from Greenland, which is the only country where, as yet, it has been found. It is a mineral composed, we believe, of sodium, aluminium, and fluorine; but the results of analyses are given in Moh's *System of Mineralogy*. M. de Lille, of Paris, has discovered a process by which aluminium may be obtained from cryolite, so as to afford it at as low a price per ounce as silver; and, since an ounce of the former has four times the volume of an ounce of the latter, it will of course give us articles of plate of the same size so much cheaper, that is, at one-fourth the price. Besides this metal and crystals of soda, a clay is obtainable, which will be valuable to calico-printers as a substitute for a compound of alum and sugar of lead.

CHEMICAL ACTION OF LIGHT.

A PAPER has been read to the Royal Institution, "on the Measurement of the Chemical Action of Light," by H. E. Roscoe, Esq. The speaker having given a short account of the chemical action effected by the solar light and by some artificial lights, proceeded to explain the process and apparatus by which Prof. Bunsen of Heidelberg and himself had endeavoured to arrive at some positive measure of the chemical action of the solar rays, and to discover the laws by which these actions are regulated. These experiments, though still incomplete, have established the following facts in connexion with this subject:—1. That the amount of decomposition effected by the light is directly proportional to the time during which the exposure takes place. 2. That the amount of decomposition is directly proportional to the amount or intensity of the light. After describing the mode of experimenting which was adopted, Mr. Roscoe concluded by expressing his conviction that before long some such instrument for the measurement of the action of the chemical rays would be generally adopted.

IMPROVED LAMP.

M. VILLE describes (in Liebig's *Annalen*) a very convenient apparatus for obtaining a regular supply of hydrogen or sulphuretted hydrogen, which is a modification of Döbereiner's lamp. He points out, that in the fundamental reaction (that of protochloride of iron on a nitrate) a method of nitrogen determinations, similar in execution and principle to that of Dumas, may be formed. The deutoxide of nitrogen is passed over copper-turnings, and the nitrogen of the air, it would attract that element with the utmost avidity. So far from this being the case, aluminium is scarcely acted on by any of the strong acids (except hydrochloric acid) in the cold,—neither is it attacked by sulphur. Dr. Percy has obtained interesting alloys of this metal;—of these several were exhibited, namely, with copper, tin, and gold,—one with copper at 5 per cent. of aluminium deserves notice: it laminates well and "dips" of a fine golden colour,—the dipping liquid was nitric acid. As to the uses of aluminium, this metal is at present too costly to be employed for many purposes for which it is singularly adapted. It is, however, adopted as the material of weights for the determination of small quantities. The lightness of this metal, and its freedom from all liability to rust or tarnish, recommends it to the surgeon and the dentist: pianoforte strings are said to have been made of it;—while its property of conducting heat, its high specific heat, and the resistance it offers to corroding agents, indicate it as perhaps the best-known metal for culinary vessels. But as soon as it is sufficiently cheap it will, doubtless, be employed in covering iron surfaces (such as rails, pipes, &c.) which are exposed to the atmosphere. It has been found from experiment that a clean iron surface will receive an adhering plating of aluminium.

This light and elegant metal begins, it appears, to come into more general use, at least in France. The eagles which surmount the colours of the army, hitherto made of copper gilt by galvanism, are now made of aluminium, thus lightening the weight of the flag by nearly 2¾lbs. Aluminium is more sonorous than bronze, and is consequently brought into use for musical instruments. Spoons and forks, drinking-cups, &c., have also been formed of it. The weight of the new metal is about one-fourth that of silver. Fine silver being worth 225f. the kilogramme, and aluminium 300f., a piece of the latter equal in size to a kilogramme of silver will only be worth 75f. instead of 225f. Thus an article which in silver would cost 50f. would be only 16f. in aluminium.

ALLOYS OF ALUMINIUM.

SEVERAL British and French chemists are engaged in experimenting on the alloys which this new metal is capable of forming. Dr. Percy observes that its lightness (sp. gr. 2·25), and its freedom from all liability to rust or tarnish, recommend it to the surgeon and the dentist, and as an excellent material for culinary utensils. It is not acted on by sulphur nor by any of the strong acids except the hydrochloric in the cold state. When means are found of procuring it at a cheaper rate, it will form an admirable plating for iron works exposed to the atmosphere. It unites with most of the metals, and an alloy of ten parts of aluminium with ninety of iron, according to M. Debray, has a hardness superior to bronze, and when heated, works with greater ease than soft iron.

ALUMINIUM FROM CRYOLITE.

IN June last, Messrs. E. Hald and Rahr, a Danish house, sent out their brig Sonderjylland, Captain Brocksdorf, to Arksuk Fiord, in latitude 61 deg. 20 min. on the west coast of Greenland, for the purpose of bringing back minerals, and especially cryolite, for the obtaining of which peculiar privileges had at different times been granted by the King of Denmark to individual and associated miners; and that Messrs. Hald and Co. have received intelligence from Messrs. C. F. Fistgen and Co., to whom the brig was consigned at Copenhagen, of her safe arrival in that city on the 21st of September, after a voyage of only twelve days (the shortest on record), with a full load of cryolite. This is the first cargo of cryolite received from Greenland, which is the only country where, as yet, it has been found. It is a mineral composed, we believe, of sodium, aluminium, and fluorine; but the results of analyses are given in Moh's *System of Mineralogy*. M. de Lille, of Paris, has discovered a process by which aluminium may be obtained from cryolite, so as to afford it at as low a price per ounce as silver; and, since an ounce of the former has four times the volume of an ounce of the latter, it will of course give us articles of plate of the same size so much cheaper, that is, at one-fourth the price. Besides this metal and crystals of soda, a clay is obtainable, which will be valuable to calico-printers as a substitute for a compound of alum and sugar of lead.

CHEMICAL ACTION OF LIGHT.

A PAPER has been read to the Royal Institution, "on the Measurement of the Chemical Action of Light," by H. E. Roscoe, Esq. The speaker having given a short account of the chemical action effected by the solar light and by some artificial lights, proceeded to explain the process and apparatus by which Prof. Bunsen of Heidelberg and himself had endeavoured to arrive at some positive measure of the chemical action of the solar rays, and to discover the laws by which these actions are regulated. These experiments, though still incomplete, have established the following facts in connexion with this subject:—1. That the amount of decomposition effected by the light is directly proportional to the time during which the exposure takes place. 2. That the amount of decomposition is directly proportional to the amount or intensity of the light. After describing the mode of experimenting which was adopted, Mr. Roscoe concluded by expressing his conviction that before long some such instrument for the measurement of the action of the chemical rays would be generally adopted.

IMPROVED LAMP.

M. VILLE describes (in Liebig's *Annalen*) a very convenient apparatus for obtaining a regular supply of hydrogen or sulphuretted hydrogen, which is a modification of Döbereiner's lamp. He points out, that in the fundamental reaction (that of protochloride of iron on a nitrate) a method of nitrogen determinations, similar in execution and principle to that of Dumas, may be formed. The deutoxide of nitrogen is passed over copper-turnings, and the nitrogen estimated as such. But this is much less general and less certain than the others.

IMPROVEMENT OF THE DAVY LAMP.

M. DUBRUILE has perfected Davy's Lamp, by establishing a connexion between the burner and the shade, so that if the latter is withdrawn the light is put out. Thus are workmen prevented from exposing themselves to the risk of an explosion.

PURE SPIRIT FROM OLEFIANT GAS.

AMONG the remarkable substances formed by the distillation of coal, there is none which has attracted more notice than that known as Paraffine Oil. This article may be considered olefiant gas in a liquid state; and a young French chemist, M. Berthelot, publicly announces in the *Comptes Rendus*, that he has succeeded in producing alcohol or pure spirit from olefiant gas. According to his statements of the results of his experiments, when olefiant gas is shaken violently in a glass vessel with sulphuric acid and metallic mercury for a considerable time, it is absorbed; on adding water and distilling the mixture, alcohol is said to pass over, which on examination is found to be simple spirit of wine. It matters not from what substance the olefiant gas is obtained, whether from alcohol or from coal gas, the result is the same—a pure alcoholic spirit.

COMPARATIVE VIEW OF PEAT AND PEAT CHARCOAL FOR AGRICULTURAL PURPOSES.

MR. E. W. DAVY has communicated to the *Philosophical Magazine*, No. 71, experiments which show that Peat-Charcoal (contrary to the many statements which have been made by its advocates) has very little power of absorbing and retaining the ammonia of excrementitious matter when mixed with it; whereas Peat possesses this valuable property in an eminent degree, and absorbs and retains it in a most striking manner, which would appear to be owing (at least in part) to peat containing some substance which acts the part of an acid in neutralizing and fixing the ammonia of the volatile carbonate; for Mr. Davy found that when peat in certain proportions was mixed with urine which was highly alkaline (from the quantity of carbonate of ammonia it contained), and the mixture filtered after a short time, the filtrate, though it contained ammonia, was quite neutral to test-papers, showing evidently that the ammonia of the carbonate had combined with some other acid to form a neutral salt. The evolution of ammonia in the case of peat-charcoal seems to arise from two causes, namely, its inability to retain the volatile carbonate of ammonia existing in decomposing animal matter, and the property Mr. Davy had observed it to possess of decomposing to a certain extent the fixed salts of ammonia; as, for example, the sulphate, phosphate, muriate, and urate which may be present in such matter, and converting them also into the volatile carbonate which is readily evolved. This latter property would seem to depend on the alkaline and earthy carbonates formed during the process of charring;

for when the charcoal was boiled for some time in diluted muriatic acid, and well washed with distilled water so as to remove as much as possible those salts, and again dried at a red heat, the power it possessed of decomposing the fixed salts of ammonia, though not completely removed, was, however, greatly diminished, which clearly shows its connexion with those substances. Peat, on the other hand, does not possess this property in the slightest degree. These facts prove the great superiority of peat over peat-charcoal for agricultural purposes as regards the important substance ammonia; for by the use of peat, the ammonia is retained more or less completely in the manure to exercise its fertilizing action on vegetation, whereas the peat-charcoal suffers it to be in greater part dissipated and lost.

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As regards carbonic acid, the great food of plants, peat has a decided advantage over peat-charcoal, as the former readily undergoes decomposition in the soil, particularly if it is in contact with decomposing matter (as excrementitious substances), and gives rise to carbonic acid in the soil, both to supply the wants of the young plant before its leaves are sufficiently formed to obtain this indispensable substance from the surrounding atmosphere, and to render soluble in water certain earthly salts, &c. required by vegetation, and present them in a state in which they can easily be taken up by the roots of plants. Charcoal, on the other hand, from its being so little liable to undergo change, or be oxidized and converted into carbonic acid at the ordinary temperature, would, under the same circumstances, furnish only a very minute quantity of carbonic acid, even after the lapse of a long period.

Peat, likewise, from its greater elasticity, is better calculated than peat-charcoal to improve the texture, and render more pervious to the air heavy clay soils deficient in vegetable matter; and besides many other arguments which might be adduced in its favour, peat in the partially-dried and coarsely-powdered state in which it should be employed, would only be about one-fifth, if so much, of the expense of peat-charcoal. All these circumstances show that peat is greatly superior to peat-charcoal in manufacturing manures for agricultural purposes.

NEW PROPERTIES OF FRESHLY-CALCINED CHARCOAL.

BY M. MORIDE.

THE deoxidizing power of wood charcoal is well known, when used in the dry state and under the influence of an elevated temperature; but I do not know that any one has mentioned it as reducing metals in the midst of neutral, alkaline, or acid liquors; neither am I aware that any one has observed that in contact with a dilute and alcoholized acid, freshly calcined wood charcoal caused the formation of ether. I am continuing this study, but I have determined to make known the results of my first experiments.

Coke, charcoal from lignites, animal and bone charcoal, do not produce the effects of which I am about to speak.

1st. When incandescent wood charcoal is plunged directly, or after being extinguished with cold water, into an acid solution of sulphate of copper, the metal is gradually deposited upon the charcoal until it may be entirely recovered. In neutral or alkaline liquors the reaction is not so well performed. In Barreswill's liquor, for instance, the copper deposited upon the charcoal has a very beautiful iridescent appearance. When nitric acid, hydrochloric acid, or sulphuric acid is used to acidify the solutions, the effect is the same, only that it is clearest with sulphuric acid.

2nd. I have observed that the metallic salts of organic acids are less easily decomposed than those which contain mineral acids.

3rd. The solutions of silver in nitric acid, whether neutral or acid, and chloride of silver dissolved in ammonia, are easily decomposed by freshly calcined wood charcoal. The silver is soon seen to cover the charcoal in the most beautiful manner; it sometimes appears crystallized.

4th. Copper may, by this same means, be precipitated from ammonial solutions; but if these solutions likewise contain silver, the latter will be first reduced.

5th. Finally, incandescent wood charcoal plunged in Fowler's solution, acidified with sulphuric acid, produces a very agreeable ether, which I intend to examine. It will be easy to make in this way, by varying the acids, nitric, acetic, sulphuric ethers, &c.

6th. Zinc, iron, platinum, lead, and mercury may be precipitated by wood charcoal; but they redissolve in acid liquors: this does not occur at all with silver, and with copper not until twenty-four hours after the operation.—*Comptes Rendus*, and *Chemist*.

EFFECT OF CHLORINE IN COLOURING THE FLAME OF BURNING BODIES.

A CONSIDERABLE time back, Mr. D. Forbes, F.G.S., whilst examining some saline minerals for boracic acid, and employing the usual test as to the power of colouring flame green, when treated with sulphuric acid and alcohol, it was found that a green flame presented itself, very similar to that which would be expected in case boracic acid were present in the minerals. On the most careful examination, however, no traces of boracic acid could be detected, and it was evident that the colouration of the flame must have proceeded from some other source.

As chlorine was present in considerable amount in the minerals in question, it became interesting to see whether its presence might have produced the green colour; and the experiments made on the subject fully confirmed this view. A number of further experiments on the power possessed by chlorine to colour flame, led to the following conclusions, which are stated briefly, as the results themselves sufficiently explain the *modus operandi*.

Chlorides treated with concentrated sulphuric acid and a very small amount of alcohol, produced green flames similar to those eliminated from borates under like treatment. Quantitatively, however, the flames were of less intensity; that is, the same weight of a borate would produce considerably darker green flames than when a chloride was used.

When chlorides were moistened with sulphuric acid and heated in the blowpipe flame, a faint green colouration was observed, which generally confined itself to the inner flame.

When hydrochloric acid is dropped cautiously on the flame of burning alcohol, a greenish tinge is observable.

A jet of chlorine or of hydrochloric acid gas directed upon the flame of a spirit-lamp, or of coal-gas, produces a jet of green flame :

this was also found to be the case when (by means of a convenient burner) chlorine gas was passed into the centre of a flame of burning coal-gas, or of vapour of alcohol.

When burning alcohol was injected into a globe filled with chlorine gas, the alcohol vapour continued burning at the mouth of the globe, with a very flickering but often brilliant green flame.

From the above experiments, it will be seen that chlorine has in itself a decided colouring action on the flame of burning bodies, which may consequently in some cases lead to its being confounded with boron, as the green colour imparted to flame has hitherto been regarded as a most characteristic test of the latter element. When, as often happens, chlorine and boron occur together, this test consequently becomes nearly valueless.—*Philosophical Magazine*, No. 69.

EXPLOSIVE ACTION OF SODIUM ON WATER.

BY FREDERICK W. GRIFFIN, PH.D.

THE Action of Sodium on Water contained in a glass vessel is such an elegant proof of the composition of that liquid and other points, as to lead to its being occasionally introduced in lectures. I have, however, found the experiment liable to a grave accident, which ought altogether to banish it from public demonstrations. Some years ago, during my private course of lectures, I passed a piece of the metal, about a quarter of an inch square, into a tube filled with water, 18 inches in length by 1 in diameter. When the action was nearly over, a powerful explosion occurred, which forced the tube (weighing upwards of a pound) violently through my hand and dashed it to pieces against the ceiling. As I had often before performed the experiment with perfect safety, I presumed that air must have somehow got mixed with the hydrogen; the more so as, simply holding the sodium in the fingers, I had, to slip it under more quickly, brought the mouth of the tube very near the surface of the water. On all subsequent occasions I placed the sodium in a little tube closed at one end, which it almost filled, and stopping the mouth with the finger, opened it below the larger tube, which was kept at least a couple of inches under water, so that there was no possibility of letting in air by any sudden jerk or otherwise. All went off well for several times, till at a public lecture in Devonshire an explosion resulted more violent than the first, and the tube was blown into splinters, which strewed the floor of one half of the room, and slightly wounded several persons. Since that occurrence I have relinquished showing this experiment in public at all, though numerous trials appear to prove that a piece less than a pea may be used with safety, though there is sometimes a slight concussion at the end. The cause of the detonation remains to be explained. In the last instance, at any rate, it is quite certain that no explosive mixture with air was formed, and I have little doubt that the effect proceeds from the water round the sodium being thrown into the *spheroidal state*. This view seems confirmed by the fact, that at the first moment of contact a large quantity of gas is always liberated, but the action speedily becomes weaker, and the evolution of hydrogen extremely slow. In all probability, the metal is then merely decomposing the atmosphere of aqueous vapour around it; and when the piece is small, it disappears tranquilly in this way; when it is larger, so that the action is prolonged, its temperature slightly falls, contact ensues, and a burst of gas and steam takes place with explosive violence. In both cases the tube was three-quarters full of gas, and I noticed a sudden downward rush of the liquid the moment before the explosion.

The detonation, with occasional fracture of the vessel, observed by Wagner and Couerbe to take place when sodium floating fused on water is struck with a spatula, probably proceeds from the same cause, the highly-heated globule being forced mechanically into sudden intimate contact with the liquid.

While on the subject of sodium, I may add that when it is melted with a little naphtha in a sealed tube containing no air, it presents to the full extent the high lustre and mobility of mercury, from which indeed it cannot be distinguished by the eye; but as soon as it solidifies, it assumes a slightly crystalline and dead white surface, more nearly resembling frosted silver.—*Philosophical Magazine*, No. 76.

EXPERIMENTS WITH AMMONIUM.

PROF. A. W. HOFFMAN has made a series of experiments for the production of Ammonium, the metallic basis of the well-known volatile alkali. At a lecture delivered at the Royal Institution, Professor Hoffman observed that in examining ammonia gas (N H 3) he found, on comparison, that it was a type of a certain class of substances, such as phosphuretted hydrogen, arseniuretted hydrogen, antimoniuretted hydrogen, &c. These differ somewhat in their physical character, but their chemical composition is identical, except that the nitrogen of the ammonia is replaced by phosphorus, arsenic, and antimony. The Professor went on to say that he had found, during his researches, that the hydrogen could be replaced in these several substances by an organic base equivalent to ethyle, forming with H N 3 ethylimine, diethylimine, and tetrathylimine, and with the other substances phosphethine, arsethine, and stibethine. He found that tetrathylimine formed a salt with hydrochloric acid, equivalent to chloride of tetrathylimine. He then went on to show that ammonium, in combination with chloride (N H 4 Cl.), corresponds with the potassium in chloride of potassium, but explained that it could not be separated as N H 4 O, or ammonia, by the oxide of silver, as potash (or the oxide of potassium) can. He demonstrated, however, that the ethylimine can be separated from its chloride, and thus establishes his theory. Sir H. Davy attempted to separate ammonium by the galvanic pile, but did not succeed until, by accident, he had some mercury at the bottom of the vessel, when he obtained an amalgamation of ammonium mercury. Left to itself, this amalgam decomposes into ammonia gas (N H 3)—hydrogen and mercury—which proves fully that ammonium has been present. A better way of making it, Professor Hoffman observed, is to decompose a solution of chloride of ammonium by an amalgam of mercury and sodium, when a double reaction takes place, producing chloride of sodium, and the amalgam of ammonium and quicksilver. This amalgam, which the Professor exhibited to an admiring audience, resembles butter, and has a strong metallic lustre. This isolation of the ammonium in a pure state still remains to be accomplished.

IODINE IN THE UNITED STATES.

THE curative properties of Iodine in a variety of diseases have been known for the last twenty years to the faculty of Europe and the United States, but hitherto its use has necessarily been limited to its combination with other substances—as an "alcoholic tincture," or with double its volume of iodine of potassium in other preparations, its exhibition in either form being very frequently inadmissible —when the introduction of "pure iodine" uncombined into the system would, had it been possible, have been extremely desirable. This difficulty, so long and so severely felt, will, it seems, for the future, be entirely obviated by the result of the chemical experiments recently effected by a physician and chemist of Brooklyn, New York, judging from the following editorial of one of the first medical publications of the present day, the *American Medical Monthly*, for September, edited by Edward H. Parker, A.M., M.D., &c., under the supervision of the faculty of the "New York Medical College." The following is the article alluded to:—"Dr. Cansdell's 'aqueous solution of iodine.'—In our number for July we noticed a 'preparation of iodine,' of which samples had been sent us by a gentleman of this city. In that notice we ought, perhaps, in justice to have stated that our attention was first called to the possibility of producing a concentrated 'aqueous solution of iodine,' by Dr. Henry W. Cansdell, of Brooklyn, New York, who tells us that for some years he has been trying experiments, with a view to effect that object, in Paris and in London, with only partial success, but more recently in this city, with the most satisfactory results, having found in the Croton water of New York chemical properties which neither the waters of the Seine nor the Thames appeared to possess. Dr. Cansdell has sent us some of the 'solution' prepared by him, which has been very carefully analyzed by a skilful chemist, and is found to be a really pure and concentrated 'solution of iodine' in water, uncombined with any other substance, and of a strength ten times greater than had hitherto been considered practicable by any of the chemists of Europe or the United States; thus placing in the hands of the faculty a simple, easily-controlled, and effective means of introducing pure iodine into the system of patients in all those diseases in which the use of iodine is indicated. Dr. Cansdell states that he has used this preparation with the most beneficial results in many severe cases of scrofula, rheumatism, and particularly in obstinate cases of intermittent fever, where the exhibition of quinine and 'Fowler's solution' had failed to produce their usual effects. And in order that the faculty may have an opportunity of testing the therapeutical value of this newly-discovered preparation, Dr. Cansdell has offered to furnish a gratuitous supply to any or all of the hospitals in the city; and, with a liberality of spirit that should at least entitle him to the thanks of the profession, he has pledged himself shortly to acquaint us with the mode of preparing this addition to our remedial agents, which we shall have much pleasure in communicating to the faculty." We learn that the doctor has brought his discovery before the French and English medical societies.—*Philadelphia Evening Journal.*

PRESERVATION OF FRESH MEATS.

MR. GEORGE HAMILTON, F.C.L., has read to the Liverpool Chemists' Association a paper on the "Preservation of Fresh Meats." After noticing the different processes hitherto employed for the preservation of meat, he detailed a long series of experiments which he had performed in 1852, and which had led him to the discovery of the preservative properties of binoxide of nitrogen, which preserves meat from putrefaction without changing its colour or consistence; nor did it afterwards putrefy when exposed to the air. Since the first announcement of these experiments, at the meeting of the British Association, held there in 1854, the honour of a similar discovery had been claimed for a French *savan*, but l'Abbé Moigno, who was present in the chemical section when Mr. Hamilton's paper was read, says, in a letter to that gentleman, "I shall be happy to make known your priority." The lecture was illustrated by a number of specimens of meat which had been prepared according to the process, and which looked as fresh as if they were just killed; and when cooked, as some of the specimens were, they could not be distinguished from ordinary meat.

PETRIFYING ANIMAL SUBSTANCES.

THE *Piedmontese Gazette* gives an account of a sitting of the Royal Medico-Surgical Academy of Turin, at which a committee named to examine certain specimens of anatomical preparations executed by Dr. Longo, of Sicily, by means of a special discovery of his, read its report, in which it was stated that Dr. Longo had succeeded in petrifying animal substances—a secret which Segato had taken with him to the grave, and of which M. Baldacconi, late director of the Zoological Museum of Siena, in Tuscany, rediscovered some traces in 1843; that the specimens sent to the Society were perfectly hard and free from smell; that their natural form had been preserved, except in some cases a slight flattening of their surface; that their size was not reduced, and their surface remained free from the corrugations so difficult to avoid by the common methods; but that they had lost their colour, their weight had increased considerably, and their texture had become so changed that even the microscope could not discover its nature. The Academy concluded that Dr. Longo's method, in its present state, was not applicable to the preservation of bodies in museums, but that he ought to be encouraged in his praiseworthy endeavours, in order to correct the defects still inherent in his system.

Professor Abbene then read a paper on the results which he had obtained from the blood of a horse drawn at different periods of etherization, from which he was led to conclude that etherization had the effect of deoxygenizing the blood, and was, therefore, an excellent means of diminishing the phlogistical condition of a patient about to undergo operation. Professor Berutti then explained certain experiments of his to ascertain whether the opinion held by certain physiologists was true, namely, that the skin does not absorb substances dissolved in water. He stated that he had repeatedly immersed different animals in baths saturated with ferro-cyanuret of potash, ioduret of potash, and also strychnine, respectively, keeping them in for upwards of an hour, without any effect being perceived which might lead to the supposition of absorption, and without any traces of those substances being found either in the blood or the urine. Several members present objected to the conclusions Professor Berutti was inclined to draw from his experiments; but the latter maintained his opinion, declaring at the same time that he would continue his experiments with other substances.

EGG ALBUMEN IN CALICO-PRINTING.

We have been permitted by Walter Crowe, Esq., of Thornliebank, near Glasgow, to publish the following curious piece of statistics indicating the extent to which egg albumen is employed in calico-printing. This substance is used as a medium for affixing upon the cloth certain insoluble pigments, such as the artificial ultramarine, not attachable by the ordinary processes of dyeing, and is a new and valuable auxiliary to the calico-printer.

MM. Dollfus, Mieg, and Co., calico-printers of Mulhausen, use per annum 8000 kilogrammes of dry albumen, at a cost of 10 francs per kilogramme = 80,000 francs; 320 eggs produce 1 kilogramme, which × 8000 = 2,560,000 eggs; one hen produces 200 eggs per annum, and, therefore, 12,800 hens are required to supply this one factory. The albumen is produced chiefly at Annonay, near Grenoble.—*Edinburgh New Philosophical Journal*, No. 7.

COPPER SALTS.

Langenbeck and Städeler have investigated the Action of the Copper Salts of the Fatty Acids on the Organism. They find that solution of the oxide of copper in fats, as well as the copper salts of fatty acids of high atomic weight, and especially of stearic and oleic acids, have an injurious action on the system, causing vomiting and diarrhœa; but that this action, even in large doses, is not fatal. The copper salts of volatile fatty acids act, on the other hand, as strong poisons, and their action is the more marked the lower the atomic weight of the acid. Acetate of copper has a very poisonous action, which is delayed, but not prevented, by a quantity of admixed fats.

Soluble copper salts are decomposed by solution of soap into insoluble stearate and oleate of copper; but in the organism this change is not sufficiently rapid to hinder the poisonous action. Solution of soap is nevertheless the most appropriate antidote, as the vomiting is not prevented. It is best to add to it a small quantity of oil, to prevent the injurious action of the soap on the mucous membrane of the stomach.

Langenbeck and Städeler find that in these experiments the copper was more particularly found in the liver, whence it passes into the bile, and with this reaches the intestinal canal, and is removed from the system.—*Liebig's Annalen; Philos. Mag.*, No. 74.

PERFUMES OF FLOWERS.

M. MELLON, the chemist, has communicated to the Paris Academy of Sciences a paper on the essential Perfumes of Flowers, at the request of—in point of fact communicated by—Marshal Vaillaint, the French Minister of War. The result of M. Mellon's investigations was this:—Hitherto the essential oils of plants have been looked upon as the sole sources of their odours, and they have been obtained by distillation with alcohol or ether; but some perfumes cannot be extracted in that way; and M. Mellon has discovered that most perfumes could be more satisfactorily extracted by dissolving the essence by means of the bisulphuret of carbon and ether, and evaporating at a low temperature. A kind of extract is left which, for want of a better name, he calls the perfume (*parfum*), and which has amazing powers of diffusing scent. Marshal Vaillant has communicated the paper because it appears that Algeria abounds in odoriferous plants; and the process of M. Mellon seems likely to materially improve the manufacture of perfumes by obtaining them in much smaller bulk, and in a form unalterable in the air. And it appears to be a fact that the matter is of so much importance commercially, that France exports at present perfumes to the extent of 30,000,000fr., or about 1,200,000*l.* sterling.

CHEMICAL WRITING.

MR. A. TOLHAUSEN has patented a new process of producing Chemical Writing, and of marking and inscribing chemically any characters or figures upon paper or other substance of similar character. To prepare the paper, the patentee saturates the common sizing used for writing-paper, with salts, or substances of considerable solubility, and which, when dried with the paper, will maintain dryness under ordinary atmospheric changes. He now takes a deliquescent salt,—for cheapness a ferric oxide, as the nitrate, chloride, or sulphate of iron,—and triturates and mixes it intimately with plastic clay. He then moulds the ferric clay to constitute a pencil, bakes it, and plunges it into molten bees' wax or spermaceti, to form an air-tight coating. The prepared paper is now written upon with the pencil, and the ferric salt in the pencil, during the act of writing, absorbs moisture, comes in contact with the salt in the paper, and the two unite chemically, thereby producing coloured writing.—*Mechanics' Magazine*, No. 1738.

A SUBSTITUTE FOR SULPHURIC ACID.

De Luna has made some experiments on the possibility of substituting for sulphuric acid some of its compounds, in cases where they are to be had cheap. He found this to be the case with the sulphate of magnesia, which occurs in the province of Toledo. By heating this body with common salt, hydrochloric acid is evolved, and a residue left, consisting of magnesia and sulphate of soda. From this residue a sulphate of soda of greater purity than the commercial salt is easily prepared. In the above process, by adding manganese, chlorine may be obtained. Similarly, nitric acid is formed on heating sulphate of magnesia and nitrate of soda or potash.—*Liebig's Annalen; Philosophical Magazine*, No. 71.

TREATMENT OF FATTY ACIDS.

M. Fontainemoreau has patented the following improvements in Treating Fatty Acids. Braconnet has demonstrated that if a certain quantity of concentrated sulphuric acid is applied to grease and oils, an instantaneous combination takes place, and that boiling water separates the sulphuric acid, and allows the greasy matter to rise to the surface decomposed. The product thus obtained is a greasy acid, in an imperfect condition, which cannot be purified, and its solid and liquid elements cannot be separated, except by repeated treatment by alcohol, essence of turpentine, or ether. This operation is therefore not capable of producing a manufacturing result. These facts led to the idea of rendering available this effect of sulphuric acid by substituting for the use of alchohol, ether, and the essence of turpentine, the manufacturing process of distillation, for purifying the greasy acids, and extracting therefrom the stearic and oleic acids of commerce; and it is in this that the invention consists.

NEW PROCESS OF VINIFICATION.

It has been discovered by analysation that the grape substances giving out colour, taste, bouquet, and flavour to wine,—viz., tartar, tannin, essential oil, and colouring matter,—constitute only 1 per cent. of its composition, the remaining 99 per cent. consisting merely of sugar and water. It is this 1 per cent. alone which makes wine, distinguishes it from all other liquids, and bestows its different valuable qualities. It appears that the above-mentioned component parts—especially that which is most precious, the essential oil—are only one-fourth absorbed by the usual process of fermentation; there is, therefore, left undeveloped at the bottom of the fermenting tuns or vats 75 per cent. of flavour, &c., which, if saturated in a solution of refined sugar and water, will give out one-third of its unexhausted properties, which is sufficient to produce wine of a better quality than that derived from the natural must. This operation may be three times repeated with the same result; and, even if tried a fourth time, will yield sufficient flavour to make a small description of vinous liquid. This discovery is due to the French chemists, who, on account of defective vintages, have deemed it worthy to investigate the subject. Thus we learn that art has triumphantly succeeded in making a perfect wine from a reserved constituent power heretofore considered as the refuse principal. We will not at present expatiate further on this truly interesting and startling discovery, but leave it for your consideration and reflection till next month, when we shall furnish you with copious extracts translated from a French pamphlet, published by the scientific investigator of the subject, M. Abel Petoit of Chamirary, France.—From Ridley and Co.'s *Monthly Circular.*

MACLAREN'S AERATED WATERS ENGINE.

An ingenious improvement has been made in the Engine used for the manufacture of Aerated Waters, which has been patented by Mr. Maclaren, of Edinburgh. The advantages possessed by this invention over the engines now in use are its extreme portability, cheapness, and power. In the first place, it only occupies a space of about five feet six inches by two feet, or rather less than a fourth of that occupied by the most convenient apparatus hitherto used, while its cost is reduced to one-third, and it is at the same time capable of producing from 100 to 200 dozen bottles per diem of any of the various descriptions of mineral waters, at a cost of about one farthing per dozen, and an excellent artificial champagne at about 8s. per dozen.

The construction of the machine is as follows:—The first part, the generator, is a leaden vessel, into which the sulphuric acid and chalk are put for the purpose of generating the carbonic acid, which, as it is produced, is conveyed by pipes into a gasometer. From the gasometer, the gas, together with a certain proportion of water, is pumped (by means of a force-pump, fitted with external conical valves, resisting great pressure), and forced into a copper sphere, until the pressure is raised to some point between 80lb. and 120lb. to the square inch, by which means the gas and water are mechanically combined. From the condenser the liquid is conveyed by strong pipes to the bottling apparatus. It was to this part of the apparatus that our most particular attention was attracted, and it is without doubt one of the most ingenious mechanical contrivances that can possibly be conceived. The difficulties to be overcome at this point are many, and consequently the machinery, to obviate them, is far too complex to be rendered intelligible by any description. Suffice to say, that the bottles are filled and corked without the slightest loss of gas, and without any danger to the workmen from the chance of their bursting; an accident which is of such common occurrence, that in all soda-water factories the men employed in bottling are obliged to wear leather paddings and wire masks to protect them from the pieces of glass; and even these contrivances do not prevent the men from being injured occasionally. No precaution whatever is necessary in bottling with Mr. Maclaren's engine.

As these machines are very easily managed, and their original cost is not great, their adoption in club-houses, hospitals, and other large establishments, will be a matter of considerable economy. The Government have evidently taken this view of the case, as they lately despatched to each of the six principal military hospitals in the East one of the engines, with everything necessary to keep them in working operation for six months. Before concluding this subject, it may be as well to disabuse the public mind of a very prevalent, and, at the same time, a very absurd delusion, viz., that there is any real difference in the various descriptions of aerated liquids called respectively potass, soda, Carrara, and magnesia waters. They are actually and virtually but one and the same thing, carbonic acid and water. The only real distinction that exists is comprised in the shape of bottles, which can hardly be supposed to exercise much influence either upon the flavour or medical virtues of the fluid. The adage that every untruth is but a truth exaggerated, may, it is true, be applied to this case. It is true that a "trace" of the substances designated in the various names may be found in the fluids; but that the said "traces" answer any other purpose than creating a distinction without a difference, it is absurd to imagine.

FILTRATION OF WATER.

Mr. H. M. Witt, F.C.S., Assistant Chemist to the Government School of Applied Sciences, has communicated to the *Philosophical Magazine*, No. 76, a paper "on a peculiar Power possessed by Porous Media (Sand and Charcoal) of removing Matter from Solution in Water." The paper consists of certain experiments which were undertaken with the view of ascertaining by chemical analysis the more precise nature of the effects produced upon ordinary river-water, such as that of the Thames, by its passage through filters composed of these media respectively, and of comparing their powers; but it is believed that the results obtained possess an interest extending considerably beyond the question to assist in the solution of which they were made.

The system of purification adopted by the Chelsea Water-works Company at their works at Chelsea, consisted hitherto (for the supply has by this time commenced from Kingston) in pumping the water up out of the river into subsiding reservoirs, where it remained for six hours; it was then allowed to run on to the filter beds. These are large beds of sand and gravel, exposing a filtering surface of about three-fourths of an acre, or 32,670 square feet; and the filtration taking place at the rate of one foot per hour, yields about 204,187 gallons of filtered water per hour.

The filters are composed of the following strata in a descending order:—

	ft.	in.
No. 1. Fine sand	2	6
2. Coarser sand	1	0
3. Shells	0	6
4. Fine gravel	0	3
5. Coarse gravel	3	3

These several layers of filtering materials are not placed perfectly flat, but are disposed in waves, as seen in the sectional drawing; and below the convex curve of each undulation is placed a porous earthenware pipe, which conducts the filtered water into the mains for distribution.

We have not space for the details, but quote Mr. Witt's brief summary of the most important results of this investigation:—It has been shown,—

1st. That sand, charcoal, and probably other porous media, possess the very peculiar property of removing, not merely suspended impurities, but even dissolved salts from solution in water.

2nd. That charcoal enjoys pre-eminently the power of abstracting organic matter from solution: but that even sand likewise is capable of effecting the same result, though to a far less extent.

3rd. That these powers, possessed by both these media, increase in intensity to a certain extent with the degree of impurity of the solution.

4th. That these properties of porous media have important bearings upon hygienic science, agricultural principles, and geological phenomena.

The various analyses given show great variations in the composition of the river-water, between the two points at which experiments were made, viz., at Chelsea and Kingston, as well as at the different seasons of the year.

Mr. Robert Hunt, F.R.S., Keeper of the Mining Records, has addressed to Mr. Witt the following examples, within his own knowledge, confirmatory of Mr. Witt's views.

"At Perran-porth, some six or seven miles north of Truro, the heaps of waste (*deads*) from the old mines contain considerable quantities of copper pyrites, which is, in the process of decomposition, converted into sulphate of copper. This salt is washed out by the rains, and the solution flows through the sands (*blown sand*) widely spread over that district. The sulphate of copper is separated by the sand, and the sand containing the copper is collected from time to time and sold to the copper-smelters. Again, at Botallack Mine, the water which filters through the rocks from the Atlantic Ocean in the levels which are worked out under the bed of the sea is found to have lost much of its original saltness."

CHEMICAL COMPOSITION OF THE THAMES WATER.

THE author of the preceding paper has communicated to the *Philosophical Magazine*, No. 77, the results of his investigation of the Variations in the Chemical Composition of the Thames Water, which he commences with these remarks:—

So numerous are the chemical analyses of the water of the Thames which have been published during the last few years, and by chemists of such eminence have they been made, that it would appear altogether superfluous to make further additions to their number; but one most important fact has scarcely attracted sufficient attention, that any single analysis, however carefully and accurately executed, represents only the composition of that particular sample of water under examination, and not the general or average composition; in fact, the quantities of the several impurities of the water of the Thames differ, as might be expected, most essentially *at the various points in its course, and at the several seasons of the year.*

To the variations in composition at different points of the river's course attention has been drawn long since, especially in the Report by Professors Graham, Miller, and Hoffman, to the Secretary of State for the Home Department, made in 1851, by whom it was recommended that the supply of London should in future be taken from some point above the tidal influence, further removed from the contamination of the London sewage.

But great discrepancies have often occurred between the analyses of the water at any particular point made by different experimenters, due doubtless to the changes which take place at different seasons of the year; and it became evident that a correct opinion of the composition of the water, at any special point of the river's course, could only be formed by making a *large number of analyses* extending over a considerable *space of time*, and from them deducing the *mean composition.*

This desideratum was partially supplied by Dr. Robert Dundas Thomson, who, in the *Quarterly Journal of the Chemical Society* for July, 1855, published the results of a series of analyses made between the 1st of September, 1854, and the beginning of the year 1855; but it is obvious that this includes only a quarter of a year, and, moreover, only that particular quarter following the drought and heat of summer and autumn, the effect of the spring rains being altogether omitted.

The analyses detailed below extended *over the whole year*, viz., from May, 1855, to May, 1856; so that from them the maximum, minimum, and *mean* composition, may be deduced for the whole year.

We have only space for the concluding table, which exhibits a fair view of the question.

Comparison of the average Composition of the Thames Water at Chelsea and at Kingston, after filtration, i.e., *in the state in which it is supplied for public consumption.*

	Mean composition at Chelsea after sand filtration.	Mean composition at Kingston after sand filtration.	Excess of impurity in filtered water from Chelsea over that from Kingston.
Total residue. . . .	30·03	23·91	6·12
Suspended matter . .	1·84	1·58	0·26
Soluble matter:—			
Organic	1·30	0·64	0·66
Inorganic	26·89	21·69	5·20
Chlorine	9·59	0·86	8·73

Mr. Simpson (engineer to the Chelsea Water Works) is of opinion, from his own practical experience in the matter, that the results detailed above can only be considered as representing the mean composition for the year during which the experiments were made; that, in fact, from the much greater increase in the volume of the upland water which comes down the river in some years, when the rainfall is sometimes almost double what it was during the past year, and its diminution during others, when the rainfall does not exceed one-half what it then was, there is every reason to believe that far greater fluctuations in composition sometimes occur than have been demonstrated by this investigation.

RANSOME'S PATENT FILTERS.

MESSRS. RANSOME and Co., of Ipswich and Westminster, have recently brought forward a variety of improved Filters, in which two most important purifying processes—filtration by ascension, and the use of reduced charcoal—are introduced.

Of the advantages of filtration by ascension it is unnecessary to say more than that, by it the heavier impurities contained in water or other fluid, which are carried downward by the action of gravitation, instead of being deposited in and clogging up the filtering medium, are allowed to fall to the bottom of a chamber from which they may be readily removed, and consequently, filters constructed upon this principle will keep in order much longer than the ordinary ones, and cost less for renewal.

The great efficacy of charcoal as a purifier was never so well understood as at present, and it is gratifying to observe that the application of it as a filtering medium has not been delayed.—*Mechanics' Magazine*, No. 1698.

OZONE.

M. SCOUTETTEN states that he has made a certain number of experiments, which seem to prove that the Ozone of the atmosphere is formed—1. By the electrization of the oxygen secreted by plants; 2. By the electrization of the oxygen which escapes from water; 3. By the electrization of oxygen disengaged during chemical action; 4. By electrical phonomena reacting on the oxygen of the air. He adds that a series of varied and repeated experiments appear to show —1. That plants as well as water furnish constantly to the atmosphere ozone during the day; 2. That this phenomenon ceases during night; 3. That it is suspended during the day by withdrawing water or plants from the action of direct light, as by putting them in the diffused light of a room, or covering them with a piece of linen or a sheet of paper; 4. That ozone is not produced when boiled distilled water is used; that the same thing takes place when plants are introduced into a bell-jar filled with this boiled water, or when ordinary boiled water is used with a layer of oil on the surface to prevent absorption of atmospheric air; 5. That the formation of ozone takes place when the water and plants are inclosed in a glass globe suspended at a distance from the earth by a thread. He remarks that ozone is nascent oxygen, and that it is to properties which oxygen acquires by positive electrization that we must attribute the combinations it forms, and which cannot be accomplished by pure oxygen. Ozone is formed in the atmosphere by continuous invisible electrical currents, as well as by successions of sparks, more or less powerful. M. Wolf, of Berne, attributes many diseases to the effects of atmospheric ozone. By observations made at Berne in 1855 he endeavours to show a remarkable correspondence between the variations in the quantity of ozone in the atmosphere, and the changes in the intensity of an epidemic dysentery at Berne in the months of August and September.—*L'Institut.*

M. Ch. Brame confirms these observations as to ozone being given out by plants under the influence of the sun, and as to its existence in rain-water. He attributes in a great measure to ozone the formation of the nitrate of ammonia met with in rain-water.—*L'Institut.*

Professor W. B. Rogers has also made observations on Ozone in the Atmosphere. The Professor uses the prepared paper and scale of colours of Schönbein's Ozonometer, which, although imperfect as a means of comparison, is the best for practical use yet devised. The slip of paper is suspended out of doors in a box open only at the bottom, so as to be shielded from the rain and snow, and from strong light, at the same time that it is freely exposed to the air. Usually, it is allowed to remain in this position for twelve hours, when it is removed for observation, and a fresh slip substituted; but when there are indications of a great prevalence of ozone, the test is examined, and renewed at shorter intervals.

On comparing the recorded observations for six weeks, Professor Rogers has been struck with what seems to be a fixed relation between the direction of the aerial current and the amount of ozone prevalent at the time. As long as the wind continued to come from eastern or southern points, he found the ozone to be nearly or quite absent; but whenever the current has changed to west or north-west, the test-paper unfailingly indicated its presence in considerable force. The rapidity and amount of this effect has always been greatest when the wind has hauled suddenly to west and north, and has blown violently, but it has continued to manifest itself, although with slow abatement, as long as the current held from this quarter.

To illustrate this effect, Professor Rogers referred to examples within the month of February. Thus, on the 11th, the wind being light from west by south and south-west, there was no indication of ozone, and during the morning of the 12th, the wind continuing from the same general quarter, furnished a like negative result. About 1 P.M., however, the current changed suddenly to north-west, with a snow squall, after which it continued to blow in gusts in the same direction until late at night. Two hours after this change, viz., at 3 P.M., the test-paper was found to be charged with ozone to the amount of $\frac{7}{10}$ of the maximum of Schönbein's scale, and at 10 P.M. a second paper, which had been freshly substituted for the former, gave $\frac{8}{10}$. Again, on the 15th and 16th, the wind blowing from south and south by west, showed no ozone; retaining the same general direction through the night of the 16th, and part of the following morning, it gave a like negative result. About 11 A.M. of the 17th, the wind hauled towards west, and about 1 P.M. it began to blow strong from west by north, after which it continued gusty from this quarter and north-west until late next day. The test-paper hung out at 9 A.M. of the 17th, was found at 1 P.M., or two hours after the change, to present ozone amounting to $\frac{3}{10}$; and another substituted at that time, showed at 5 P.M., or five hours after, a change measuring more than $\frac{8}{10}$.

Although the observations thus far made have indicated the prevalence of ozone in connexion with winds from west and north-west, and its absence in the case of those moving from the opposite quarters, they have been continued for too short a time, and have been too local, to warrant any positive inference of a general kind. The development of ozone in the air being probably dependent on temperature, relative dryness, solarization, electricity, and other physical conditions which are perpetually changing, we cannot hope to read precise laws in regard to its production and disappearance without long-continued and varied observations. Yet, from the marked contrast in respect to moisture and other properties between our great continental and our oceanic winds, it seems not improbable that some such opposite relations to ozone as above indicated may be found actually to obtain.—*Silliman's Journal*, July, 1856.

ULTRAMARINE.

BRUENLIN proposes a new theory of the constitution of blue and green ultramarine. His view is, that ultramarine is a compound of a silicate of the formula of nepheline with a polysulphide of sodium. A translation of this paper is given in the *Philosophical Magazine*, No. 75.

Wilkens has an article on artificial ultramarine, in which he adverts to the views put forth by Stölzel (*Philosophical Mag.*, June,) on the constitution of this body. Winkens considers that in artificial ultramarine a certain constant compound is contained, but mixed with other foreign bodies. Resting on a number of careful analyses, as well as on its reactions and properties, he considers blue ultramarine to have the formula—

$$2(Al^2O^3\ SiO^3) + Al^2O^3\ 3SiO^3 + NaO\ |$$

The formula which Wilkens derives from his analyses is different from that proposed by Bruenlin, who considers it to be a compound of a mineral of the formula of nepheline with pentasulphide of sodium.

But both chemists agree in the fact, that when decomposed by acids, one equivalent of sulphur is liberated as sulphuretted hydrogen, and four equivalents as free sulphur. Wilkens thinks that hyposulphite of soda, with sulphide of sodium, is the colouring principle of a silicate of alumina. The sulphur in ultramarine cannot be replaced by any other body, nor can the sodium. Experiments carefully made with this view, with potash, lime, and magnesia, afforded no ultramarine. Iron exerts no influence in producing the blue colour.

Green ultramarine, which always precedes the formation of blue, is considered by Wilkens to be a sulphide of sodium compound, but he had arrived at no certain results as to its constitution, since, from the various methods of its formation, it occurs of very different form and composition. — *Liebig's Annalen ; Philosophical Magazine*, No. 79.

ANALYSIS OF A METEORIC STONE.

THIS Meteoric, which fell in Norway, was sent by the finder to the University of Christiania, with the statement that, on the 27th December, 1848, in the evening, and when the sky was clear, a loud noise like the firing of many shots was heard, and a very bright light was seen. Two days afterwards, the stone was found lying on the ice, in which it had sunk to the depth of about half an inch, the hollow having evidently been produced by the ice having been melted. In a direction south-east of the spot on which the stone was found, two depressions were observed in the ice, into one of which an angle of the stone fitted, so that it must have rebounded more than once before coming to rest. The stone is nearly as large as a child's head, and weighed 850 grammes. Externally its colour is brownish-black. The interior has a greyish-white colour and granular texture. Its specific gravity is 3·539. The stone was composed of several different minerals, which could be separated partly by the magnet, and partly by the action of different re-agents. The composition of the different substances was :—

Magnetic Portion.		Silicate decomposable by Hydrochloric Acid.		Undecomposable Portion.	
Fe	84·20	$Si\,O_3$	37·80	$Si\,O_3$	57·10
Ni	14·42	Mg O	31·68	Mg O	19·46
Fe S	0·49	Ca O	3·08	Ca O	1·47
		Fe O	27·44	$M_2\,O_3$	5·62
				$Fe_2\,O_3$	14·72
			100·00	Chrome iron, Tin stone,	Traces.

The decomposable silicate may be expressed by the formula 3 RO SiO_3 and is therefore olivine. The undecomposable silicate may be most nearly represented by the formula 2 R_2O_3, 7 RO, 8 SiO_3. The composition of the entire stone is given below, along with that of the stone which fell at Blanksko in 1833, and which approaches it very closely in composition.

		Blankſko.
Nickel iron	8·22	17·15
Sulphuret of iron	4·32	—
Olivine	49·00	42·67
Undecomposable silicates .	38·20	39·43
Chrome iron and tin stone .	0·26	0·75
	100·00	100·00

—*Poggendorff's Annalen ; Edin. New Phil. Journal*, No. 6.

SPIRIT FROM BEET-ROOT.

AMONG the numerous novelties introduced since the Paris Grand Universal Exposition, is the Distillation of Beet-Root, and the feeding and fattening of cattle with the residue after distillation. Several methods of distilling the roots have been adopted in France, but all of them, if they produced a satisfactory amount of alcohol, left a residue of little value for feeding purposes; until a new method was discovered by M. Leplay, a French chemist and distiller. This system is simple, and is as follows:—The beet-root, by means of a root-cutter, which is sold by Messrs. H. Dray, is cut into slices 1 inch wide and ¼ inch thick. These slices are placed in fermenting tubs, and by the addition of a certain quantity of acid and water, aided by the use of yeast, they are brought to a high state of fermentation.

When fermented, the slices are placed in iron cylinders, in layers upon perforated iron-plates; steam from a low-pressure boiler is then introduced into the bottom of the cylinders, and passing through the holes in the perforated plates, boils the beet-root, and thus extracts the alcohol, which has formed in the slices during fermentation.

The vapour or steam which rises from the layers of slices passes off at the top of the cylinders through a worm placed in a vessel of cold water, where it becomes condensed, and runs from the worm at a strength varying from twenty over proof to twenty under. The spirit resembles whisky in flavour. It is easily rectified and made into spirits of wine, and in France is the object of an extensive commerce.

In 1853 only 20,000*l.* worth of these spirits was made; in 1855, two millions sterling in value was distilled. The residue of the beet-root distilled by the system of M. Leplay will remain in a state fit for the nourishment of cattle for two years, if required, with no other care than that of throwing it into a drained pond or reservoir. It appears from the Report of the French chemist, that 90 per cent. of the nutritive azote originally contained in the beet remains in these residues. The house of Messrs. Dray and Co., of Swan-lane, London Bridge, have arranged with M. Leplay, the patentee, to carry out the invention in England.

The points to which the public attention should be directed as respects the distillation of alcohol from beet-root are:—1st, the economy of corn; for did not we grow so much barley we should grow much more wheat; it is not so with beet-root, for it does not take the place of a white or grain crop, but prepares the ground for wheat.

2nd. Beet-root distilling gives the root also another advantage over sweeds or mangel-wurtzel.

The beet-root, once distilled, may be kept an indefinite period, since it is not affected by either cold or heat; after two years kept in an open tank it has been eaten with avidity by sheep and other cattle. It may almost entirely replace the green crop for oxen and sheep, for, mixed with chaff, it is a favourite food for cattle all the summer.

The nitrogen or agotic parts of the beet remain in the residues, which are the nutritive parts, and produce fat. The farmer has, therefore, almost as much advantage in growing beet as in growing wheat. If the Reports (and they are too numerous to be contradicted) which we receive from France, Belgium, and Germany, are to be believed, a ton of beet-root will produce from eighteen to twenty gallons of proof spirits, and when this valuable product has been extracted, the residues or pulps remain available to the farmer for his cattle; now, twenty gallons of proof spirits are worth, *to-day*, nearly 3*l.*, and the total expense of obtaining these twenty gallons would not exceed 6*s.* 8*d.*: the farmer will therefore have cleared above 56*s.* per ton for his beet without the residues.

ACTION OF STRYCHNIA ON THE ANIMAL ECONOMY.

PROF. KÖLLIKER, of Wurzburg, has communicated to the Royal Society some experiments with Strychnia (the acetate) which gave the following results:—

1. Strychnia has not the least influence on the peripheral nerves through the blood, which is best shown by cutting the nerves before administering the poison.

2. Strychnia paralyses the motor nerves of the voluntary muscles by exciting them to too energetic action,—a paralysis which may be compared to that caused by powerful electric currents acting upon the nerves. In frogs, when the tetanic spasms are over, the nerves often show no trace of excitability; in mammalia they generally retain it in a slight degree, but never show the same energy of action as when uninjured.

3. Strychnia does not affect the sensory nerves.

4. The heart is not affected by strychnia, not even during the tetanic spasms, with the exception only that its pulsations are sometimes a little slower during the tetanic state. On the contrary, the lymph-hearts of frogs contract themselves as soon as the tetanus begins, and remain in this state as long as the spasms last.

5. The tetanic fits can be brought on in two ways; first, through *the sensory nerves*, which, by irritating the grey substance of the spinal cord, produce the tetanic contractions as reflex movements; and, secondly, *through the brain*, which is not affected at all by strychnia, and preserves its powers of volition and sensation. Accordingly, animals poisoned with strychnia try to move in the ordinary way, but every attempt brings on a tetanic fit, so that it is plain that the spinal cord may also be excited by the brain to its peculiar actions.

6. If the tetanus produced by strychnia has been strong, the *muscles are less irritable*, and pass much sooner into the state of *cadaveric rigidity*, which is very strongly marked, and seems to last longer than it generally does. The same early onset of rigidity may be observed in animals killed by tetanus excited by electricity.—*Proceedings of the Royal Society.*

DETECTION OF STRYCHNINE.

THE following letter from Dr. Herapath to the Secretary of the Royal Society—On the Detection of Strychnine by the formation of Iodo-strychnine—has been read:—

Will you do me the favour to announce to the Royal Society that I have been engaged during some time past in the application of my discovery of the optical properties of iodo-strychnia to the detection of this alkaloid in medico-legal inquiries. I find it is perfectly possible to recognise the 10,000th part of a grain of strychnia in solutions by this method, even when experimenting on very minute quantities. In one experiment, I took 1-1000th of a grain only, and having produced ten crystals of nearly equal size, of course each one possessing distinct and decided optical properties, could not represent *more* than the 1-10,000th part of a grain; in fact, it really represents much less, inasmuch as one portion of the strychnia is converted by substitution into a soluble hydriodate, and of course remains dissolved in the liquid.

Will you oblige me by getting this notice brought before the Society; as a new test for strychnia, at this juncture, possesses considerable interest, the colour tests having been so dubiously spoken of by toxicologists.

In order to operate in this experiment, it is merely necessary to use diluted spirit of wine about in the proportions of one part spirit to three of water as the solvent medium, and to employ the smallest possible quantity of the tincture of iodine as the re-agent, and after applying heat for a short time, to set it in repose. On spontaneous evaporation or cooling, the optical crystals deposit themselves, and may be recognised by the polarizing microscope.

I am, &c.,
W. B. HERAPATH.

Professor Frank, of Edinburgh College, has addressed to Professor H. Balfour the following results of a few of many experiments which he has made upon the Detection of Strychnine:—

1. The best method of eliminating this powerful poison from the contents of the stomach, is certainly by digesting those matters with alcohol, filtering, and concentrating the filtered liquid by a gentle heat. To separate any animal matter taken up with the strychnine, boiling this liquid with a little acetic acid, and again filtering, will afford a clear solution of the strychnine, and this concentrated will afford the poison in a fit state for administering it to small animals, or for the application of chemical tests.

2. After many trials of various tests, that which seems one of the best is a neutral solution of chloride of gold, especially if a slight excess of acetic acid exist in the liquid, or be added to the chloride.

This addition throws down from solutions of strychnine a gamboge yellow precipitate, which, if the quantity of the strychnine be considerable, shows a tendency to form minute crystals, while the chloride of platinum affords a less copious precipitate of an *orange-yellow* colour; but the chloride of gold is most to be depended on.

3. I have made comparative experiments with chloride of gold on all the vegetable alkaloids in the subjoined list, not one of which gives any precipitate at all with this test, which, therefore, will serve to discriminate strychnine from those other alkaloids, a point of considerable importance in the investigation of poisons. 1. Salicine. 2. Quinine. 3. Cinchonine. 4. Codeine. 5. Inuline. 6. Lupuline. 7. Veratrine. 8. Picrotoxine. 9. Solanine. 10. Atropine. 11. Delphine.

4. With regard to the delicacy of this test, I may state that six

drops of a saturated solution of strychnine in alcohol, in which, however, it is not very soluble even at a boiling heat, added to twenty minims of liquid, showed a slight yellow precipitate upon standing for some time.

5. Another good test for strychnine is obtained, as is well known, by adding a few drops of sulphuric acid to bichromate of potass. When this is added to a solution of strychnine, it produces no precipitate, but forms a pale blue liquid that seems very characteristic of strychnine.

There have also been read to the British Association papers "on several New Methods of Detecting Strychnia and Brucia; a New Method of Extracting the Alkaloids from Nux Vomica, for Toxicological and Manufacturing Purposes. Experiments on Animals with Strychnia, and probable Reasons for non-detection of Strychnia in certain cases. A new Method of Instituting Post-Mortem Researches for Strychnia," by Mr. T. Horsley.

In the first lecture, Mr. Horsley observed that the circumstances attending Palmer's trial induced him to make a series of experiments on the subject, and he tried the effects of a precipitant formed of one part of bichromate of potash dissolved in fourteen parts of water, to which was afterwards added two parts in bulk of strong sulphuric acid. This being tried upon a solution of strychnine, the bulk was entirely precipitated in the form of a beautiful golden coloured and insoluble chromate. The experiment, as performed by Mr. Horsley, was very interesting, and scarcely a trace of bitterness was left in the filtered liquor. He did not claim to have originated this discovery of the use of a chromic salt and an acid liquor; but the point to which he called attention was the essential difference in the mode of application, and he maintained that it was as much out of the power of any human being to define the limit of sensibility which he had attained, as it would be to count the sands or to measure the drops of the ocean. Taking thirty drops of a solution of strychnia containing half a grain, he diluted it with four drams of water. He then dropped in six drops of a solution of bichromate of potash, when crystals immediately formed, and decomposition was complete. Splitting up the half grain of strychnia into millions of atoms of minute crystals, he said that each of these atoms, if they could be separated, would as effectually demonstrate the chemical characteristics of strychnia as though he had operated with a pound weight of the same. He then showed the chemical reaction with those crystals. Dropping a drop of liquor containing the chromate of styrchnia into an evaporating dish and shaking it together, he added a drop or two of strong sulphuric acid, and showed the effect as previously noted. He next showed the discoloration produced in chromate of strychnia and chromate of brucia by sulphuric acid, the former being changed to a deep purple and then to a violet and red. It had been asserted since the trial of Palmer that the non-detection of strychnine in the body of John Parsons Cook was owing to the antimony taken by the deceased having somewhat interfered with the tests. Such a supposition was, in his (Mr. Horsley's) opinion, absurd. Nothing, he considered, could more incontestably disprove the fallacy than either of two new tests which he then performed. These he considered double tests, because they had first the obtainment of a peculiar crystalline compound of strychnine, which was afterwards made to develope the characteristic effects by which strychnine is recognised. Mr. Horsley next related a series of experiments which he had made on animals with strychnine, and entered into the probable reasons for its non-detection in certain cases, although (as he had just shown before) a method existed of detecting infinitesimal quantities of strychnia by tests. He procured three rats at seven o'clock, P.M., (assisted by Dr. Wright) gave each rat a quarter of a grain of powdered strychnia, and two hours afterwards a quarter and half a grain more to one of the three. Next morning at four o'clock they were all alive, and had eaten food (bread and milk) in the night, but at seven, or a few minutes after, they were all dead. The longest liver was one of the rats that had only had a quarter of a grain. In about three hours afterwards he applied the usual test, but could not detect the least indication of strychnine in the precipitate. There was, moreover, a total absence of bitterness in all the liquor. He tried every part of the bodies of the rats with the like results. What then became of the strychnine? Had it been decomposed in the organism, and its nature changed, as Baron Liebig intimated? As to the non-detection of strychnine, he thought it not improbable that the strychnine might have become imbibed into the albumen or other solid matter, and so abstracted from the fluid, forming by coagulation (say, for instance, in the blood) a more or less insoluble albuminate. This idea had occurred to him from noticing the coagulation of the glairy white of egg with strychnine, and the fact of his not recovering the full quantity of the alkaloid whenever he had introduced it. At any rate, it merited consideration.

In his second experiment, Mr. Horsley administered three-quarters of a grain of strychnia to a wild rat, but the animal evinced little of the effects of poison, and it was purposely killed after five days. His third experiment was with two grains of strychnia, administered as a pill wrapped up in blotting-paper, to a dog—a full-sized terrier. It was apparently quite well for five hours, when the operator went to bed, but was found dead next morning, but lying apparently in the most natural position for a dog asleep. When taken up, blood flowed freely from its mouth. On opening the animal (continued Mr. Horsley), I found the right ventricle of the heart empty of blood, whilst the left was full, some of the blood being liquid and some clotted. The stomach was carefully secured at both its orifices, and detached. On making an incision, I was surprised at not seeing the paper in which I had wrapped the pill, naturally expecting it would have been reduced to a pulp by the fluid of the stomach. I therefore sought for it, and lo! here it is, in precisely the same condition as when introduced into the gullet of the dog, and containing nearly all the strychnine. I have been afraid to disturb it until I had exhibited it to you, and now I will weigh the contents, d ascertain how much has been absorbed or dissolved. This ex-riment is important, as showing the small quantity of strychnia ne-ssary to destroy life; and, had I not been thus particular to search for e paper envelope, it might possibly have led to a fallacy, as I must ve used an acid, and that would have dissolved out the strychnia, d the inference would have been that it was obtained from the ntents of the stomach, whereas it had never been diffused. In is case, also, none of the absorbed strychnia was detectable in the od or any part of the animal, although the greatest care was served in making the experiments. The lecturer added that he had de further experiments, which he thought proved that it was ghly probable a more or less insoluble compound of organic or imal matter with strychnia is formed.

DETECTION OF PHOSPHORUS IN CASES OF POISONING.

MITSCHERLICH has published a very simple and satisfactory ethod of detecting Phosphorus in forensic investigations. The atter to be tested for phosphorus is to be distilled in a flask with ater and sulphuric acid, and the vapours conveyed through a glass be into a vertical glass condenser. This condenser is simply a ass tube which passes through the bottom of a wide glass cylinder led with cold water, which is constantly renewed by a funnel. A ssel to receive the distillate is placed under the end of the con-nsing tube. (The arrangement resembles Liebig's condenser aced vertically.) If there be phosphorus in the substance in the sk, its vapour passes over with the stream into the condenser, and distinct light is seen in the dark where the vapours meet the oled portion of the tube. This light lasts for a very long time, d a luminous ring is usually observed. More than three ounces fluid could be distilled from substances which contained only the $\frac{1}{100000}$ of phosphorus without a cessation of the light. Even after urteen days the effect was observable. An addition of oil of tur-ntine prevents the light, but alcohol and ether distil over, and en the light appears. In the distillate, globules of phosphorus ay be detected, and are easily recognised. These were observed en in a mass which contained but $\frac{1}{3}$ of a grain of phosphorus in 5 nces of matter. When the mass contains much phosphorus the stillate contains phosphorous acid, which is easily oxidized and etected. The author found that phosphoric and phosphorous acids not pass over when distilled carefully with water. A fresh uman stomach boiled with water gives no soluble phosphates; on e other hand, a stomach in a state of decay yields to water phos-oric acid, which can readily be detected by ammonia and mag-esia.—*Silliman's Journal.*

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THE cases of the poisoners, Palmer and Dove, have given an impetus to toxicological researches, not only in England but on the Continent. Professor Otto, of Brunswick, a chemist, who for many years past has made the subject of poison his especial study, contributes in a recent number of a German philosophical journal, some new and curious particulars, not only in relation to strychnia, but to poison generally. He has made a discovery in relation to the poison arsenic, which is very noteworthy. Orfila at one time thought he had satisfactorily proved arsenic to be a normal constituent of the bones of man, an opinion which, if confirmed, would have gone far to render inoperative chemical testimony in relation to the unfair or criminal presence of that body. Orfila subsequently altered that opinion; but recent chemical investigators have demonstrated the presence of arsenic in sources where it would have been little suspected. Amongst others, that metal has been proved to exist invariably in the ochreous deposits which certain varieties of natural water throw down. Cognisant of this fact, Professor Otto thought of examining for arsenic the crust which had formed on the inside of his teakettle, and had not the slightest difficulty, by the application of Marsh's test, in demonstrating the presence of arsenic. The water used in London deposits a large amount of crust on the inside of teakettles. That crust holds a variable portion of oxide of iron, and, probably, if subjected to chemical tests, will be found to contain arsenic.

WHEAT GRAIN.

A PAPER has been read to the British Association, "on the Products and Composition of Wheat Grain," by Mr. J. B. Lawes and Dr. Gilbert. This communication contains the results of a large number of experiments made by the authors during several years, upon wheat grown in this country, as well as abroad. Dr. Gilbert subjected the various coarse and fine varieties of flour to analysis, and showed that the nitrogen increased in proportion as the sample was coarser and contained more bran. The flour that contained least nitrogen was that which took up least water in the process of bread-making, and an interesting question arose as to the nutritive value of bread containing much or no bran; Dr. Gilbert's opinion being in favour of the latter, as far as working men are concerned, notwithstanding the theoretically higher value of bread containing bran. Another interesting fact stated by Dr. Gilbert was, that the Black Sea wheat in Europe, and the Southern States wheat in America, were far richer in gluten than those from more northern latitudes, those from Dantzic containing least gluten, while they stood highest among bread-making grain. The character of the gluten seemed dependent in some degree on its oily constituent, and therefore the quality of the bread depends on the maturation of the seed.

Dr. R. D. Thomson remarked that the value of bread might depend on the state of hydration of the starch and gluten: but was doubtful as to the value assigned to the nutritious qualities of starch, as the French chemists proved that the starch was often left undigested.

Dr. Voelcker stated that he had arrived at similar experimental conclusions as Dr. Gilbert, but while he acknowledged that starchy bread was mechanically the best, he combated Dr. Gilbert's view, that this was the most wholesome kind of bread for the working man. He traced the phosphoric acid found by Dr. Gilbert in the bran to phosphorus contained as such in the gluten, Dr. Voelcker having found this element in caseine and legumine.

USE OF ARSENIC IN STEEPING GRAIN FOR SEED.

Boussingault has communicated to the *Annales de Chimie* some experiments on the Use of Arsenic in Steeping Grain for Seed. This process has two objects, the one to protect the harvest from disease, the other to prevent the seed from being devoured by vermin. The substances generally used are salt, glauber salt, lime, and sulphate of copper. But although these may hinder the development of cryptogamic sporules, they have little effect in preventing the seed from being eaten. The greatest part of the substance used remains in the husk, which the animal rejects.

The most effectual means is the employment of arsenic; this not only preserves the seed from decay, but if eaten by the vermin it destroys them, being so strongly poisonous. By using arsenic in a soluble form, such as the arsenite of soda, it may be added to the grain in perfectly definite proportions.

Boussingault's process is as follows:—A solution of arsenite of soda is prepared, which contains 57 grammes of arsenious acid in the litre. Of this arsenical solution 3½ litres are taken and added to 12½ litres of water. A hectolitre of corn is placed in a large tub, and these 16 litres of mixture are added, the corn being continually stirred. In about an hour the whole of the liquid is absorbed, and the grain is then dried. It is, of course, necessary to exercise extreme care in using the arsenical solution, and it is well to colour it strongly by the addition of sulphate of iron and prussiate of potash, so that its presence would be readily betrayed.

This steeping is not an unprofitable affair, for it first effectually preserves the harvest, and secondly, by killing the vermin which might devour it, converts them into useful manure.—*E. Atkinson, Ph. D., Philosophical Magazine*, No. 76.

POISONOUS ARRACK DISTILLATION.

Dr. A. Smith, in a paper communicated to the *Edinburgh New Philosophical Journal*, No. 8, on the Preparation of Sugar and Arrack in Ceylon, says:—With regard to the sources from which arrack may derive a slight trace of lead, my inquiries have caused me to conclude that there are three; from one or all of which a little of that metal may be yielded. Before enumerating these, however, it may be well to state that the arrack of Ceylon always contains a considerable amount of acid, which, I think, must be derived, in a great measure, from the fermentation of the toddy being allowed, through the carelessness of distillers, to overstep the vinous stage of the process, and thus generate acetic acid, which afterwards distils over with the spirit.

Of the quantity of acid present in the fermented toddy, some idea may be formed from the fact that, at three distilleries, chosen at random, two fluid ounces apothecaries' measure of toddy, which in neither of the instances had been kept beyond what is considered an average period, required, when carefully tested on the spot, as taken from the fermenting vat, in one case eleven, in a second thirteen, and in a third fifteen grains of bicarbonate of soda to render it neutral, it having before been decidedly acid.

The sources which probably supply lead are—1st, The tinning of the still. 2nd, The soldered joinings of the worm. 3rd, The glazing of such of the earthenware jars as are so prepared. That the acid toddy must act on the tinning of the still, cannot, I think, be doubted; and as the fluid frequently boils and froths over during working, a portion of the contents of the still becomes mixed with the arrack in the receiving vessel, and in that way, if not in any other, lead may find its way into the spirit. That the soldering of the worm is a fruitful source of lead in arrack can still less be doubted, when it is remembered that, in a worm of 15 or 20 feet in length (the usual length), a considerable surface of solder actually exists in the joinings of the pieces composing it. In this case, however, I presume that the manner in which lead is chiefly removed from the solder is by the arrack washing off, in its passage along the worm, the carbonate, which may have been formed by the action of the atmosphere on the lead in the solder during the intervals of working.

From the well-known action of acids on the glazing of earthenware, I think it is highly probable that arrack containing so large a proportion of acetic acid, as my experience of that made in Ceylon leads me to believe always exists in it, cannot long remain in jars, such as I have above described, without removing some portion of their glazing. But, in this instance, as in the case of the tinning of the stills, since it is usually only *first distilled arrack* which is kept in the jars, it is possible that any lead withdrawn by it from their glazing, may be again separated when redistillation takes place. At one distillery, and one only, I found glazed jars used to store the regular arrack. In such a case, any impregnation yielded by them would be likely to continue.

In consequence of the several modes in which lead may obtain admission into sugar and arrack, according to the mode of manufacture described above, it is evident that slow poisoning with lead may be apt to attack those who make use of these articles. Accordingly, a virulent epidemic of colic, which attacked a detachment of troops stationed at Newera Allia, was traced by me to the cause in question. An account of this epidemic, and of the investigations connected with it, has been published, partly in the *Edinburgh Monthly Journal of Medical Science*, 1853, vol. xvi., and finally in the *Edinburgh Medical Journal* for July, 1856.

NITRATES IN PERNAMBUCO.

The Earl of Clarendon has forwarded to the Secretary of the Royal Agricultural Society of England the following communication from Mr. Cowper, of the British consulate at Pernambuco:—"I have much satisfaction in informing your lordship that having prosecuted my researches, according to your instructions, I have at length succeeded in discovering the existence of nitrates in large quantities within this empire. The gentleman who has assisted me in this service writes to inform me that he has traversed the mountains north-west of Ipu for sixty miles, and finds that the stratum of carbonate of soda extends the whole distance, and in any quantities. To the west of Ipu, he discovered the nitrates of which I transmit specimens, and also of the earth in which they were found. The formation has extended as far as Mr. Lowden's search, which is about fifteen or twenty miles. Alum, of which I also forward specimens, abounds in the neighbourhood. Gold is very abundant, both in quartz and in the streams, particularly the Lure. I forward a sample. From Lapa to St. Antonio the ground is covered with hematite, or red iron ore, and the mountain range of St. Icao appears to be composed of it. I forward specimens and some pyrites, which appeared full of metal. I will forward your lordship a small map of the country by the next opportunity, with some suggestions respecting the formation of a port at Camoci, for the export of these various productions; and as I naturally feel the liveliest interest in this wonderful region, the metallic riches of which I discovered, perhaps your lordship will permit me personally to continue its survey, as it altogether lies within the district of my consulate."

ANALYSES OF COW'S MILK.

In Liebig's *Annalen*, M. Bœdeker is stated to have made a series of analyses of Cow's Milk taken at the various periods of the day in order. The times selected were the morning at 4 o'clock, noon at 12 o'clock, and evening at 7 o'clock. From these analyses, it appears that the increase of fat in the milk from morning to evening is so considerable that the total quantity of solid substances in the evening milk amounts to one-third more than in the morning milk. The quantity of butter in the evening milk is more than double that of the morning.

The quantity of proteine substances, albumen, and caseine together, remains almost constant. The quantity of sugar of milk is greatest at midday, and decreases towards evening.

The specific gravity of milk is no criterion of its value. A higher specific gravity may indeed be caused by sugar of milk and proteine substances; but a lower specific gravity does not necessarily arise from an increase in the quantity of butter, but also by a greater amount of water.

The importance of this difference, not only for physiological chemistry, but also for dietetics and practical agriculture, is obvious, when we consider that a pound of the morning milk of the cow contains about three drachms of butter; a pound of the evening milk, on the contrary, seven drachms.

PHOTO-GALVANOGRAPHY; OR, ENGRAVING BY LIGHT AND ELECTRICITY.

Herr Paul Pretsch, late Manager of the Imperial Printing Office, Vienna, has invented a very remarkable method of Engraving, by the combined processes of Photography and Electricity. The following description of his invention is from a lecture delivered by him, on the 23rd of April last, at the Society of Arts:—

My invention consists in adapting the photographic process to the purpose of obtaining a raised or sunk design on a glass or other suitable plate covered with glutinous substances, mixed with photographic materials, which design can then be copied by the electrotype process, so as to procure plates suitable for printing purposes. The operator first coats a glass plate with a gelatinous or glutinous solution, suitably prepared with chemical ingredients, sensitive to light, as follows:—One part of clear glue is soaked in about ten parts of distilled water, but the quantity of water depends upon the strength of the glue and the state of the atmosphere. Meanwhile, there are prepared three different solutions, viz., a very strong solution of bichromate of potass, a solution of nitrate of silver, and a weak solution of iodide of potassium. The glue is dissolved by heat, and a small quantity of it is added to each of the two solutions of silver and iodide. The remaining greater portion of the glue is kept warm, the solution of bichromate of potass added, and well mixed. After which the small portion of the glue with silver is added, and also mixed well, and allowed about ten minutes' time for combining. Finally, the small portion of the glue with the iodide is added, the whole mixture strained, and it is then ready to be poured on the plates of glass or other suitable material. When dry, the coated plate is ready for exposure. The photographic picture, the drawing, print, or other subject to be copied, being laid on the prepared coated surface, they are to be placed together in a photographic copying frame, and exposed to the influence of the light. After a sufficient exposure, which is exceedingly variable, according to the intensity of the light, the plate is taken out from the copying frame, when it will be found to exhibit a faint picture on the smooth surface of the sensitive coating. It is then washed with water, or a solution of borax, or of carbonate of soda, as may be necessary. The whole image comes out in relief with all its details, and, when properly done, with all its brilliancy.

If the original is a photograph, chalk, sepia, or Indian ink drawing, the copy represents the different tints in grains; if in lines, the copy will reproduce the lines.

When sufficiently developed, it must be washed with spirits of wine. The surplus moisture is removed, and the plate is covered with a mixture of copal varnish diluted with spirits of turpentine. After some time, the superfluous varnish must be removed by oil of turpentine, and the plate treated again, or immersed in a very weak solution of tannin or other astringent liquid. During this part of the process the plate must be carefully watched and removed as soon as the picture or design is considered sufficiently raised; it is then washed in water and dried. In this state the plate is ready to be copied. This may be effected by the customary methods of rendering the coating conducting, and placing it in the electrotype apparatus, producing an intaglio copper-plate; or, if first moulded, the intaglio mould furnishes the means of obtaining a relievo plate by electro-deposition in a similar way. To produce a *sunk* design on the prepared plates, I proceed as before, but after washing with the spirits of wine the plate must be dried on a warm place, and in due time the picture or design will appear sunk like an engraved plate. The printing plates are produced as before described.

If an intaglio plate is made, it may be printed from at the common copper-plate printing-press; on the other hand, the relievo-plate may either serve as the matrix for producing an intaglio printing-plate, or it may be itself employed in "surface" printing, like a wood-cut. In the latter case, the narrow lines of the impression being sufficiently raised, the broad white spaces must be cut out on the printing-plate, or built up in the matrix. The common, well-known stereotype process also affords another means of producing the necessary plate.

It is well known to practical men that any impression made by fatty ink can be transferred on stone or zinc, for the purpose of printing from it in a chemical way. This method can be also used in the present process, and there are some hopes of obtaining a good impression from the first glass plate, which can be transferred and printed.

A more copious account of this invention has appeared in the *Saturday Review*, No. 59.

PHOTOGRAPHS OF THE SUN'S DISK.

We learn from the Annual Report of the Kew Committee, presented to the Council of the British Association, that the apparatus suggested by Sir John Herschel for photographing the spots on the sun's disk is progressing under the superintendence of Mr. Warren De la Rue. The solar photographic telescope was promised by the maker complete in three months: the object-glass was finished, and some progress had been made with the stand. The diameter of the object-glass is 3·4 inches, and its focal length 50 inches; the image of the sun will be 0·465 inches, but the proposed eye-piece will, with a magnifying power of 25·8 times, and focal length, increase the image to 12 inches, the angle of the picture being about 13° 45′. The object-glass is under-corrected in such a manner as to produce the best practical coincidence of the chemical and visual foci. (Mr. Ross has found, that if for the greatest intensity of vision, in common lenses, the ratio of the dispersive powers of the two media is 0·65, that the chemical and visual foci will coincide best practically when with the same media the ratio is altered to 0·60, the media he sometimes uses being Pellat's flint and Thames plate.) The eye-piece consists of two nearly achromatic combinations, their forms, foci, and focal lengths being arranged upon the basis of the photographic portrait lens, the conditions being nearly similar.

It is contemplated to form the system of micrometer wires on a curved surface; and it may ultimately be found to be advantageous also to curve the photographic screen, as the small curvature necessary, namely, about two-tenths of an inch, will present no mechanical difficulties. As in practice it may possibly be found desirable not to produce the sun's image with too great rapidity, a provision is contemplated for the absorption of some of the most energetic active rays by the interposition of coloured media of different tints.

The telescope being for a special object, it will have no appliances except such as appertain exclusively to that object, so that the only means provided for *viewing* the sun will be through the finder intended for facilitating the adjustment of the sun's image in position as regards the micrometer. The polar axis will be furnished with a worm-wheel and clock-work driver, and the declination axis with a clamping circle. A shutter for covering the object-glass, and capable of being rapidly moved by the observer, will be so contrived as to be under his command, whether he be at the time near the object-glass or near the screen, eight feet distant.

It was originally intended to place the telescope in an observatory 12 feet in diameter, provided with a revolving roof; adjoining the observatory a small room for chemicals was to have been constructed, so as to facilitate the fixing of the pictures. It has, however, been found possible to somewhat alter the construction of the tube, so as to reduce its length sufficiently to allow of the telescope being placed under the dome of the Kew Observatory, which is only 10 feet in diameter.

PHOTOGRAPHY IN THE EYE.

We give the following upon the authority of the *Boston Atlas*, U.S. Dr. Sanford, who examined the eye of Beardsley, murdered at Auburn, to test the truth of the statement that the last scene viewed by a dying man remains fixed on the retina of the eye, publishes this interesting statement:—At first we suggested the saturation of the eye in a weak solution of atrophine, which evidently produced an enlarged state of the pupil. On observing this, we touched the end of the optic nerve with the extract, when the eye instantly became protuberant. We now applied a powerful lens, and discovered in the pupil the rude, worn-away figure of a man, with a light coat, beside whom was a round stone, standing or suspended in the air, with a small handle stuck as it were in the earth. The remainder was débris, evidently lost from the destruction of the optic, and its separation from the mother brain. Had we performed the operation when the eye was entire in the socket, with all its powerful connexion with the brain, there is not the least doubt but that we should have detected the last idea and impression made on the mind and eye of the unfortunate man. The thing would evidently be entire; and perhaps we should have had the contour, or better still, the exact figure of the murderer. The last impression before death is always more terrible on the brain from fear than any other cause, and figures impressed on the pupil more distinct, which we attribute to the largeness of the optic nerve and its free communication with the brain.

PHOTOGRAPHIC PROCESSES.

The Oxymel Process, announced by Mr. Llewelyn, Penllergare, is, undoubtedly, the most valuable discovery in the art of photography that has been made since Mr. Scott Archer introduced collodion. By the help of oxymel all the beautiful delicacy of the finest collodion pictures may be obtained, with the convenience of the paper process, and with much more certainty, and much greater ease. Tourists may take a dozen or two plates, ready prepared, and during a week or a fortnight may expose them in a camera as they may require, and in the evening, or even in a day or two afterwards, may develop the pictures they have obtained at their convenience. Mr. Llewelyn went through a course of many hundred experiments before he arrived at a satisfactory conclusion, and little or no improvement can be made on the exact formula which he has promulgated. Although great care and great cleanliness are necessary to success in the usual collodion process, it is indispensable that there be still much more care and much more cleanliness in the use of oxymel. The least decomposition set up while the plate is in the slide, or the least ray of light falling on the sensitive surface is wholly fatal. If the glass be touched by fingers contaminated with chemicals—if the camera and the slide be not perfectly constructed—if the top of the slide when the shutter is raised be not protected from the light by a cloth—or, in fact, if any one of the usual precautions be neglected—then the chances are great that the operator will be completely foiled.

Oxymel (*οξυς acid, μελι honey*), for the purpose of photography should be manufactured of

Acetid acid	7 fluid ounces.
Distilled water.	8 fluid ounces.
Honey (despumated). . .	5 pounds.

Mix the acid added to the water with the honey made hot. It should be filtered till it is quite clear and free from any cloudiness or sediment. It can be obtained of most photographic chemists, but several houses have undertaken to supply it in its purest possible state, and from the formula above given. The method of procedure includes the ordinary collodion process, and the coating of the plate with a weak solution of the oxymel. For the full instructions, see Mr. Delamotte's pamphlet on the *Oxymel Process*.

Photography by Candlelight.—As many amateurs in Photography have but little spare time during the day in which they can practise the various processes, the following suggestion may be found useful:—Take three millboards, about twelve inches high, by nine inches wide, and cut out a large piece, say eight inches by five inches from the centre of each. Lay all three boards close together side by side, and having pasted or glued them well, cover them entirely with two thicknesses of yellow calico. Ornament them in any way you please on the other side. When set up so as to form a triangle, this makes a most excellent photographic lantern, sold, ready made, in which a candle may be placed, and by the light of which all the manipulations of the Oxymel process may safely be conducted. When not in use this lantern will fold up and make a very good portfolio for paper, &c.—*P. H. Delamotte on the Oxymel Process, &c.*

Photographic Tent.—Major Fitzgerald, of Maperton House, Somerset, has invented a new Photographic Tent, the weight of which does not exceed a few pounds. It can be erected and taken down in an incredibly short space of time,—it requires no wooden framework or poles,—it excludes all light but that by which the photographer manipulates, and it is not nearly so hot as the ordinary tent.

Mawson's Portable Photographic Camera.— Mr. J. Mawson, of Newcastle-upon-Tyne, has introduced an improved Photographic Camera, in which great portability and efficiency are combined. It is one of the lightest and most compact of the portable class, and not less convenient, or in other respects inferior to the more bulky. It is suitable for every climate, and it should be observed, that though very light, it is substantial, and likely to be extremely durable. The focus is obtained in the most convenient manner, by means of a screw, the head of which projects beneath the focusing tablet. The rigid brass tube which usually projects from the lens, has substituted for it a collapsable tube. It is available for the calotype, collodion, albumen, waxed paper, and other photographic processes, and may be fitted either with simple achromatic lenses for views, or compound lenses for portraits. When the camera is unfolded, the base is seen to consist of a slide and sheath. The slide bears a bracket, to which the lens is attached by means of a sliding front. The sheath carries the main frame, which is grooved, either for one or two dark chambers, and the focusing glass. The body is composed of strong leather-like cloth, both light-proof and water-proof. One end of the body is fixed to the main frame, and the other is connected with the lens by a conical tube of pliant cloth, the neck of which is elastic, and contracts over a collar behind the lens. The projection at the back of the instrument shows the focusing tablet, with a shutter for its protection, and a screen which supplies the place of the ordinary focusing cloth. Folding the camera is effected by first detaching the cloth tube from the lens, and packing it with the body in the space between the dark chambers and focusing glass. The slide is then screwed in; and, when released from the detent in front, the main frame is turned square with the base.

Transferring Photographs — Preparing Surfaces for receiving Photographic Pictures.—Mr. Alexander Rollason, of Birmingham, photographic artist, has effected an invention, which consists of improvements in transferring to paper, linen, card-board, bone, ivory, wood, metal, or stone, the film of collodion or albumen used in collodiotype or albumenized plates, by which he can either remove a photograph from the glass or plate on which it has been produced, or, by transferring the plain film on to certain of the substances above named, produce a new base or medium on which photographic pictures may be taken.

In his specification, Mr. Rollason says, "I can by the same means transfer from a plate or glass a plain film of collodion, or albumen, to any suitable base, such as a sheet of paper, or linen, wood or ivory; this will itself form a medium which may be placed in the camera, and a picture taken upon it;" but as this is simply transferring the film *before* the picture is taken, instead of *after*, no further description is necessary.—*Mechanics' Magazine*, No. 1696.

CLOUDS AND ARTISTIC EFFECT.

MR. E. VIVIAN has read to the British Association a paper "on Photographs Illustrating a New Process of Introducing Clouds and Artistic Effect." The result was extremely pleasing: the concentration of light and shadow, and the introduction of middle tint, effecting as fresh an improvement upon the ordinary photograph as the tint stone does in double lithography; thus enabling the photographer to compose pictures in accordance with the rules of art, without the least sacrifice of detail, or departure from the truth of the original negative, so far as the latter is true to nature; supplying the deficiency of the yellow ray, and modifying that of the blue, thus reducing the actinic image to the chiaroscuro of the visual, by toning down the glare produced by the reflection of blue light on foliage, and the unnatural whiteness of slate roofs, water, &c., and affording the means of introducing skies and aërial effects of equal force and delicacy. A plate once prepared may be used for printing any number of positives without further re-touching.

APPLICATION OF PHOTOGRAPHY TO THE COPYING OF ANCIENT DOCUMENTS, ETC.

DR. DIAMOND, in a letter to *Notes and Queries*, states, that he has turned his attention to this branch of the art for some years with perfect success, and recommends the following treatment as the result of his experience. An old mixture of collodion originally made sensitive with a compound of iodine and bromide of ammonium is best; but any old collodium is to be preferred to newly mixed. A light object (such as the page of an ordinary book) half size, if a single lens is used with an ordinary diaphragm, is to be exposed about three minutes; full size, twelve or fifteen minutes; if magnified, longer in proportion. A double combination lens takes only half the time, but should be much stopped with a diaphragm. The picture is to be developed as usual with a weak solution of pyrogallic acid freely dashed over the surface. After cleaning the picture *perfectly* from the hypo, a mixture should be passed over it, composed of two drachms of bichloride of mercury and two drachms of chloride of ammonia, dissolved in ten ounces of common water. The picture now assumes a bluish tint. Wash it quickly and thoroughly, and pour over it at once a solution of hyposulphite of soda, five grains to the ounce of water. This produces a most intense black, and the negative, being washed and varnished, is finished and permanent. The Doctor concludes by affirming that this process is applicable to the production of photographic copies not merely of MSS. on vellum and paper, but of engravings, medals, seals, oil paintings, and all similar objects; and the beautiful specimens he produces in support of his assertion are most convincing and satisfactory.

Mr. Lyte and Mr. Delamotte disagree about the uses of photography in copying old documents. If old papers *can* be copied by the sun, the art will acquire a new value; and come into requisition among historians, lawyers, antiquaries and genealogists, as well as among artists, amateurs, and idlers. Here is a case in point. Mr. Bruce, in announcing in *Notes and Queries*, the discovery of a series of letters written by Charles I., referred to an historical paper of vast importance, the original instructions given by Charles to the Earl of Glamorgan about raising Irish troops for service in England against the Commons. That paper has been much discussed. Its terms have been denied. The authenticity of the paper is open to suspicion. At one time it was in the hands of Dr. Lingard: its present hiding-place is not commonly known; and is now sought. Whoever possesses this paper,—if he should refuse to part with it to the British Museum, where it ought to be,—would probably not object to its being photographed, so that an exact copy could be rendered accessible to historical inquirers. That it could be copied, with the greatest accuracy, we have no doubt. Some copies of old papers and old coins (executed with the greatest beauty by Dr. Diamond) are now before us:—the best evidence, out of the profession, that Mr. Delamotte's views are correct.

PHOTOGRAPHY UNDER WATER.

MR. THOMPSON, of Weymouth, describes, in the *Journal of the Society of Arts*, the means he adopted for taking a Photograph of the bottom of the sea in Weymouth Bay, at a depth of three fathoms. It appears that the camera was placed in a box with a plate glass front, and a moveable shutter to be drawn up when the camera was sunk to the bottom. The camera being focused in this box on land for objects in the foreground at about 10 yards, or other suitable distance, was let down from a boat to the bottom of the sea, carrying with it the collodion plate prepared in the ordinary way. When at the bottom, the shutter of the box was raised, and the plate was thus exposed for about ten minutes. The box was then drawn into the boat, and the image developed in the usual manner. A view was thus taken of the rocks and weeds lying at the bottom of the Bay. Mr. Thompson anticipates that it will be a ready and inexpensive means of arriving at a knowledge of the condition of piers, of bridges, piles, structures, and rocks under water.

FROZEN MERCURY.

A CORRESPONDENT of the *Morning Post* (Feb. 14, 1856) inquires if proofs have been adduced, and where recorded, of the philosophical accuracy of the term "frozen" as applied to mercury when at a certain temperature below zero.

A doubt on this subject (he continues) arose in my mind in contemplating an experiment lately made by Professor Tyndall, at the Royal Institution, wherein the rippling image of an apparently placid surface of mercury was reflected upon a screen by means of the electric light. The remarkable degree of mobility thus shown to exist in mercury gave rise to a train of thought, leading me to consider the various known states of the metal, and, in the course of it, to think that there must be a distinguishable difference, which, when the discovery was made that fluid mercury did pass into a solid state, was overlooked, or not brought into notice. It is to be remembered that water, in descending to 32 deg., has already reached and passed, by several degrees, its state of greatest density. And consequently, although frost has power to fix water, yet by frost its bulk is not made less; and that a conversion of water, by congelation, into a fixed and not malleable mass, is altogether another operation, and one that is quite distinct, from a condensation of mercury; besides which differences, freezing is ever accompanied by an expansion of the substance of the water, and by a visible arrangement of its particles in definite crystalline forms. But mercury at 40 deg. below is to all appearance simply reduced from a fluid to a solid of less bulk and malleable. And assuming that to be so, then it follows that the epithet "frozen," well and truly as it describes the state of water become ice, is not equally well applied when used to characterize the solid state of mercury.

Another correspondent (Feb. 20) replies, that while admitting that all scientific phraseology should be precise and definite, he must yet question his accuracy as to the matter of fact. The truth is that the verb to "freeze" is not of scientific usage, strictly speaking. According to the theory of modern science, all bodies are susceptible of three forms—the solid, the liquid, and the gaseous—which they assume under difficult conditions, and in which everybody presents its peculiar characteristics. Thus, some bodies, when solidified, are crystalline—as in quartz, glass; and others—such as granite, bismuth, and cast-iron—are only so occasionally, or imperfectly. Some metals can be presented in a crytallised form by dexterous treatment, and of others it is impossible to make crystals artificially, although native crystals are sometimes found in the mines which produce the ore. Ice and cast-iron, again, after contracting as they cool down to a certain point, expand when they solidify, while almost every other substance continues to diminish in bulk as it loses heat, to the last.

"Frozen," on the other hand, is a merely vernacular term, applied to bodies which are liquid at ordinary temperatures, and yet solidify with degrees of cold within the limits of climatic influences, or what we may consider as *natural* frigidity. Of these there are only two—water and quicksilver; and we therefore say that they freeze when they become solid. But there is no reason why the term "frozen" should be associated with one set of properties rather than the other. Or if in common apprehension it appears most natural that a liquid should "freeze" into a crystalline solid, the only reason is that we see a thousand specimens of solidified water for one of solidified mercury.

Natural History.

ZOOLOGY.

FLUIDITY OF THE BLOOD.

Dr. W. B. Richardson has made a beautiful series of experiments by which he has proved that the fluid condition of the blood depends on the presence of a minute quantity of ammonia, probably in the form of a neutral carbonate. He found that the chloride of ammonium in the blood will not keep it fluid. The chloride seems to be decomposed when the blood is in a fluid state. The amount of ammonia in the blood seems to vary in different conditions. When the blood is at rest, it parts rapidly with ammonia and coagulates. Ammonia is also found in the breath, the quantity varying. After fatigue or fasting, there is much ammonia given off by the breath, while after meals there is less. This ammonia constitutes one of the sources whence plants derive their nitrogen. In cases of purpura, the breath is ammoniacal. In very low fevers the breath is distinctly alkaline. Dr. Blair, of British Guiana, has observed this in yellow fever. In this disease, ammonia, which causes alkalinity in the breath and secretions, renders the blood fluid. (Dr. Richardson's experiments on this subject have been rewarded with the Astley Cooper Prize.)

THE TEETH.

Mr. John Tomes has communicated to the Royal Society, a paper "on the presence of fibrils of soft tissue in the Dentinal Tubes," whence the following is an abstract.

Referring to the structural characters of dentine, and to the prevailing belief that the dentinal tubes in the normal condition contain fluid, the author goes on to show that the recognised histological characters fail to account for the high degree of sensibility exhibited by the dentine when diseased, or when suddenly exposed by the removal of the enamel.

It is found, moreover, that the dentine is not uniformly sensitive throughout, but possesses a much higher degree of sensibility at the peripheral distribution of the dentinal tubes than deeper in the substance of the tooth; and it is urged that these facts cannot be accounted for by the presence of a fluid in the dentinal tubes, nor by supposing that the hard unyielding dentine is intrinsically endowed with sensation. This view of the matter is borne out by the fact, that all sensibility is at once lost if the pulp of the tooth be destroyed.

Daily experience shows that a tooth may remain useful for a long time after the pulp, and consequently the dentinal fibrils, have been destroyed. If, however, a tooth which has been so circumstanced be examined, it will be found that one of two actions has been set up. Either additional cementum will have been developed upon the surface of the fang, or its bulk will have become diminished by absorption. Similar conditions supervene when the crown of a tooth has been lost by caries.

In old persons, we find the teeth are lost without apparent disease in the dental tissues. The teeth become loose and fall out, the roots being in such cases translucent like horn. This condition is the result of consolidation of the dentinal fibrils, and is followed by absorption of the cementum and dentine. Cases may be found in which the whole of the fang has been observed, but reduction to two-thirds or half of the normal bulk is very common.

The concurrence of the foregoing changes in the sensibility of the tooth, with the destruction or consolidation of the dentinal fibrils, will, the author considers, justify the conclusion, that the dentinal fibrils, in a state of integrity, are necessary to the normal condition of dentine.

ON THE ELECTRICITY OF MUSCLES.

PROFESSOR MATTEUCCI comes to the following conclusion in regard to the electric currents exhibited by muscles at rest :—

a. The electro-motive power of a cut muscle is independent of the size of its transverse section.

b. The electro-motive power increases with the length of the muscle.

c. The electro-motive property of the muscles of living or recently killed animals is greater in mammals and birds than in fish and amphibia. The *duration* of this force, which in all cases decreases most rapidly in the first moments after death, is greater in fish and amphibia than in the higher orders of animals.

d. The nerves have no direct influence on the electro-motive force of muscles. In general, all causes which exert an influence on the physical structure and chemical composition of muscles, so as to modify, in ways unknown, their irritability or contractility, act equally on their electro-motive power.—*Proceedings of the Royal Society.*

NATURE OF THE INVOLUNTARY MUSCULAR FIBRES.

THE following is a summary of the conclusions which Professor Ellis has arrived at on the main subject of his inquiry :—

In both kinds of muscles, voluntary and involuntary, there is an interweaving of the fibres with the formation of meshes.

The fibres in both kinds are long, slender, rounded cords of uniform width, except at the ends, where they are fixed by tendinous tissue, and in both the size of the fibres in the same bundle varies greatly.

In neither voluntary nor involuntary muscle is the fibre of the nature of a cell, but in both is composed of minute threads or fibrils. Its surface-appearance in both kinds of muscle allows of the supposition that in both it is constructed in a similar way, namely, of small particles or "sarcous elements," and that a difference in the arrangement of these elements gives a *dotted* appearance to the involuntary and a *transverse striation* to the voluntary fibres.

The length of the fibres varies in both cases with the organ or part examined, and the connexion with tendon always takes place after the same manner, whether the fibre is dotted or striated.

On the addition of acetic acid, fusiform or rod-shaped corpuscles make their appearance in all muscular tissue ; these bodies, which appear to belong to the sheath of the fibre, approach nearest in their character to the corpuscles belonging to the yellow or elastic fibres which pervade various other tissues : and, from the apparent identity in nature of these corpuscles in the different textures in which they are found, and especially in voluntary, as compared with involuntary muscle, it is scarcely conceivable that in the latter case exclusively they should be the nuclei of oblong cells constituting the proper muscular tissue.

The paper concludes with a statement of the mode of procedure which the author has found most suitable for examining the tissue which forms the subject of his inquiry.—*Proceedings of the Royal Society.*

A PHYSIOLOGICAL CURIOSITY.

St. Martin, the man who has an opening into his stomach, produced by a gunshot wound, is in New York, and a number of the physicians of this city have been experimenting with a view to ascertain the time required to digest food. A thermometer introduced into his stomach through the opening, rose to 101 Fahrenheit. The carrot, Dr. Bunting says, is consumed in five or six hours. Rare roast beef will thoroughly digest in an hour and a half. Melted butter will not digest at all, but float about in the stomach. Lobster is comparatively easy of digestion. Upon the application of the gastric juice to a piece of purple tissue paper, the colour at once faded. In relation to the patient's health, Dr. Bunting observed that it had been uniformly excellent, having, since his recovery from the first effects of the wound, supported a large family by his daily labour. These experiments do not differ materially from those made by Dr. Beaumont, twenty years ago. Mr. St. Martin is at present a little upwards of fifty years of age, of a spare frame, but apparently capable of considerable endurance. He is in excellent bodily health, and has much vivacity of manner. The opening in his stomach has had no injurious effect upon his health, nor has it prevented him from pursuing active and severe labours. If he does not keep a compress to the aperture in drinking water or swallowing anything else, the whole contents of the stomach will pass out through that opening. Through this opening comes out a small part of the stomach, i. e., the inner coat, which shows its different appearance—thick or swollen when under the work of digestion, and thinner when the digestion is over.

CYCLOPS MONSTROSITIES.

Dr. Crisp has exhibited to the Zoological Society, the brain and a sketch of the head of a monoculous lamb. It was born alive, at the full period of gestation, and weighed four-and-a-half pounds. There was one large eye in the centre of the forehead, and the nostrils were absent. Dr. Crisp remarked, that, although the Cyclops variety of monstrosity was not very rare, but few cases were on record of the dissection of the brain.

CAMELS IN THE UNITED STATES.

THE first importation of camels having proved so completely successful, the Government of the United States intend sending the store-ship *Supply*, Captain Porter (which is now fitting out), for a second cargo. Thirty-four camels were introduced into Texas last year by way of experiment, and so satisfactory was the result that it is to be repeated.—*Californian Farmer.*

AUSTRALIAN PTEROPUS.

MR. FAIRHOLME has communicated to the Zoological Society a few observations on the habits of an Australian Pteropus, a species of which genus is in the Society's Gardens. He stated it as well known in the southern parts of Australia in the summer months, but by far the largest flights are seen in the warmer latitudes. The attention is generally attracted to them, just as daylight disappears, by the heavy flapping sound of their wings, as they fly in great numbers overhead, all in the same direction. These flights often continuing to pass for many hours together, on their way to their feeding-places, generally about the banks of rivers, where the tree known as the flooded-gum grows, on the leaves of which they feed. Mr. Fairholme was fortunate enough to have seen two of these places of assembly,—one on a small island in Moreton Bay covered with dense scrub, or jungle, another in the scrub close to his former residence, about forty miles inland from the Bay:—and he states, there would be no difficulty in procuring at Moreton Bay any number of young flying foxes, as the island on which they congregate is close to the anchorage for ships.

CHEIRAMUS MADGASCARIENSIS, CUVIER.

A LIVING specimen of the singular animal, the Aye-Aye, a native of the west coast of Madagascar, has been brought to Paris, and an account of its habits has been read before the Paris Academy of Sciences by Dr. Vinson. Some of the more remarkable peculiarities are as follows:—

The fore-feet of the Aye-Aye are very slender, and the long fingers are terminated by hooked nails; the longest of these is the ring or third, next the middle finger. This last, black, slender, resembling the foot of a large spider, is distinguished from the others, not by its form alone, but also by the purposes to which it is applied. The animal climbs trees, and hangs upon them by its ordinary fingers, but with the slender one it takes its food, carries it to its mouth, searches for larvæ in the bark of trees, and with this filiform finger it drinks, which it never does with its lips directly. When drinking, it dips the long finger into the liquid, and passes it rapidly through the mouth, in a manner licking it with its tongue; the form of its lips, flattened horizontally, being wonderfully adapted for this operation, which the animal repeats with great rapidity.

The most remarkable attitude of the Aye-Aye is that of repose. Squatting upon its hinder legs, it places the head between the fore-feet, and brings over it the thick and bushy tail, of which all the hair is then expanded, and by degrees it covers itself entirely up as with a cloak.

It was at first wild and fierce, endeavouring to hide itself from the presence of any one, but in the space of two months it became tame, remaining at liberty, and not attempting to escape. It was extremely fond of "café au lait" and "eau sucré," drinking by means of its long finger, which it passed and repassed from the vessel to its mouth with incredible agility. Soon after its arrival it one day escaped, and was with difficulty recovered. It exhibited the activity of a monkey on the trees, leaping from branch to branch, and crossing wide spaces with an ease and agility equal to that of the "Lemur catta."—*Rev. et Mag. de Zool.; Edin. New Philos. Jour.*, No. 6.

NEW BIRDS, ETC.

MR. GOULD has exhibited and described to the Zoological Society a portion of the birds collected by Mr. J. M'Gillivray, the naturalist attached to H.M. surveying ship *Rattlesnake*, and lately sent home by Capt. Denham, the commander of the expedition. They were obtained in the Fijis, San Cristoval, Isle of Pines, and other islands. Mr. Gould named them as follows:—*Centropus Milo, Janthœnas hypœnochroa, Turacœna crassirostris, Lorius chlorocercus* and *Hirundo subfusca*. These five birds are now deposited in the British Museum.

Mr. Gould also described a new and very beautiful pigeon from the Solomon Islands, the only specimen he had ever seen, which was sent to him by Mr. Webster, who made an expedition to the above islands. This beautiful pigeon, certainly the most brilliantly coloured of the entire group, Mr. Gould named, in honour of Her Imperial Majesty the Empress of the French, *Jotreron Eugeniœ*.

Mr. Sclater read a "List of the Mammals and Birds collected by Mr. Bridges in the vicinity of the Town of David, in the Province of Chiriqui, State of Panama." Mr. Sclater observed, that this was a very interesting locality to naturalists, being a stage in the passage between North American and South American zoology which had been very little explored. Among the mammals, the occurrence of a sloth and an anteater (*Cyclothurus didactylus*) was remarkable, these animals not having hitherto been observed so far north. Among the birds, of which forty-six species were obtained, and which presented a singular admixture of Central American and New Grenadian forms, were two species apparently undescribed. These were a bush shrike, proposed to be named *Thamnophilus Bridgesi*, and a pigeon (*Geotrygon chiriquensis*).

Mr. Sclater also read a "Note on a Small Collection of Birds, from the Island of Ascension," which had been placed in his hands by Dr. Acland, of Oxford, for examination. The species were only six in number, all Natatores, and none of these of great rarity; but, as no previous notice existed of the birds found in that island, it was thought that their names were worthy of record, as a contribution towards a more accurate knowledge of the geographic range of species.

Mr. Sclater also communicated a paper, by M. Jules Verreaux, of Paris (Corresponding Member), "On a New Form of Accipitres, proposed to be called Urubitornis." The type was stated to be the bird named *Circaetus solitarius* by Tschudi, in his "Fauna Peruana," —and the genus seemed intermediate between Harpyhaliætus and Urubitinga. Three specimens of this scarce eagle had lately been obtained, by Mr. Gurney, for the Norwich Museum, one of which (kindly sent by Mr. Gurney for that purpose) was exhibited.

TROGONS, ETC.

MR. GOULD has communicated descriptions and exhibited specimens of a new Trogon and a new Odontophorus. The former was very closely allied to *Trogon puella*, being precisely similar in every character except that of the colouring of the breast, which is orange instead of scarlet. Mr. Gould characterized this Trogon under the name of *Trogon aurantiiventris*. The species of Odontophorus exhibited and described was nearly allied to *Odontophorus guttatus*, but differs in the lighter colouring of the breast and the redder hue of the crest. Specimens of this bird, which Mr. Gould named *Odontophorus Veraguanensis*, were procured by Dr. Seeman, at Panama, and by Mr. Bridges, from near David, in Veragua. Mr. Sclater's Descriptive Catalogue of the known Species of Tanagers, Part II., containing the genera Pyrrhocoma, Nemosia, Cypsnagra, Tachyphomus, Trichothraupis, Eucometis, Lanio, Phœnicothraupis, Lamprotes, Orthogonys, Pyranga, and Ramphocelus, was communicated to the meeting by the Secretary.

BIRDS FROM NEW ZEALAND.

MR. GOULD has introduced to the notice of the Zoological Society two species of Birds from the New Zealand group of islands which he conceived to be new to science: one, a magnificent parrot, pertaining to the genus Nestor; the other, an equally interesting species of duck belonging to the genus Spatula. Both these birds were placed in Mr. Gould's hands, for the purpose of describing, by Walter Mantell, Esq. The Nestor is by far the largest of the three species of the form now known, and is certainly one of the most interesting of the ornithological novelties lately discovered. It differs from its near allies, *N. hypopolius* and *N. productus*, in its greater size and in the uniformity of its colouring. Mr. Gould characterized this bird under the name of *Nestor notabilis*. The shoveller forms the fifth species known of the genus Spatula. The species of this well-defined form previously described are *S. clypeata*, *S. rhynchotis*, *S. maculata*, and *S. capensis*. For the present bird, which made the fifth species, Mr. Gould proposed the name of *Spatula variegata.*

STRANGE NOTES OF NEW ZEALAND BIRDS.

SIR THOMAS TANCRED, Bart., states that in the Province of Canterbury, New Zealand, there are some small birds in the swamps, one of which has a very peculiar note, exactly like the squeaking of the iron wheel of a plough, or of a wheel-barrow which wants grease. Another, frequenting the same locality, has a very distinct, short song, which it constantly reiterates, and seems to stop short in the midst. Some idea may be given of it by saying that it sings the first nine notes of the Agnes Polka, thus—

—*Edinburgh New Philosophical Journal*, No. 5.

PSALTRIA FLAVICEPS.

MR. P. L. SCLATER has read to the Zoological Society a note on *Psaltria flaviceps*, an American species of the Parine genus Psaltria, and exhibited a specimen of this little-known bird, which had been named *Ægithalus flaviceps* by Professor Sundevall, of Stockholm, and *Conirostrum ornatum* by Mr. Lawrence in the *Annals of the New York Lyceum*. Mr. Sclater, however, considered that it ought to be placed in the genus Psaltria,—of which two North-American species were given by Mr. Cassin, in the synopsis of North-American Parinæ, contained in his volume on the *Birds of California and Texas.*

MEXICAN BIRDS.

MR. SCLATER has laid before the Zoological Society a Catalogue of the Birds lately collected by M. Auguste Sallé in Southern Mexico, and pointed out the principal novelties in the collection, which consisted of 233 species, and was principally formed near Cordova, in the state of Vera Cruz, and partly, also, in the vicinity of the Peak of Orizaba, in the state of La Puebla. Mr. Sclater observed, that there were examples of many well-known South American forms in the present collection which had not hitherto been noticed so far north ; the zoology of the hot Eastern seaboard which M. Sallé explored being, as might have been expected, much more tropical in its character than the table-land of the interior, whence most Mexican collections have hitherto been brought. The species new to science were characterized under the following names :—*Certhiola Mexicana*, *Anabates rubiginosus* and *cervinigularis*, *Anabazenops variegaticeps*, *Xenops Mexicanus*, *Sclerurus Mexicanus*, *Scytalopus prostheleucus*, *Parus meridionalis*, *Formicarius moniliger*, *Todirostrum cinereigulare*, *Muscivora Mexicana*, *Elænia variegata*, *Tyrannus speciosus*, *Pipra mentalis*, and *Myiadestes unicolor*.

THE WILD TURKEY.

MR. GOULD has exhibited to the Zoological Society the magnificent skin of a Wild Turkey which had been transmitted to him from Mexico by the late M. Floresi. This on comparison with the wild turkey of North America, a specimen of which was on the table, appears to be perfectly distinct from it; and the object of Mr. Gould's communication was not only to characterize this unnamed species as *Meleagris Mexicana*, but to establish the fact, that this hitherto unnoticed bird is the true original of the domesticated turkey of Europe.

NEW TURKEY.

THE Queen has presented to the Zoological Society a large and brilliantly-coloured species of Turkey (*Meleagris ocellata*) which has been known for many years to inhabit the vicinity of the Lake Peten, near the confines of the provinces of Vera Paz and Belize, Central America: but so rare is even the skin of the bird in this country, that a stuffed specimen is valued by dealers at about forty guineas. The late Earl of Derby, who was most zealous in his endeavours to improve the breeds of birds likely to be serviceable for food, went to the expense of sending collectors out to Honduras, almost solely with the view of procuring living specimens of this turkey for his aviary at Knowsley. For nearly twenty years his lordship looked forward to the gratification of possessing the species, but all attempts to bring it alive to England failed. This, we are happy to announce, has at length been accomplished by Mr. Skinner, the well-known collector of orchideous plants of Guatemala, assisted by Captain Wilson, of the West India mail packet *Parana*. Mrs. Stevenson, the lady of H.M. Superintendent of Belize, possessed a fine cock ocellated turkey and two hens, which she was desirous of presenting to the Queen, and Mr. Skinner undertook the delicate task of bringing them to England. They are taller, thinner, and more erect than the common turkey, with the plumage marked with iridescent peacock-like eyes, the legs being pink, and the head of a peculiar soft clear grey-blue, crested with clear, bright orange warts. They are to be seen at the Society's gardens, in the Regent's-park.

BIRDS FORMING GUANO.

M. A. RAIMONDE, Professor of Natural History at Lima, was sent in 1853 by the Peruvian Government to the Chincha Islands, in order to ascertain the quantity of Guano existing in these islands. During a sojourn of more than six weeks he made observations on the origin of the guano deposit, and on the birds to which it owes its existence. In some places the guano deposit is thirty metres in depth. From the bodies of animals, as well as from various manufactured articles found in it, he concludes that the deposit belongs to the present epoch of the earth's history. The birds observed during his visit were *Pelecanus majus*, Molin; *Carbo Gaimardii*, Lesson; *C. albigula*, Brandt; *Sula variegata*, Tschudi; *Spheniscus Humboldtii*, Meyen; *Plotus anhing*, Lin.; *Rhyncops nigra*, Lin.; *Larus* *modestus*, Tschudi; *Puffinaria Garnotii*, Lesson; *Sterna inca*, Lesson. These species do not all live constantly on the islands; some of them only appear at the breeding season. The pelicans do not appear to produce much guano, as they almost always inhabit the cliffs, and their excrement falls into the ocean. The same may be said of the species of Carbo. The species of Sula contribute more to the deposit, their numbers being greater, and their habitations being more in the interior of the islands. The species of Plotus and Rhyncops are very rare; those of Larus are more numerous. The Sternas only visit the islands to lay their eggs, but their numbers are so very great that they must contribute in a great measure to the formation of guano. The Spheniscus abounds in the southern island, which is inhabited. These birds not being able to fly, hollow out habitations for themselves in the guano. The birds which produce the largest quantity of guano are the Puffinarias; their number is incalculable.—*L'Institut*, May, 1856; *Edin. New Philos. Journal*, No. 7.

EDIBLE NESTS OF SWALLOWS.

M. HUTEN, chief physician of the Invalides at Paris, states that these nests, collected in Java, are considered by the inhabitants as formed from fish spawn. The viscid filaments often seen hanging from the bills of the birds are said to be derived from the spawn.—*Ibid.*

THE GREAT BUSTARD.

A VERY fine specimen of this bird (*Otis tarda*) was, on the 3rd of January, 1856, taken near Hungerford, in Berkshire, just on the borders of Wiltshire. Mr. Yarrell stated it to be a young male bird, in the third year. It is the only specimen that has been taken for many years in England.

An interesting paper on the Bustard appeared in *Fraser's Magazine* for September, 1854, believed to have been written by the Rev. Charles Badham. It states that a bustard was shot in 1843 between Helston and the Lizard Point; but this was a female bird. It is added that "this is the first instance of the capture of the Great Bustard in Cornwall, and the last instance known to us of the noble species in Great Britain." Mr. Yarrell, however, in a paper which he read before the Linnæan Society in 1853, mentions specimens having been taken in 1850, in Romney Marsh; and in 1851 in Devonshire, but these were female birds.

The specimen taken near Hungerford, when captured had its left leg broken just above the knee-joint; and although it "showed fight" at first, it was ultimately very easily taken on the ground by the little boy who found it, and who caught hold of the end of the wing on the side of the diseased leg of the bird, and so, having been once thrown on its side, it became powerless. The wound on the leg is described as a stale wound, thought to be the result of shot by a ball, and not a common charge, as the limb was not shattered, but broken off. The weight of the bird when captured was 13½ pounds;

and it measured from tip to tip of the wings 6 feet 3 inches. A clever engraving of the bird, by F. J. Smyth, appeared in the *Illustrated London News* for Feb. 16, 1856.

On Feb. 12, this fine specimen, mounted, was exhibited to the Zoological Society. Mr. Gould, after paying a compliment to Mr. Leadbeater for the manner in which the specimen had been got up, made some general remarks on the great bustard, giving its various ranges throughout the world, and regretting that, from the progress made in the science of agriculture and various other causes, it might at the present time be considered as extinct in this island.

THE BITTERN.

DR. CRISP has exhibited to the Zoological Society some parts of the anatomy of the common Bittern (*Botaurus stellaris*), two of which birds, now comparatively rare, had recently been shot on the eastern coast of Suffolk. The stomach, which was exhibited, was large, and contained near its cardial orifice a circle of gastric glands ; a roach, weighing about four ounces, was digested at this part, but the tail, which was in the œsophagus, was intact.

NEW PIGEON.

MR. G. R. GRAY has communicated to the Zoological Society a paper "on a new Species of Pigeon," which had passed a portion of its existence in the Society's Gardens, and which he had every reason to suppose had remained hitherto undescribed. It belonged to the same division as the Garnet-winged Pigeon of Latham (*Columba erythroptera*, Gm.), which has been placed in Dr. Reichenbach's subgenus Phlegœnas by H. I. H. Prince Bonaparte; but considering the numerous divisions that have been formed in this class of birds Mr. Gray thought it might with equal propriety be divided from it. The bird was characterised under the name of *Calœnas* (*Phlegœnas*) *Stairi*.

RARE SNIPES.

A FINE specimen of the *Scolopax Sabini*, or Sabine's Snipe, was shot by Martin T. Smith, Esq., M.P., on the 17th of October last, in a turnip field at Raynham, near Fakenham, Norfolk, and is now in the possession of the son of the hon. gentleman, a member of Trinity College, Cambridge. The genus of which this bird is a handsome specimen is so rare in this country, that Macgillivray could not refer to a specimen in his *British Water Birds*, but was obliged to transcribe the description of Mr. Vigors (who announced its discovery in the 14th volume of the *Transactions of the Linnæan Society*). It is of the snipe kind, but is distinguished from every other species of *Scolopax* by the total absence of white from its plumage, or any of those lighter tints of ferruginous yellow which extend more or less in stripes along the back of them all. In general appearance it bears a greater resemblance to *Scolopax Rusticola* than to any other European *Scolopaces*, but it may immediately be recognised as belonging to a different station in the genus, the two exterior toes being united at the base for a short distance, as in the greater number of the congeneric species, while those of *Scolopax Rusticola* are divided in the origin. Three birds possessing the same characteristics as this specimen have been previously shot in England (according to Thompson), 10 in Ireland; in Scotland, none at all. The bird now alluded to agrees with Mr. Vigors' description in every respect.

POLISH FOWLS.

MR. WOODWARD has exhibited to the Zoological Society living specimens and preparations illustrating the very remarkable peculiarities existing in the skulls of the feather-crested variety of domestic fowl, now known as Polish. In these birds the anterior portion of the frontal bone is expanded into a large spherical tuberosity or cyst, which is partly osseous and partly membranous. The anterior portions of the brain are entirely contained in this tuberosity, being protected from external injury solely by the feathers of the crest and the integuments; the posterior portions are situated, as usual, in the cavity of the cranium, and as the communication between it and the tuberosity is constricted, the brain necessarily assumes the form of an hour-glass, the anterior being the larger portion. This very extraordinary structure, which is well developed even before the escape of the chick from the shell, was noticed by Peter Borelli in 1656, and again described, with many errors, by Blumenbach, in *De Nisus Formativi Aberrationibus*, 1813. Blumenbach states that it is confined to the females, which is incorrect,—that the fowls are remarkably stupid, whereas their instincts do not appear to differ in the slightest degree from those of the other non-incubating varieties of domestic fowl,—and, lastly, that the tuberosity is caused by a tight constriction of the integuments, which, however, does not exist. Pallas, who also notices the peculiarity, erroneously attributes it to a cross with the Meleagris—and the description of a very old specimen in the Catalogue of the Museum of the College of Surgeons states it to be the result of disease, whereas it is the normal condition in all largely-crested fowls.

THE NEW ELECTRIC FISH FROM OLD CALABAR.

THE REV. MR. WADDELL, of Old Calabar, has communicated to Mr. Andrew Murray the following additional information respecting the new Electric Fish (*Malapterurus Beninensis*, Mur.) described in the *Year-Book of Facts*, 1856, p. 143.

I have four electric fish in a large basin, the largest about six inches long, and as thick as the neck of a quart bottle; the smallest about three inches long, and the thickness of your finger. They have been there in a healthy state for some months. I procured eight small fishes, varying from two to three and a half inches in length, which I put in with the others. The electric fish continued, as usual, side by side, quiescent at the bottom, while their visitors swam and darted about in a lively manner, and even ventured down among their dangerous neighbours, rousing them to activity, passing through their ranks, and disturbing them not a little, without seeming to be either afraid of them or molested by them. They frequently rubbed sides without any effect similar to what I had before observed being produced. I retired, but returned in half an hour, when I then found the new-comers, all but one, the largest of them, lying at the bottom among the electric fish. Having taken out the seven which were evidently struck, I found four of the smallest quite dead and stiff, their backs twisted or curved, and their mouths gaping open. Three of them, though much benumbed, revived when transferred to another basin of water, and, after an hour or two, recovered perfectly, and were as lively as before. The one which escaped at first was left with his dangerous companions, but was not so lively as at the first. It would swim about a little, then sink, again rise and make a few darts, and then sink again. Tired of watching him, I went on with my book, but after a little returned, and found him quite dead, his back curved downwards very considerably, and his mouth gaping half an inch open. Taking him by the tail, I lifted him out as stiff as if frozen, and further, observed his colour quite gone; a very dark-brown before, he was now as pale as ashes. I had noticed something of this change of colour in the first four affected, but not of so marked a kind as in this last one. The three which recovered from the first attack remained to be tried again, and were put in with the electric fish a second time, when quite strong and lively. They swam and frisked about as playfully and safely as on the first occasion, and I watched them intently, and for a longer time than before, but observed no movement on the part of the electric fish, though the others sometimes darted down among them. I left them as before, and after a little returned, when all three were lying benumbed at the bottom. Being removed to another basin, one of them revived, the others were dead. Obviously they were not so severely struck as the others had been, the powers of the electric fish being probably by this time somewhat weakened. The one that still survived recovered completely to admit of a new experiment. If you ask me what do they live on? I cannot answer. Those with me eat nothing. They are on my study table, and I see them daily, but give them nothing. Even their water is seldom changed, yet are they strong and lively. I cannot learn that they have been ever found larger than a herring.—*Proceedings of the Royal Physical Society of Edinburgh.*

KEEPING FISH ALIVE.

A French fisherman, of Remiremont (Vosges), named Noel, has discovered a means by which fish may be carried alive a great distance. The apparatus consists of a tin case separated into two parts by an open-work partition. In one of these the fish are placed, and in the other is fixed a mechanical contrivance for keeping up a considerable supply of air in the water. This discovery is due to Noel's having observed that trout always perfer agitated waters, as, he supposed, containing a greater quantity of air than still waters. He accordingly endeavoured to find the means of supplying a great quantity of air to water, and ultimately completed the apparatus which has proved successful.

ARTIFICIAL BREEDING OF FISH.

M. Coste has brought before the Paris Academy of Science, a curious physiological fact, as well as one of some importance in an economic point of view. A lake trout, *Salmo lemanus*, Cuv., reared from ova artificially impregnated, and hatched in his ponds in the College of France, has spawned naturally on the 12th November, upon a bed of gravel, previously prepared, at a particular part of the reservoir, where it was wished to make it deposit its ova. This trout, reared in the narrow fish-ponds devoted to the experiments of M. Coste, was two years and a half old, 35 centimetres in length, weighed 750 grammes, and produced 1065 ova. These have now been impregnated by the male of a common trout (*Salmo fario*) of the age only of nineteen months.—*Rev. et Mag. de Zool.; Edinburgh Philosophical Journal*, No. 6.

ARTIFICIAL BREEDING OF SALMON.

A CORRESPONDENT writes from Perth, March 4:—We are now able to state that one, the first of the pond-bred fish has been caught as a salmon. The fish was caught on Saturday morning by Mr. John Young, Watergate, at some of his fishing stations between Soggieden and the mouth of the Earn. Mr. Young, thinking that so many pond-reared fish had been taken last year as grilse, thought it unnecessary to send it to Mr. Buist, superintendent of the fishings for his inspection, but sold it to a party in town, which was unfortunate, as its identity as a pond-bred fish would have been more completely ascertained. We have seen Mr. Young, and he had not the least doubt of it being a Stormountfield fish, and sold it as such. Mr. Young caught a number of the fish as grilse himself last summer, and is quite qualified to speak to the marking on the fish. The salmon weighed 10½lbs., and was a beautiful shaped fish, and, when brought to table, was declared rich in flavour. The ovum which produced this fish was deposited in the boxes at Stormountfield, by Ramsbottom, in November or December, 1853, and hatched in March or April, 1854. It is now, therefore, certain that in about two years from the hatching of the ovum, the fish ascends the river as a salmon, and that an artificial reared fish is equal, if not superior, to one reared in the river. Mr. Young is certain that many more pond-bred salmon will be taken yet this spring, and has promised to let the superintendent know when he takes any more. It is a great pity that it is so difficult to make the fishermen on the river alive to the importance of reporting the fish when caught. There is still no appearance of any of its ova deposited this year chipping the shell. The keeper, however, reports the eggs healthy: no addled ones are to be seen.

THE HERRING.

THE controversy regarding the habits of the Herring, going on among fishermen and naturalists, has led one of the former class to give his experience, which is as follows:—

1. Herrings spawn on rocks or rocky-bottomed ground. They will never spawn on soft ground where the surface is friable or moveable, because the spawn would not adhere, and very young herrings will never be found on soft ground, but are only to be seen in the vicinity of rocks or rocky ground. 2. All old or full-grown herrings caught off Peterhead and its locality come right in from the deep sea in shoals, larger or smaller, in search of spawning ground. 3. After herrings have spawned they take off to the deep sea like a race-horse. They fly quickly through the water, swimming lightly on or near the surface. A fisherman can know a shoal of spawned herrings at sea from their motions. A shoal of full fish will swim deep in the water and move slowly. 4. Full fish coming in from the deep sea upon hard or spawning ground will not migrate far from the locality till they spawn, and then they will fly off. 5. The full herrings caught at Peterhead are those come in from deep water in search of spawning ground. 6. The young herrings caught off Peterhead and locality in July and afterwards are those spawned on the coast. The great catch at Peterhead for two or three nights last season, proceeded from shoals come in from the deep

sea, in search of spawning ground, mixing with shoals of young herrings spawned on the coast. 7. A shoal of full herrings appearing off Fraserburgh will remain there, and the Peterhead boats have no chance of catching any of them unless they go there for them: because if it comes rough weather, they will be driven too far off, and, in moderate weather, they will not leave the locality of the spawning ground. 8. On the other hand, a shoal of full herrings appearing off Peterhead would have no chance to migrate to Fraserburgh, because, once at spawning ground, they would remain there unless driven out to sea by rough weather. 9. An experienced fisherman, at the first of the season, will go far off, perhaps twenty miles or more, to meet the shoals coming in from deep water. Whenever he falls in with them, knowing they are making for spawning ground in-shore, he will shorten his distance the following night, perhaps two or three miles, and continue to shorten night after night, until they are caught close in-shore. 10. Herrings are found on the coast all the year round, in different stages of advancement. Those found from the end of the fishing till about July of the succeeding year are those spawned on the coast. Fishermen have seen young herrings in myriads, like "bansticles," off the rocks in Cruden. They are supposed to grow quickly.—*Inverness Courier.*

OYSTER AND OYSTER-BEDS OF THE BRITISH SHORES.

BY T C. EYTON, F.L.S.

For the purposes of this Report, I shall divide the subject into three sections—1*st*, That relating to the oyster-beds of England, and the laws respecting them. 2*ndly*, An account of the different beds from my own observations, and reports and information that have been sent to me; and, 3*rdly*, an account of the natural history of the oyster, together with a short summary. The oyster-fisheries of England are of great antiquity. The luxurious Romans held the British oyster in great estimation, and they do not appear to have fallen off in that of the epicure of the present day.

Numerous Acts of Parliament have been passed at different times for the protection of the fisheries. The last, under which the present free months are appointed, was passed in the present reign (6th and 7th Vict. cap. 79), in consequence of a convention entered into between this kingdom and France. Section 45 enacts that the fisheries shall open on the 1st day of September, and shall close on the 30th day of April.

I have received reports from or visited the following oyster-beds:—

Loch Ryan in the mouth of the Clyde.
The whole of the beds of North Wales.
Loch Fyne, which is a bed of no commercial value.
The whole of the Isle of Man beds.
The Jersey, Guernsey, and Sark beds.
The Kentish and Essex beds.

The oysters whose spawn I am about to describe were taken in Loch Ryan on the 10th of July, and were forwarded to me in a box packed with wet grass; they were thirty-two in number, out of which only three proved in spawn. From a rough calculation, the number of animals contained in the spawn of one of these was about three millions, which I believe to be rather under than over the mark. The first I opened had spawn exuded, and lying between the folds of the mantle in a mass; it was of a purplish colour, and on examining it with a hand glass, I could perceive some motion, but on placing a small quantity on a glass plate underneath a half-inch power in the microscope, I could clearly perceive that what I took for ova, in the first instance, were living animals varying slightly in form. They were furnished with cilia, which were in constant and rapid motion, were semitransparent, and had two reddish elongated dots placed on each side behind the cilia. They were very tenacious of life, the cilia moving until the water was dried up on the glass. Some that I placed in a little salt and water lived until the next day.

Having examined the young oyster before it quits the parent shell, and also one year old, there are two gaps in the history to be determined; in the first place, is the oyster exuded from the ovary as ova, or in a living state? In the second, what are the intermediate states it goes through from that in which I have now seen it until it becomes attached to a stone, shell, or other substance?

From the summary reports of the different beds at different depths, it appears that the present fence months do not suit all beds, and that with proper management, the market might be supplied with oysters for several months more out of the twelve than it now is according to law.

That the depth of water appears to exercise the principal influence in the time of spawning; and that it is very doubtful on some beds in deep water if the oyster spawns at all, but that probably the young, when first they make their exit from the shell, are drifted from a neighbouring shallow bed to those in deeper water.

That the commonly received opinion among fishermen and others, that the oyster deposits its spawn in masses, is entirely erroneous.

That the oysters are best in shallow water, and near the entrance of a river into the sea, if the ground is suitable, and feed quicker in such situations; the oysters also are larger and coarser in deep water than shallow.

These points are only put forward provisionally, but I hope next summer to be able to clear them up, as well as to present to the Association a more complete Report.—*Proceedings of the British Association.*

SCYLLARUS ARCTUS.

IN Pennant's *British Zoology* the only locality given for this species is "Found by Dr. Borlasse on Careykillas in Mounts Bay." A specimen of this rare crustacean was taken in the spring of 1856, near the same locality. It was caught in one of the pilchard nets in Pemberth cove, about seven miles from Penzance, and was noticed by the fishermen as a species not known and not previously seen by them. It was procured from them by my active correspondent, Mr. H. J. Shearer, factor for Lord Falmouth, and sent down to be identified.—*Edin. New Philos. Journ.*, No. 7.

LITHODES.

THE Secretary has read to the Zoological Society a paper, by Mr. Adam White, "on Crustacea of the genus Lithodes, with a Brief Description of a Species hitherto unrecorded." It was found by

Mr. Lobb, cast ashore after a violent storm, on the coast of California; and, as it has some peculiarities of structure in its legs and antennæ, carapace and abdomen, distinguishing it from any other, Mr. White named it *Lithodes petalocerus*, from the beautiful petal-like lobes of its antennæ.

BRITISH TEREBRATULA.

M. TEGETMEIER has exhibited to the Zoological Society preparations of the mantle and oral apparatus of the recent British Terebratula (*Terebratula caput serpentis*) specimens of which had been forwarded in a living state from Oban, Argyle, by J. Leckenby, Esq., of Scarborough. It appears that this shell, although a native of the deep sea, can live a week out of water, if placed in a bottle or tin box with moist sea-weed. The valves are so accurately adjusted as to prevent the escape of the contained fluid. The mantle, arms, and *cirri* of this species are frosted over with radiated *spicula*, composed of carbonate of lime, as described by Oscar Schmidt, and forming a beautiful object for the polariscope. To the Palæontologist this structural peculiarity is extremely interesting, as it explains the preservation of many parts of the internal organization, including the delicate *cirri* in fossil Brachiopoda. Mr. Fraser exhibited several rare birds from the collection of T. C. Eyton, Esq., of Eyton, and provisionally described three new species.

HALIOTIS ALBICANS.

DR. GRAY has read to the Zoological Society a paper "on a Monstrosity of *Haliotis Albicans*," of which Mr. Cuming had shown to him four specimens, procured in Paris,—their peculiarity arising from having an elongated, continued slit occupying the place where the series of perforations are usually situated; this slit extending more than one-third of the length of the spiral ridges on the outer, or left side of the whorl. The slit does not extend to the margin of the shell; and there is generally a more or less deep pit on the inner surface at its extremity. When Dr. Gray first saw the shell, he was inclined to regard it as a monstrosity; but when he considered the uniformity of the peculiarity in the specimens he possessed, and in those which had been seen by Mr. Cuming, he thought that it might be the type of a new form. A comparison, however, of the shell with the specimens of *Haliotis albicans* in the British Museum, from Van Diemen's Land, had induced him to believe that they were only varieties of that or some very nearly allied species, and that the peculiarity of their structure was produced by the locality they inhabit; the absence of the shelly matter between the perforations being probably produced by the continued abrasion to which the shells had evidently been exposed, either by some chemical peculiarity in the water, or by the attack of parasitic animals.

DISTRIBUTION OF BRITISH LAND-SHELLS.

THE French have ever been remarkable for their attention to natural history, even under the most disadvantageous circumstances. Examples of this are recorded in the history of the great expedition to Egypt under Napoleon I., and of the more recent French expedition to Algeria. We have now, in the *Revue et Magasin de Zoologie*, for December. 1855, a contribution to Crimean Zoology by Dr. L. Raymond, known by his researches made during the Algerian Expedition. These are published by M. Bourguignat in his *Aménités Malacologiques*, and consist of a list of the land-shells of the genera Helix and Bulimus, observed during the last winter in the East, among which some new species are described. The following British species occur in the localities given below :—

H. carthusiana. Very common at Gallipoli, Constantinople, Balkan, Varna.

H. pisana. Constantinople, in the cemeteries, Silivri, on the shores of the Sea of Marmora.

H. virgata. Gallipoli, Constantinople, Bosphorus generally. (*H. maritima*, Drapardn. with the preceding very common).

H. ericetorum. Around Constantinople, Adrianople, &c., Varna.

Bulimus acutus. On all the coasts of the Sea of Marmora and Black Sea.—*Edinburgh New Philosophical Journal*, No. 6.

SHELLS FROM THIBET.

Mr. Woodward has exhibited to the Zoological Society, some land and fresh-water shells, collected by Dr. T. Thomson in Thibet and Kashmir, in 1847-8, when he accompanied Major Cunningham and Captain H. Strachey in one of the most adventurous journeys ever made in the Himalaya. Ten of the eighteen species are British shells, and the rest widely distributed Indian forms, one of which (*Cyrena fluminalis*, Müll.) formerly inhabited this country. *Helix pulchella* and *Zua lubrica* were found in the alluvial clays of Iskardo, and *Valvata piscinalis* at Kashmir. These shells, so widely distributed, have also a very high antiquity, being found in the newer tertiary deposits of the Thames valley, associated with remains of the extinct elephant and rhinoceros.

EXTERNAL CHARACTERS OF ANIMALS.

There have been read to the Linnæan Society, "Remarks on the influence of the sexual organs in modifying the external characters of Animals," by William Yarrell, Esq., V.P.L.S. This paper was illustrated by numerous drawings of insects, the common lobster, &c., presenting on the right side the characteristic form and markings of the male sex, and on the left those of the female, or *vice versâ*.

ENEMY TO THE LAMB.

Dr. Crisp has exhibited to the Zoological Society specimens and drawings of the *Strongylus filaria*, which he discovered had lately proved so destructive to lambs in many parts of England. In several lambs examined by Dr. Crisp millions of these entozoa and their ova were found in the bronchial tubes and in the intestinal canal. He believed from various experiments made by him, that salt or sulphur given with the food, and the inhalation of sulphurous gas, would be the most likely means of destroying these parasites.

NEW LEPIDOPTERA.

MR. G. R. GRAY has communicated to the Zoological Society a paper "on a new Species of Lepidopterous Insect," included among the various novelties sent home by Mr. Macgillivray during the voyages of H. M. ships *Rattlesnake* and *Herald*. It belongs to the great genus Papilio, and to the sub-division Ornithoptera, and, like the other known species of that group, its flight is very elevated, so much so that it became necessary to employ powder and shot to secure the specimen. No lepidopterous insect of its magnitude has hitherto been known from the locality of this species; which is supposed to be either Solomon Islands, Aneiteum, New Hebrides, or the Figi Group, at any rate from one of the islands in the South Pacific Ocean. Mr. Gray proposed the name of *Papilio* (*Ornithoptera*) *Victoriæ* for this splendid insect.

COLEOPTEROUS INSECTS IN THE BRITISH MUSEUM.

MR. ADAM WHITE has communicated to the Zoological Society a paper, entitled "A Decade of Descriptions of Coleopterous Insects in the Collection of the British Museum, hitherto apparently undescribed." In this decade ten species belonging to the families Prionidæ, Lamidæ, and Cetoniadæ were given and described under the following names:—*Psalidocoptus scaber*, *Tragocephala comitessa*, *T. chevrolatii*, *T. ducalis*, *T. gemmaria*, *T. Guerinii*, *T. Buquetiæna*, *Schizorhina* (*Hemipharis ?*) *Emilia*, *S.* (*Hemipharis*) *Ida*, *Cetonia* (*Protætia*) *procera*.

HOW THE ACTIAS SELENE ESCAPES FROM ITS COCOON.

THERE have been read to the Zoological Society, extracts from a letter addressed to Mr. Adam White, of the British Museum, by Mr. Thomas Hutton, and dated Mussonee, November 27, 1855. It stated that he had despatched a box, *vià* Calcutta, on the 22nd inst., containing living Cocoons of *Actias selene*, in order that an opportunity may be afforded of witnessing the mode in which the moth effects its escape, as Mr. Hutton thinks the proceedings will be interesting to entomologists generally. Two cocoons are added, in which the pupa is dead, in order to show how distinctly visible are the wing spines which formerly induced Mr. Hutton to name the genus "Plectropteron"—a term which he still thinks more applicable than Actias, in which the generic characters make no mention of the spine. As this instrument exists in both the species found in India, it will probably also be detected in *A. luna* of America; and whether the generic name be changed or not, the characters must be revised. Before proceeding to separate the threads by the wing spines, Mr.

Hutton has ascertained that the moth ejects from *the mouth* a few drops of a clear, colourless fluid, with which the gum is dissolved, and it appears to use the tuft of down on the front, between the eyes, as a brush for the application of the solvent. This is a curious fact, as the genus, like Saturniæ, is said to have *no mouth!* Mr. Hutton believes the fact to stand thus:—There is no mouth organized for the *reception* of *nourishment*, though sufficiently so to secrete the fluid in question,—this can be ascertained by dissection; but that a fluid is ejected from that organ is a fact which he has repeatedly witnessed, and it is probable, therefore, that Saturnia and other genera secrete a similar fluid, and similarly apply it to the threads. Mr. Hutton wrote long since about the wing spine to Mr. Westwood, who doubted the fact of its existence.

ANTS.

A CURIOUS discovery is said to have been made by a French gentleman, whose garden was most inconveniently invaded by ants. They swarmed at Rambouillet in his flower-baskets and among his flower-beds to such a degree that it was impossible to attack them with boiling water without killing the plants. M. du Ribert therefore took another course. After stirring well up the ant heaps and removing the "eggs," he scattered over them a few handfuls of guano; and with such success, as he states, that his whole garden was presently cleared.—*Gardener's Chronicle.*

THE GLOW-WORM.

THE producer of this ethereal radiance is a most ordinary-looking brown insect, destitute of wings, and with little power to use its legs; the male is winged and flies at night, not unfrequently to lights in houses. It would be delightful to think of such creatures as fed and nourished on tender plants and the honey of flowers, but the truth must be told; and they are voracious eaters of flesh—the flesh of snails. The subject has been studied; they have been taken in the act. It is too horrible to think of all the details of their history; let us draw a veil over the scene; and, as with some examples of human genius, be content with the ultimate lustre, without inquiring into minutiæ of its origin and support.—*The World of Insects; by J. W. Douglas.*

THE LEAF-INSECT (PHYLLIUM SCYTHE).

A LIVING specimen of one of this species of Leaf-Insect has been, for nearly eighteen months, an inmate of the hot-house of the Royal Botanic Gardens of Edinburgh. For the greatest period of its life, it so exactly resembled the leaf on which it fed, that when visitors were shown it, they usually, after looking carefully over the plant for a minute or two, declared they could see no insect. It had then to be more minutely pointed out to them, and although seeing is notoriously said to be believing, it looked so absolutely the same as the leaves among which it rested, that this test rarely satisfied them, and nothing would convince them that there was a real live insect there, but the test of touch. It had to be stirred up to make it move, or still more commonly was taken off the plant, and made to crawl on the finger of the attendant; and the excitement of this constant stirring up and handling was found to be so much the reverse of beneficial to the animal, that restriction on its days of receiving company was found to be indispensable. The public owe the gratification of seeing this curious insect in its living state to Mrs. Major Blackwood, who got a supply of eggs in the spring of 1854, whence a pair came out on the 9th and 10th of May; one or two followed every week till the end of May, when a week or so of cold weather occurred, during which no more came out; but when fine weather again returned in the beginning of June, they again began to come out in greater numbers, from one or two of which was reared a specimen to perfection. A Fuchsia was first tried as their food, but this the insect soon left for the common myrtle. It never sought to leave the plant till it was full grown, and furnished with wings, when it was found necessary to put a muslin bell-shaped cover over the plant, to prevent the insect flying away. The temperature of the house in which it was kept was as nearly 55° as could be maintained.

Mr. Andrew Murray has communicated to the *Edinburgh New Philosophical Journal*, No. 5, a notice of the above specimen, with remarks on its metamorphosis and growth, from which we have only space to quote these few details:—After having reached the form of a six-legged jointed insect, it emerges from the egg by pushing off the lid. It comes out middle foremost, that is, its head and tail are packed downwards, so as to meet each other; the back between them first appears, and they are drawn out next; the legs are extricated last. The colour of the insect at this stage is a reddish-yellow, something of the hue of a half-dried beech-leaf; for it is to be observed, that although the colour of the insect varies at different periods of its life, it always more or less resembles a leaf in some stages. When it has once settled to eat the leaves on which it is placed, the body speedily becomes bright green. Among the leaves of the common myrtle it cannot be distinguished by the colour of the body (the legs are browner); and its habit of carrying itself tends to add to the deception. It bears its tail generally curled up a little, just about as much bent as the myrtle leaf. As it bends its tail up, however, the curl would be the wrong way, unless the insect walked back downmost, which, in point of fact, is its constant habit, adhering to the underside of the leaves. This habit brings to light another beautiful contrivance for still farther heightening its resemblance to a leaf. The upper surface is opaque green, the under surface glossy, glittering green, just the reverse of the myrtle or guava leaf; so that, by reversing its position, it brings the glossy side up and the dull side down. It is provided with tarsi to suit this upside-down mode of life. Between each of the claws there is a large spongy pad, which, as with flies walking on the ceiling, enables it to adhere firmly to the leaf; indeed it was always difficult to disengage its hold of anything it stuck to.

The leaf-insect is subject to three moults, as is generally the case with the Orthoptera. At the third moult, the full-grown wings and antennæ were produced. The day previous to the casting of the skin, the insect was observed to be unusually lively, shaking and working about with its body, while the feet seemed firmly attached to the leaf. Before the moultings the insect became of a greyish tinge, doubtless caused by the skin having become loose, through the shaking process alluded to.

After each of the first two moultings, the insect assumed a beautiful emerald-green colour, while after the last moult the body had a slight tinge of yellow round it. It subsequently gradually became yellower and brownish at the edge, passing through the different hues of a decaying leaf. Like the leaf it resembles and feeds upon, it seemed to decay on arriving at maturity: and it is to be observed that its sere and yellow leaf also occurred at the period of the year when the foliage assumes its autumnal tint, viz., in the end of September and beginning of October. How far the causes which bring about this result resemble each other in plants and animals will be an interesting subject of inquiry to the physiologist, when we have a better supply of the insect to experiment upon. Mr. Murray's paper, in the *Edinburgh New Philosophical Journal*, is illustrated with three coloured plates of the insect in its various stages. It is not an inch in length when hatched, and not much more at its first moult. In died in October, 1855.

The genus has been long known through a species named by Latreille and succeeding naturalists, *Phyllium siccifolium*; but the species properly entitled to this name is still uncertain, it having been at first supposed that there was only one species, and every specimen of a *Phyllium* having been referred to it. This confusion has been somewhat cleared up by Mr. George R. Gray, who, availing himself of the rich collection in the British Museum, published a Monograph of the genus, in the first volume of the *Zoologist*, in which he describes thirteen species, nine of which were new. The genus seems peculiar to the Eastern world; three of the thirteen having come from the Philippine Islands, three from the East Indies and Ceylon, one from Java, one from Mauritius, and one from the Seychelle Islands. The locality of the remaining four species (among which is the old *Ph. siccifolium*) is unknown. The species with which we have to do, was described by Gray, under the name of *Ph. Scythe*, but without giving a figure of it, a want which we have endeavoured to supply. It comes from Silhet, and the mountainous district of India adjoining Assam. Specimens of the female not unfrequently occur in the cases of insects sent from thence, but the male comes much more rarely. Mrs. Blackwood found both males and females, as well as the young insect in all stages, plentiful in the valleys below Cherrapoonjie in the Kasiah Hills, which form part of the southern boundary of the valley of Assam.

REPTILES AND FOOD.

Dr. Crisp has exhibited to the Zoological Society toads, frogs, and slow-worms that he had kept during the winter, showing that some reptiles would increase in size, and be apparently in good health, without food. Dr. Crisp stated his belief that the statement recently made by some writers, that toads and frogs might be generated without the usual metamorphosis of the tadpole state, was erroneous.

TURTLES.

Professor Agassiz has stated to the Natural History Society of Boston, that he has been of late engaged in an investigation into the geographical distribution of the Turtles of North America. He has collected specimens from all parts of the country, and he thinks he has obtained one or more individuals of nearly every species in North America, and that he has alive, in his yard at Cambridge, all species but three to be found in the United States proper. The facts relative to their geographical distribution are now well established, and his reasoning, in accounting for the diversity of the localities in which the same species are found, is, that different individuals of the same species are adapted, by peculiar organizations, to different climatic influences, and that there is no general law of distribution for which physical agents can account.

POISON OF RATTLESNAKES.

Some experiments have been made at the Society of Arts to test the efficacy, as an antidote, of a root brought to this country by the Hon. R. Temple; and which, if not the veritable guaco so famed among the Indian tribes for its medicinal properties, resembles it closely in appearance, belongs to the same class of Serpentaria, and is reputed throughout Central America to possess similar virtues. Mr. Temple, while admitting that there was reason to doubt whether botanists would accept the herb as identical with guaco, observed that it was so regarded by the natives of Honduras, who invariably had recourse to it when bitten by snakes—a calamity to which they were constantly liable while employed in cutting down logwood and mahogany, or engaged in the pursuit of game. The venom of the snake is so rapid in its action that an immediate application of the antidote was of course an essential condition of recovery, and it was the practice of the natives to administer the herb both externally and internally with as little delay as possible. The stalk, leaf, and root were all supposed to be equally efficacious, and after the patient had taken a strong dose of the tincture or infusion, it was customary to apply a poultice of the leaves to the wound. Whether the powers ascribed to this herb by the snake-charmers and natives of Central America were real or imaginary, and whether the efficacy of the plant was universal, or limited to the bites of the reptiles indigenous to that part of the world, were problems which yet remained to be solved, and which assuredly deserved the attention of pathologists. The experiments were not successful. Some eight or nine drachms of the infusion were given by Dr. Chambers to a healthy rabbit, which was then put into the same box with two puff-adders of the deadliest reputation. On being taken from the cage the same infusion was again administered, and the wound was fomented; but the hind legs became rapidly paralysed, tetanic convulsions supervened, and, though a small dose—not more than two drachms—of the tincture was given, the animal languished and died in thirty-five minutes from the time it was bitten. Owing to the contraction of the jaws, but little of the second dose of the infusion reached the stomach of the rabbit, and Mr. Temple was of opinion that the tincture would have afforded a fairer test, inasmuch as it had been prepared from the herb in a comparatively fresh state, whereas the infusion was made from the dry root, which may possibly be of inferior strength.

SEA-MILK.

THE phenomena described by mariners under this name are occasioned by the presence of phosphorescent animalcules. They are especially produced in the intertropical seas, and they appear to be chiefly abundant in the Gulf of Guinea and in the Arabian Gulf, the most part of the observations referring to these two localities. In the latter, the phenomenon was known to the ancients more than a century before the Christian era, as may be seen from a curious passage from the geography of Agatharchides: "Along this country (the coast of Arabia) the sea has a white aspect like a river; the cause of this phenomenon is a subject of astonishment to us."

An explanation of the phenomenon may possibly be found in the beautiful experiments upon the phosphorescence of the sea, which have been made at Boulogne in 1850 by M. Quatrefages. This naturalist has discovered that the *Noctilucæ* which produce that phenomenon do not always give out clear and brilliant sparks, but that, under certain circumstances, which he has studied with much care, this light is replaced by a steady clearness, which gives in these animalcules a white colour. We may thus understand how, when these animals are in considerable masses, they may present this steady clearness, and colour the sea white to a great extent. *Noctilucæ* do not appear to be the only animals which possess this property. Thus, in an observation of M. Grafton Chapman, the animalcules producing the white tint and phosphorescence were probably gregarious animals of the genera *Salpa* and *Pyrosoma.*

These white colours, like the red, appear frequently, though not always, in the same localities. The following example has been observed in the neighbourhood of the Cape de Verd Islands: it is taken from the narrative of the voyage of the *Venus*, by M. Dupetit-Thouars:—

On the 13th of January, 1837, at two o'clock, having perceived that the sea had changed colour, we sounded, and did not find a bottom at 300 fathoms. The changed colour of the water did not then seem to be attributable to the quality of the bottom, but more truly to the presence of little animalcules or molluscs, named "Squid" by the English. These waters which appear coloured, do not change their place to any sensible degree, in fact in several voyages I have met with them in the same position; but, not wishing to content myself with only quoting what I have met with myself, I will say that in this track we found them in lat. 21° 29′ 39″ N., and long. 21° 45′ 30″ W. of Paris; that Frésier, in his "Voyage to Chili" in 1712, found them in lat. 21° 21′ N., and long 21° 39′ W.; and the American Captain Fanning met with them, on the 12th of July, 1797, in lat. 21° 48′ N., and long. 23° 50′ Greenwich. All these observations go to prove that those coloured waters are limited, and it seems to me that they must be the same as those which were seen in the voyages which we have quoted, since the positions are nearly identical.—*M. Camille Dareste; Annales des Sciences Naturelles.*

BOTANY.

SCHLEIDEN'S VIEWS OF EMBRYOGENY.

PROFESSOR HENFREY has communicated to the British Association the fact that Schleiden and his pupil Schacht have changed their opinions relative to the development of the Embryo in plants. In place of maintaining that the extremity of the pollen-tube formed the first cell of the embryo, they believe that the germinal vesicles exist in the embryo sac before fecundation in the form of protoplasmic corpuscles, which acquire their cellular coat after the fertilization by the agency of the pollen-tube. The experiment of Dr. Radlkofer, of Munich, seems to have been the means of convincing Schleiden of his error. Schacht has confirmed these views by his researches on the process of fertilization in *Gladiolus segetum.*

FORESTS IN INDIA.

DR. M'CLELLAND'S Report, taken in connexion with Dr. Falconer's Report on the Forests of the Tenasserim provinces and Dr. Cleghorn's on the Forests of Madura and Malabar, prove—

1. That the forests of Southern India and Pegu are approaching rapidly to exhaustion. 2. That the first step necessary to check this process is a more effective organization of the forest department of the government of India. Instances are recorded in the Tenasserim provinces of the indiscriminate felling of teak trees of all ages. Trees with a straight bole of 100 feet, and trees with the wood not yet hard, were all hewn down alike. In some forests the axe never ceased for twenty years. In others every teak tree was removed. In Malabar the destruction had not been so extensive, and steps had been taken to prevent the further deterioration of the forests.

In Pegu, it appears that the Burmese Government and the squatters have overworked the forests in a most reckless manner. Trees of all sizes and ages were allowed to be cut, and it was stated that upwards of 70 per cent. of the trees cut were under-sized. In some places the forests have been worked unceasingly for thirty years. Exclusive of trees felled or killed, there remain in the northern forests about 520,000 teak trees, which at the utmost will allow thinning to the extent of 25,000 trees a year. This number will soon be exceeded, and the forests will thus speedily disappear, unless measures are taken for renewal of the trees, which it is not the interest of the lessees to provide for.

BRITISH OAKS.

Dr. Lindley has offered to the Horticultural Society some remarks "on the subject of British Oaks." The question was whether there are two kinds of oak. This has been disputed, and he doubted much whether any two persons would agree as to what constitutes the difference between them. He would, however, direct attention to a sketch of the appearance they present in their most dissimilar state. There grows, he stated, in the New Forest what is called the Durmast oak, which is known to botanists as *Quercus sessiliflora* and the common oak, or *Q. pedunculata*, so called from the acorns being produced on long footstalks. In the opinion of foresters there are several varieties of these two sorts. It is generally supposed that the Durmast and common oak differ only in the acorns; but that is a misconception. It will be seen, he said, that the Durmast has broader and rounder leaves with shorter footstalks than the other kind. Specimens of both were exhibited. They are also more glossy and not so notched as in the common oak. There is a difference in the leaves and in the acorns. If a young sprig of the Durmast is compared with the other, it will be found that there is a difference between the two—the buds are larger, and, as compared with the common oak, there is also a difference in the structure of the wood. It will be seen, he remarked, that what are called the medullary rays are large and broad in the one case, and small and thin in the other. A specimen of the wood of each was here exhibited, which showed that the rays in the Durmast were small, whilst those in the common oak were large and more easily distinguished. The wood of the latter was also stated to rend more easily than the other. Such was stated to be the differences that exist between the common oak and the Durmast in their ordinary state. The Durmast was said to grow one-fourth quicker than the common oak, and to be equally durable.

EXPERIMENTS IN THE BOTANICAL GARDEN OF THE ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

Professor Buckman, in this paper, read to the British Association at Cheltenham, first described the soil and situation of the locale occupied as his garden, which, from being situate on Forest Marble clay, is of a somewhat sterile character. The experimental portion is divided into 200 plots, most of which are 2½ yards square, some double that size, and a few still larger, now engaged in experiments with various manures. The plots are employed at the present time with crops mostly experimental, in the following classes:—Grasses, 82; Papilionaceous feeding-plants, 25; crops for green food, 12; wheat, 6; garden vegetables, 5; turnips, experiments with manures, 14; economic plants, 13; flowering and ornamental plants, 40: total, 197. For the grasses many observations were given tending to show that several so-called species prove in cultivation to be varieties,—instances of which were given in the following genera—Bromus, Festuca, and Agrestis. One case in particular of the three following forms of Festuca, *F. loliacea, F.*

pratensis, and *F. elatior*, was shown to have been produced from the same seed by the gradual change of the first two into the latter. In the Papilionaceæ the author pointed out the production of the spring and winter varieties of Vetch from the *V. angustifolia*. In the genus Trifolium he made the following remarks on *T. pratense* and *T. medium*. The *T. pratense* occurs wild in all good and rich meadows and pastures; its place, however, in poor sandy soils is supplied by the *T. medium*, on which account the latter plant was some few years since introduced into agriculture to insure a crop when the former usually failed. The seedsmen used to supply it under its botanical name of *T. medium*; but it is a curious circumstance that all the samples of this seed now in the market show it to be but a variety of *T. pratense*, and hence, at present, the best-informed seedsmen no longer send it out under the original botanical designation of *T. medium*, but under that of *T. pratense perenne*—the fact being well established that we have two varieties of broad clover in cultivation, whilst the true *T. medium* has been entirely lost to agriculture; and the whole evidence with respect to this subject showed that it has not been lost from neglect, but that it has merged into *T. pratense*; and if so, it remains as a most interesting matter for experiment, especially when it is considered that no doubt has been entertained by botanists of their distinction as species. Many experiments of a like kind were described, and their practical utility clearly pointed out.

PERUVIAN-BARK TREE.

The trees yielding Peruvian bark, which grow at an elevation of 7000 to 8000 feet on the Andes, have for a long series of years been felled for the sake of their bark, and no pains was taken to replace them. Fears have naturally been entertained that, ere long, the supply of bark, and consequently of Quinine, would fail. Efforts have consequently been made to transplant the tree into countries where it is supposed the climate would be suitable. Dr. Royle has taken measures for introducing Cinchona Calisaya or the yellow bark-tree into the higher regions of India; and of late years the Dutch Government have employed Mr. Hasskarl to transport plants of various species of Cinchona from North America to Java and other parts of the Dutch East Indies. These attempts have been successful; and the reports, in regard to the growth of the plant, are such as to lead to the expectation that, ere long, the Peruvian-bark trees will be scattered over extensive districts, and will thus be saved from destruction.—*Edinburgh New Philosophical Journal*, No. 9.

HEDGE-ROW WEEDS.

Every cultivator knows that the old adage, "One year's seeding, seven years' weeding," is scarcely an exaggeration of the increased hoe labour and fallowing caused by one year's neglect to destroy the weeds. That it is scarcely an exaggeration is evidenced by the single fact that 8000 seeds have been ripened in one poppy head.

But we have still fuller information than this, for Mr. Morton has published the following list of weeds, with the number of seeds obtained from a single plant of each, and the date of the gathering:—.

Black mustard	8000	Aug. 17
Charlock	4000	Sept. 18
Shepherd's purse	4500	— 9
Hedge mustard	5400	Oct. 13
Cow parsnip	5000	Aug. 17
Fool's parsley	6000	——
Corn bindweed	600	Sept. 26
Henbit nettle	2000	——
Red Bartsia	4800	Oct. 1
Dandelion	2040	——
Hard-head scabious	4000	Sept. 10
Blackhead	3000	——
Nipplewort	8400	Sept. 23
Stinking chamomile	40,650	——
Mayweed	45,000	Oct. 14
Ox-eye daisy	15,000	Sept. 18
Burdock	24,520	Oct. 1
Sowthistle	19,000	——
Groundsel	6500	Sept. 10
Stemless thistle	600	— 8
Musk thistle	3750	Oct. 13
Corn cockle	2940	Sept. 8
Common campion	3425	Oct. 1
Red poppy	50,000	— 19
Cleavers	1100	Sept. 11
Common dock	13,000	— 15
Dwarf spurge	1500	— 19
Petty spurge	1200	— 11
Sun spurge	1072	Oct. 14

It is true that all these seeds are not usually fertile, that they have many enemies, and may not all vegetate; but, on the other hand, they may be fertile, they may escape those enemies, and they may vegetate.

NEW PLANTS TO REPLACE THE POTATO.

M. Payen has described to the Paris Academy of Sciences a new esculent plant, the Cerfeuil Bulbeux, which he thinks might be advantageously employed as a substitute for the potato, surpassing it in nutritive qualities. A large proportion of the substance of the potato consists of water, 74 per cent. and more, according to M. Payen, while the best roots of the Cerfeuil contain only 63 per cent. In the important ingredient of starch, the superiority of the cerfeuil, when compared with the potato, is as 28 to 21. The former also contains more nitrogenous and fatty matter. The substance of the plant extracted in the shape of a pulpy mass (like potato flour, we presume), is said to have a very agreeable flavour, and the whole quantity of nutritive matter in it, compared with the potato, is stated to be as 36½ to 26. Unfortunately, he does not tell us whether the plant is great or small, whether it can be presented at table in its native form like the potato, or without any other cooking than simple boiling. The memoir states that the cerfeuil should be sown in August or September (in France), and taken up in July.

Irrigation, or watering, appears to be favourable to it, but is not stated to be indispensable.

Another substitute proposed for the potato is called the Dioscorea Gigantica, one of which, from the West Indies, shown at the late Agricultural Exhibition in Paris, was a yard in length. The Société Impériale d'Acclimatation has received one from M. Praxades Pacheco, which measures not less than 2½ metres in length, is upwards of ¾ metres in circumference, and weighs 86 kilogrammes. The specimen was one of nine which came from the same plant. Two of the others were about the same dimensions. The Dioscorea Gigantica, or "igname," grows in the province of Rio Janeiro, on the banks of rivers and in marshes; and the Société is now in possession of a considerable number of different kinds. Those which were sent from New Zealand by Mr. Piddington, of Calcutta, have been multiplied by the care of MM. Chatin, Moquin-Tandon, and Paillet, and in France it is hoped that the acclimatation of this tubercle will be effected without any serious difficulties.

In England, some attention has also been paid to this new Chinese Yam (*Dioscorea Batatas*). Several exhibitions have been made to the Horticultural Society of the plant. Of these one of the most important specimens was sent by Mr. R. C. L. Bevan. This plant is described as self-protecting, needs no watching, and defies any one to pull it out of the ground, as may be done with carrots or turnips, and which is so much complained of by farmers. These specimens were interesting, showing, by analogy, that the quince was better suited for certain kinds of soils than the pear stock; they also showed how necessary it is to keep the roots of fruit trees near the surface, and indicated that, under certain circumstances at least, to deep rooting we owe barrenness and canker.

GIGANTIC BRAZILIAN TUBER.

A HUGE Yam has been presented to the Paris Academy of Sciences from Brazil, three of which, without speaking figuratively, might dine a regiment. It was sent from the province of Rio Janeiro under the name of the *Iguama Gigantica*, and its dimensions were as follow:—Length, 8 feet 2 inches; circumference, 2 feet 9 inches; and weight 178 English pounds. The accompanying letter stated that a *much larger* one would have been sent, if the inland conveyance to the port had not been so expensive. M. Brongniart expressed doubts whether it belonged to the order of Dioscoriæ or Yams, and M. Payen proposed to settle the point by examining the structure of the feculiferous or starch-bearing cells.

SALEP.

MR. ARCHER lately stated to the Society of Arts, in a very interesting account of some of the foreign commerce of Liverpool, that the use of Salep has revived in an unexpected manner. The knobs of which this substance consists are the roots of such terrestrial orchids as our orchis mascula, &c., and they once formed a pleasant beverage sold at the corners of streets in the early morning, under the name of " hot saloop," just as coffee is now sold. Mr. Archer tells us that he should have been much puzzled at the importation of salep not only continuing, but increasing, had he not traced a lot of the root to the manufactory of a chocolate maker, from which he presumes that it is occasionally employed in that preparation. At all events, he is persuaded that salep might be advantageously employed in the manufacture of cocoa and chocolate. This conjecture seems to derive support from the nature of the aromatic principle which is present in well-prepared salep. One of the most costly ingredients in chocolate is vanilla—the pod of a climbing orchid—valued not only for its fragrance, but its stimulating qualities. The weak odour of orchis roots appears to be identical with that of vanilla, as indeed is the fragrance of the whole race, however much it may be modified or disguised by the presence of other "essences." Possibly we have here the commencement of a new source of employment for women and children in the districts where the common orchis grows wild abundantly ; possibly, also, some of the South African species, whose roots are so much larger than our own, may pay for collecting at the Cape of Good Hope and the adjacent colonies.

SORGHUM SACCHARATUM—CHINESE SUGAR-CANE.

SINCE its introduction into the United States, this plant has proved itself well adapted to this geographical range of Indian corn. It is of easy cultivation—being similar to that of maize or broom-corn—and if the seeds are planted in May in the Middle States or still earlier at the South, two crops of fodder can be grown in a season from the same roots, irrespective of drouth—the first one in June or July, to be cut before the panicles appear, which would be green and succulent like young Indian corn, and the other a month or two later, when or before the seed is fully matured. The amount of fodder which it will produce to the acre, with ordinary cultivation, may be safely estimated at seven tons, when green, or at least two tons per acre, when thoroughly cured. The stalks, when nearly mature, are filled with a rich saccharine juice, which may be converted into sugar, syrup, alcohol, or beer, or may be used for dyeing wool or silk a permanent red or pink ; and the entire plant is devoured with avidity, either in a green or a dry state, by horses, cattle, sheep, and swine.

Considered in an utilitarian point of view, this plant, perhaps, has stronger claims on the American agriculturist than any other product that has been brought to this country since the introduction of cotton or wheat. Aside from other economical uses, its value for feeding to animals alone, in every section of the Union where it will thrive, cannot be surpassed by any other crop, as a greater amount of nutritious fodder cannot be obtained so cheap, on a given space, within so short a period of time.

This plant is *not*, as some have asserted, the "Dourah Corn," or "African," or "Egyptian," or "Chocolate," or "Mummy Corn," and should not be cultivated near that variety, nor near broom-corn, a well-known variety of *Sorghum*, because the seeds will mix and destroy the value of the sugar plant.—*United States Agricultural Patent Report.*

PREPARATION OF SUGAR AND ARRACK FROM PALMS IN CEYLON.

DR. ALEXANDER SMITH states:—Three Palms yield Sugar in Ceylon: the Cocoa-nut Palm (*Cocos nucifera*), the Palmyra Palm (*Borassus flabelliformis*), and the Kittul or Jaggery Palm (*Caryota urens*). From each of these palms the juice of the flowering stalk is collected under the name of toddy, and from it sugar, known in the east as jaggery, is regularly prepared; but it is from the Palmyra Palm that almost all the Palm Sugar is obtained. It is from the sugar of the Cocoa-nut Palm that arrack is made in Ceylon. This palm becomes productive in about six or seven years. In collecting toddy, the spathe is stripped off from the spadix before it has fully expanded; the spadices are afterwards beaten between pieces of hard wood, and slices are cut with a sharp knife so as to allow the juice to flow out. Each spadix continues to yield juice for about forty days, at nearly the average rate of half-a-gallon in twenty-four hours.

When it is intended to prepare jaggery from the toddy, great care is taken by burning pieces of wood in the small earthen vessels attached to the flowers, and rubbing their interior with charcoal, to remove any impurities likely to promote fermentation: and, as an additional precaution, chips of the bark of vateria indica are placed in each, so as to retard fermentation.

The jaggery of the central provinces of Ceylon is entirely made from the Kittul juice, which yields a much larger quantity of sugar than does that of the other two palms, and of a quality much more highly prized by the natives.

When toddy is collected for the purpose of making arrack, no care is taken to prevent fermentation, and as it is brought from the trees it is poured into wooden vats in which that process rapidly advances. If attention is not paid to the fermentation, acetic acid is formed, and this often causes the arrack to take up lead from any portion of that metal with which it may be brought into contact.

Dr. Smith then entered into details as to the presence of lead in arrack, which has been traced to the modes of preparation. —*See page* 203 *of the present volume.*

VEGETABLE IVORY PLANT.

VEGETABLE Ivory is now imported chiefly from the river Magdalena into Europe and the United States of America; in some years no less than 150 tons of it have been imported into England. The "nuts" may be purchased in the toyshops of the British metropolis for a few pence each, but when bought in large quantities, they are obtained at a much cheaper rate. In August, 1854, 1000 "nuts" were sold in London for seven shillings and sixpence.

The ivory plant is confined to the continent of South America, where it grows between the 9th degree of north, and the 8th degree of south latitude, and the 70th and 79th of west longitude. It inhabits damp localities, such as confined valleys, banks of rivers and rivulets, and is found, not only on the lower coast region, as in Darien, but also on mountains at an elevation of more than 3000 feet above the sea, as in Ocana. Amongst the Spaniards and their descendants it is known by the name of "Palme de marfil," (ivory palm); whilst its fruit is called by them "Cabeza de Negro," (negro's head); and its seed, "marfil vegetal," (vegetable ivory). The Indians on the banks of the Magdalena term the plant "Tagua," those on the coast of Darien "Anta," and those of Peru, "Pullipunta" and "Homero." It is generally found in separate groves, seldom intermixed with other trees or shrubs, and where herbs are rarely met with.—*Botanical Magazine, May,* 1856.

THE CHINESE GRASS-CLOTH PLANT.

THE following extract from the Report of Mr. Nathaniel Wilson, curator of the Botanical-gardens at Bath, in Jamaica, describes the successful introduction into that island of the China Grass-cloth plant, the Rhee of Assam, and the propriety of turning to profitable account their numerous indigenous fibrous-yielding plants, which are at present quite neglected:—"I have now the happiness of recording my entire success in the cultivation of the Chinese grass-cloth plant (*Boehmeria nivea*), introduced in 1854, and a more valuable introduction could not have been made. I find the plant thrives here with a luxuriance equal to any of our native plants, and probably with more vigour than it does in its native clime. This plant (as it is now well known) produces the best fibre for textile purposes with which we are acquainted, and according to undoubted authority is worth, in the London market, from 80*l*. to 120*l*. per ton; which is surely sufficient to render the plant an object worthy of all the attention we can bestow on it, if new staples for general and profitable cultivation be desirable. I have no hesitation in saying that, by its spontaneous and luxuriant growth, a more desirable and appropriate plant for tropical culture has never before been submitted to the notice of the public. I have thirty-six of these plants ready for distribution, and could, by a small expenditure, increase the number to any reasonable extent."

NATURAL SILK FABRIC.

A REMARKABLE circumstance is said to have occurred in the silk factory of M. Garibaldi, at Cremona. It is stated that, in this factory, a quantity of silkworms, instead of forming the cocoon as usual, actually wove a kind of silk ribbon, of the breadth of an inch, and the length of upwards of twelve feet! In the course of inquiries made into this matter, it has been elicited that a similar phenomenon, only on a much larger scale, took place in Alexandria, in 1836, in the silk factory of Dr. Grillo, where the silkworms wove a ribbon two inches broad, and upwards of sixty feet in length; part of which remarkable product is now preserved and exhibited in the Museum of Natural History at Turin.

A NEW AFRICAN GRAIN.

A GRAIN called the "Fundi," cultivated in some of the districts of the colony of Sierra Leone, has been described in *Chambers's*

Journal, and brought to the notice of European agriculturists for the first time. It is a slender grass, with digitate spikes, and grows to the height of about eighteen inches. The ear consists of two conjugate spikes, the grain being arranged on the outer edge of either spike, and alternated; the grain is attached by a short peduncle to the husk, from which it is easily separated. The grain, which is heart-shaped, and about the size of mignionette seed, is covered by a thin fawn-coloured membrane, and when freed from this membrane is whitish and semi-transparent. It is highly glutinous, and has a delicate flavour, between that of rice and kiln-dried oats.

When ripe it is cut down, tied up in small sheaves, and placed in a dry situation; for, if allowed to remain on the ground and to get wet, the grains become agglutinated to their coverings. The grain is trodden out with the feet, and is then parched or dried in the sun to allow of the more easy removal of the outer membrane in the process of pounding, which is performed in wooden mortars. It is afterwards winnowed with a kind of a cane fanner on mats.

The Europeans and negroes connected with Sierra Leone generally stew it in a close saucepan, with fowl, fish, or mutton, a small piece of salt pork being added for the sake of flavour. This is said to make a very good dish. Sometimes it is made into puddings, and eaten either hot or cold with milk. The grain appears to be quite as delicate as arrow-root, while it possesses a more agreeable flavour than sago, potato-starch, and other similar preparations.

TRITICOIDAL FORMS OF ÆGILOPS.

PROFESSOR HENSLOW has exhibited to the British Association a specimen of Ægilops, which had sprung up in his garden amidst a patch of *Æ. squarrosa*, which for three years in succession had been allowed to scatter its seeds over a portion of a bed appropriated to it. All the other plants had retained the usual characters of *Æ. squarrosa*; but the one in question had become perfectly upright, and wheat-like (triticoidal) in appearance. The awns had lengthened, and the glumes were downy. The plant was barren. The triticoidal forms obtained from *Ægilops ovata* and *Æ. triaristata* are stated to be generally barren; and it has been conjectured that all such must be hybrids. It has, on the other hand, been positively asserted that such triticoidal forms are occasionally fertile, and that genuine wheat has been extensively raised from them.

NEW FRUIT.

M. BABINE has presented to the Institute at Paris some soft-skinned Melons, about the size of a pine-apple. Their flavour is very fine, and more delicate than any fruit of a similar kind hitherto known in northern countries. These melons have been cultivated at Paris by the gardener of the Princess Belgiojoso, from seed which she brought from her farm of Saffron Bolo, in Asia Minor. Although sown late in the season, they have succeeded perfectly well, and it is thought that they may be readily cultivated in France.—*Galignani.*

THE CORK-TREE.

THE Cork-Oak (*Quercus suber*) is an evergreen tree, indigenous to the south of Europe and Northern Africa, and furnishes the well-known article, cork. Some of these trees have been grown to large size in England and Ireland. The cork of commerce comes from the outer bark of the tree, which naturally falls off, though it is much more valuable when removed artificially.

When this oak has attained the age of fifteen years, according to Du Hamel, or twenty years, according to Bosc, the bark is removed for the first time; but this first bark is found to be cracked, and full of woody portions and cells, and hence it is only fit for fuel, or perhaps for tanning. The second disbarking takes place in eight or ten years, when the cork is sold to fishermen for buoying up their nets, and to others for inferior uses. But in eight or ten years more, the tree yields cork of good quality, and so continues to do until it is from two to three centuries old, improving in quality throughout the whole period.—*Agricultural Report of the Patent Office of the United States.*

ON THE GUTTA PERCHA PLANT OF INDIA.

PROFESSOR BALFOUR has read to the Royal Society of Edinburgh the following extracts from a letter from Dr. Cleghorn at Madras, dated 27th November, 1855:—"In the accompanying *Madras Athenæum* of 22nd November, you will find further particulars regarding Peninsular Gutta Percha. Besides the specimens forwarded from Travancore by General Cullen, and from the Neilgherries by Colonel Cotton, I have received samples from two coffee planters in Malabar, showing that the tree extends from Trevandrum to Tellicherry, and with 200 trees growing in one locality, it may reasonably be supposed that the Isonandra is found along the whole line of Ghauts."

The following is an extract from the Jurors' Report on the Madras Exhibition:—"From different parts of the Presidency valuable specimens have been received possessing the useful properties of Caoutchouc and Gutta Percha, in a greater or less degree. The exhibition of the inspissated gum-elastic juice of a number of trees, from different localities, and prepared in different ways, renders it probable that there are a number of similar vegetable productions, which may be advantageously introduced into commerce.

"General Cullen has forwarded a drawing and description of a large forest tree, abounding at the foot of the Ghauts, N.E. of Trevandrum. The plant delineated is evidently one of the Sapotaceæ, and the Malayan name is '*pauchonthee*.' The product, of which a good sample is forwarded, on examination bears a strong resemblance to gutta percha, both in external appearance and mechanical properties. It appears to the Jury that this gum-elastic is possessed of valuable properties."

The Editor of the *Madras Athenæum* remarks:—

"We have seen the product which General Cullen has sent to the Madras Museum, and it resembles the best of the crude gum imported from the States. Its outer surface is brownish-red, and mottled, but this deep tinge may probably have been given to it by the plantain leaf which it was wrapped in; a fresh fracture has a cream-yellow colour, slightly tinged with red. The fracture is smooth but conchoidal, and it is plastic under the heat of the hand. It has been ascertained to be a perfect non-conductor, and, possessing this quality, could be applied to all the uses for which the true gutta percha is adapted for isolating the wires of the electric telegraph," &c.

FLOWERING OF AN AMERICAN ALOE (AGAVE AMERICANA).

A LARGE American Aloe, which there is good reason for believing to be at least fifty years old, growing at Upton, in Essex, in 1855 sent up a flowering stem about 20 feet in height, the flowers of which attained their full perfection in the latter part of September, about three months after the first appearance of the stem. Up to the above season the growth of the plant had consisted in the annual unfolding of a few leaves from the central bud, while at the same time a small offshoot was occasionally sent out from the portion of the stem below the surface of the ground; these offshoots resembling their parent in their mode of growth when transplanted into separate pots. This year, however, the aloe flowered, as aforesaid, with a mighty effort, which appeared to exhaust all its energies, so that the huge fleshy leaves, which before stood firm and erect, gradually shrunk, shrivelled, and drooped as the process of inflorescence advanced; and the plant became a mere ghost of its former self, except as regarded the addition of the magnificent flower-stem. Some weeks previously, a small offshoot appeared above the earth in the pot, and on examining this, it was observed that instead of being, like its predecessors, a small leafy repetition of its parent, it bore no leaves, but two flowers like those produced a few months previously by the central stem. As it was evident that the effort of flowering had so completely exhausted the aloe that it would not live another season, it was determined to destroy it; and, the flower-stem having been sawn off, the plant was turned out of the pot, so as to afford an opportunity of tracing the flowering offshoot to the part from which it sprung. Below the surface, this offshoot consisted of a succulent under-ground stem, about 10 inches long, connected with the under-ground part of the main plant. It now further appeared that there were about a dozen or more other offshoots struggling upwards through the earth towards the surface, which they had not yet reached, terminated by pale green buds, which were found to contain, in the cases of two dissected, rudimentary flowers within the scales of the buds. Thus, the whole constitution of the aloe appears to have been remarkably affected with a tendency to flowering; and just as the part above ground, instead of producing, as usual, a few leaves, shot forth this year a stem with a multitude of flower-buds, so the underground portion of the plant, instead of sending out, as usual, a few (one or two) sprouts, terminating in leaf-buds, this year produced many (a dozen or more) offshoots ending in flower-buds, and destitute of leaves.

The above paper, by Mr. Joseph Lister, F.R.C.S.E., has been communicated to the Royal Society of Edinburgh by Professor

Balfour, who remarked that several specimens of American aloe had bloomed in England the previous year. The first *Agave Americana* which grew and blossomed in the open air in Britain was in the garden of the late James Yates, at Salcombe, Devonshire, about the year 1814. In 1855, four plants of the *Agave* are stated to have bloomed in different localities at Salcombe.

STRUCTURE OF THE VICTORIA REGIA.

MR. GEORGE LAWSON, in a paper read to the Royal Society of Edinburgh, remarks that there is a great paucity of vascular tissue in the *Victoria*, and a vast abundance of cellular tissue; and that throughout the latter there are numerous lacunæ, many of which are remarkably large, and some of them are furnished with internal stellate hairs. Stomata of a circular form occur in abundance on the green surface of the leaf, and not on the red surface of the upturned margin. An ordinary leaf, four feet in diameter, with a surface of 1850·08 square inches, contains 25,720,937 stomata. The under surface of the leaf is clothed with flexuous hairs. The thinner parts of the leaf are perforated with numerous minute holes, produced by a non-development of parenchyma, similar to that which occurs in *Ouvirandra* and other aquatic plants.

TEMPERATURE OF FLOWER OF VICTORIA REGIA.

M. R. CASPARY has made experiments on the flower of this plant, and has arrived at the following conclusions:—A short time before its opening, the flower bud exhibits an elevation of temperature, especially in the stamens. About an hour after its expansion, the temperature of the flower falls to the extent of from 0·9 to 2·9 degrees of Fahrenheit. After this the heat rises to a maximum, exceeding that of the air from 14·06 to 24·9 degrees Fahrenheit, and that of the water 1·24 to 10·44 degrees Fahrenheit. This increase of temperature is independent of any change in the heat of the air or of the water. This independent maximum, as it is called, is succeeded by a second period of floral heat, which Caspary calls dependent, inasmuch as it is under the influence of the atmospheric temperature, attaining, like it, the minimum at sunrise, and the maximum a little after mid-day. This second period has two minima and two maxima. The elevation of temperature occurs in the anthers, the filaments, the staminodia, the petals, and the ovules. The greatest heat is exhibited by the anthers; the maximum exceeding that of the water by 6·5 to 13·39 degrees, and that of the air by 19·48 to 29·9 degrees (the latter was observed on 2nd November, 1855, at 10 A.M.). The filaments are always cooler than the anthers. In the embryos the temperature is not so elevated as in the anthers, and the maximum is only 1·1 to 5·2 degrees above the water, and 4·5 to 18·9 degrees above the air. In the petals and staminodia the increase of temperature is still smaller than in the embryos, the maximum being 2·7 degrees above the temperature of the water, and 6·4 degrees above that of the air. The increase of temperature is different in different flowers, and in the anthers it sometimes attains

61·83 degrees, in the embryos 60·7 degrees. These phenomena are attributed to the absorption of oxygen and evolution of carbonic acid.—*L'Institut; Edinb. New Philo. Journ.*, No. 8.

DISTINCTIVE CHARACTERS OF MONKSHOOD AND HORSE-RADISH.

SEVERAL fatal cases of poisoning having occurred by the accidental substitution of Monkshood, or, as it is commonly called, Aconite-root, for Horse-radish, Mr. Bentley, M.R.C.S., Professor of Botany and Materia Medica to the Pharmaceutical Society, has communicated to the *Pharmaceutical Journal* the characters by which these roots might be readily distinguished from each other.

The more important distinctive characters between the two roots may be thus tabulated and contrasted:—

Aconitum Napellus. MONKSHOOD.	*Cochlearia Armoracia.* HORSE-RADISH.
Conical in form, and tapering perceptibly to a point.	Slightly conical at the crown, then cylindrical, or nearly so, and almost of the same thickness for many inches.
Coffee-coloured, or more or less brownish, externally.	White, or with a yellow tinge.
Odour merely earthy.	Odour especially developed upon scraping, when it is very pungent and irritating.
Taste at first bitter, but afterwards producing a disagreeable tingling and numbness.	Bitter or sweet according to circumstances, and very pungent.

The roots of monkshood and horse-radish may be also distinguished by the different appearances they present when scraped with a knife. Thus the former will then be observed to be of a succulent character, and the scraped portions soon to acquire a pinkish or reddish hue, whilst the latter scrapes firm and dry, and does not alter in colour.

From the above description of the roots of monkshood and horse-radish, it will be seen that instead of resembling each other, as is commonly supposed, they have scarcely any appearance in common, presenting evident and well-marked distinctive characters in their form, general appearance, colour, odour, and taste. The only resemblance between the two roots, and this but a slight one, is in the appearance of their crowns; but even supposing it possible to mistake them so far, the other characters of distinction are so well marked, that no difficulty ought to arise in distinguishing between them.

Mr. Bentley has also examined twelve other kinds of aconite, with the following results:—

Such being the case with these roots, I thought it possible that some other species or varieties of the genus Aconitum might possibly resemble horse-radish root; and as many varieties are commonly cultivated in our gardens, and as these frequently possess similar poisonous properties to monkshood, although more feeble, their substitution would equally account for the fatal accidents that have occurred. I have accordingly obtained from the Gardens of the

Royal Botanic Society in the Regent's-park the roots of twelve other kinds of aconite, specimens of which—*Aconitum Japonicum*, *A. Sinense*, *A. cæruleum*, *A. Akermannii*, *A. paniculatum*, *A. pyrenaicum*, *A. ochroleucum*, *A. neomontanum*, *A. uncinatum*, *A. Cammarum*, *A. Pallasii*, and *A. Lycostonum*. The roots of all these species or varieties, which are commonly cultivated in our gardens, resemble more or less that of the *Aconitum Napellus* (monkshood) in their colour and general appearance, the only difference between them and it consisting in the fact that some of them present a roundish or irregular-knobbed root instead of a conical one; so that it would be even more easy to distinguish them from horse-radish. Besides the above species, the roots of a number of others have been examined by me with the same result.

The distinctive characters between the various species of aconite and horse-radish roots being therefore so evident, it seems most extraordinary that a cook could by any possibility confound them; for in preparing them for the table, one could not but observe the difference in colour, form, and odour. See the paper, with engravings of the roots, in the *Pharmaceutical Journal* for April, 1856.

STRYCHNOS AND STRYCHNINE.

STRYCHNINE, or Strychnia, is usually prepared from the peltate seeds of Strychnos, which are commonly termed nux vomica, rats' bane, poison nut, or koochta. Strychnos is a tropical bush, growing to the size of a tree, and abounds on the Malabar and Coromandel coasts of the Indian peninsula. It bears a cluster of minute flowers and small orange-like fruit. The seeds are embedded in a white gelatinous pulp, which seems perfectly innocent, being greedily eaten by many sorts of birds. The seeds alone form the fatal drug. The wood of the tree is also, however, intensely bitter, and is employed in the cure of intermittent fevers and the bites of venomous snakes. Indeed, strychnine itself is an important remedial agent. In very small and repeated doses, it promotes the appetite, and assists the digestive process. It is employed medicinally in paralysis, dyspepsia, dysentery, affections of the nervous system, &c. In India, the seeds were employed in Dr. Roxburgh's time to increase the intoxicating quality of country spirits.

Strychnos belongs to the natural order Loganiaceæ, an order pre-eminently distinguished by the powerfully poisonous properties of its plants. One of these is the *Strychnos tieuté*, from the bark of the root of which the "frightful poison" called "tjettek" and "upas radja" is prepared. Another species (*S. toxifera*) is employed by the American Indians to poison their arrows, and causes immediate death when introduced into the slightest wound. *S. tieuté* is called the "upas tree" of Java, but being a climbing plant, is quite different both in general habit and botanical characters from that famous half-mythical upas tree around which so many fearful fables of death have been entwined. The name of "upas" has, however, become associated with a great number of poisonous trees throughout Asia. The true upas tree is the *Antiaris toxicaria*, which yields the antjar poison, but its seeds are wholesome. Its venom is due to the same chemical substance (strychnine), which constitutes the *Strychnos nux vomica*, a deadly poison. Dr. Lindley observes, that although much error has been written regarding the upas, there remains no doubt that it is a plant of extreme virulence, even linen fabricated from its tough fibre being so acrid as to verify the story of the shirt of Nessus, for it excites the most distressing itching if insufficiently prepared.

Mr. Archer, in a lecture delivered to the Society of Arts, states that Strychnine is used medicinally in very small quantities, but has no other legitimate application. In the year 1838, duty was paid on 1017lb. of the drug; in 1839 on only 478lb.; in 1840 on 550lb. "Ten years since," Mr. Archer remarks, "a ton of this article would have been a large annual import, it now exceeds sometimes 100 tons. Its use in medicine will not account for this large increase, and our sanitary officers will do well to make observations upon the symptoms which attend the dying ale-drinker, for notwithstanding the fine testimonials of the recipients of casks of pale and bitter ales, my firm conviction is, that the pure bitter of strychnine is a valuable auxiliary to the brewer. Great efforts were made a few years since to introduce the wood of *Picræna excelsa*, a large tree producing a wood as intensely bitter as quassia, and, indeed, this wood was supposed by the importers to be quassia, but they entered it as billet wood, in order to evade the duty. The trick was eventually discovered, and this, together with the high rate of duty, prevented the brewers receiving their supply of bitter wood. They have, doubtless, found a substitute." We recommend this statement to the attention of the custom-house authorities. We know not whether brewers, or rather publicans, are consumers of nux vomica; but it is certain that its employment is secret; and it is not fitting in a country like this that vast quantities of so deadly a poison should be permitted to enter with impunity into consumption for purposes which it is to be feared cannot but be destructive of human life. Prohibition, or prohibitory duties, might stop the evil and remove the scandal.—*Gardeners' Chronicle.* (Johnston states that the bitter substance of strychnine is so intense that its taste can be detected in 600,000 times its weight of water).

SOLAR INFLUENCE ON PLANTS.

THE development of all kinds of Plants is directly dependent on the amount of Solar Influence they receive during their growth. Herein lies a great truth which thick sowing farmers would do well to ponder. If they insist on growing 1000 plants where only 600 should be grown, then they must not expect to have a larger aggregate yield from the former than they might have from the latter, and at the same time they ought to be contented with produce of an inferior quality. A full exposure to atmospheric agency is always productive of good results in the elaboration of any species of cultivated crop, provided that that exposure is not inconsistent with a due amount of shelter.—*J. Lockhart Morton, in the Agricultural Gazette.*

Geology and Mineralogy.

PROGRESS OF GEOLOGY.

At the late meeting of the British Association, the president, Dr. Daubeny, in his opening address, thus referred to the progress of Geology :—"This science has during the last twenty years made such rapid strides, that those who endeavoured from an early period of life to follow at a humble distance the footsteps of the great leaders in that science, obeying the impulse of such zealous and ardent spirit as the one now, alas! by the inscrutable decrees of Providence, lost to his friends and to science, who constituted the head of what was once called, I hope not too grandiloquently, the Oxford School of Geology, have, if I may judge of others by myself, been often distanced in the race, and when they endeavoured to make good their lost ground found themselves transported into a new, and to them, an almost unknown region. Thus, the thorough exploration which has taken place of the Silurian and Cambrian systems, through the exertions of two of our oldest and most valued associates, has added a new province—ought I not rather to say, a new kingdom?—to the domain of geology, and has carried back the records of the creation to a period previously as much unknown to us as were the annals of the Assyrian dynasties before the discoveries of Sir Henry Rawlinson." Among the principles recently regarded as axioms in geology none seem so little likely to be disputed as this :—"That the classes of animals and vegetables which possessed the most complicated structure were preceded by others of a more simple one; and that when we traced back the succession of beings to the lowest and the earliest of the sedimentary formations, we arrived at length at a class of rocks the deposition of which must be inferred, from the almost entire absence of organic remains, to have followed very soon after the first dawn of creation. But the recognition of the footsteps and remains of reptiles in beds of an earlier date than was before assinged to them, tended to corroborate the inferences which had been previously deduced from the discovery, in a few rare instances, in rocks of the secondary age, of mammalian remains; and this has induced certain eminent geologists boldly to dispute whether, from the earliest to the latest period of the earth's history, any gradation of beings can in reality be detected." After touching lightly on the controversy raised among geologists on this question, and adverting to the investigations of Boussingault, Devile, and Bunsen, relative to the gases and other bodies evolved from volcanoes in their various phases of activity, the President glanced cursorily at the nearly allied science of geography. The important undertaking set on foot in connexion with this department of knowledge, and the interesting discoveries made in it since the last meeting of the Association, were briefly enumerated. The President then referred to the change which the sentiments of the public have undergone in relation to the claims of physical science —a change, he observed, that all had equal ground for congratulation with the practical progress made in those pursuits. In conclusion, Dr. Daubeny eloquently combated the prejudice entertained against scientific studies on the ground that they are inimical to revealed religion.

GEOLOGY OF SOUTH AFRICA.

THERE have been read to the Geological Society the following "Notes on the Geology of some parts of South Africa," by R. N. Rubidge, Esq. In a letter to Sir Roderick Murchison, F.G.S., Mr. Rubidge first referred to the occurrence of gold at Smithfield, in the Orange River Sovereignty, as detailed in his letter of May, 1854, published in the *Society's Journal*, No. 41; and stated that several pieces of gold had since been found at the spot described in the letter referred to. Besides being found in the alluvium there, gold was met with in a quartz-vein in the trap traversing the stratified rock,—in other quartz associated with the trap,—and in a mass of limestone enclosed in the trap-dyke;—but none in the stratified rock itself (which belongs to the Dicynodon or Karoo series). Mr. Rubidge next alluded to the fossil plants which he there found in the strata. Mr. Rubidge had also found bones of the Dicynodon near the Caledon River, and at Halse's farm, six miles from Smithfield. Lastly, Mr. Rubidge supplied some remarks on the geology of the copper district of Namaqualand and bordering countries.

GEOLOGY OF THE SOUTH DOWNS AND THE SUSSEX COAST.

MR. P. J. MARTIN, F.G.S., has read to the Geological Society a paper "on some Geological Features of the country between the South Downs and the Sussex Coast." In this communication the author appropriates the boulder-drift lately brought to light by Mr. Godwin Austen to an outer zone of Wealden drift, in addition to those which he has already described as mantling round the nucleus of the Weald; the corresponding parts of this zone he thinks are to be found in the valley of the Thames, and perhaps yet to be discovered amongst the greywethers and other relics of the tertiaries found on the chalk country of Hampshire and Wilts. The above-mentioned zone the author considers as the remains of the boulder deposit spread over the tertiary countries of this and the adjoining parts of the north of Europe, before their continuity was disturbed by the upheaval of the great anticlinal of the south of England. The country immediately under review, Mr. Martin regards as a sectional part of this great anticlinal, and not to be considered apart from the wide geological area to which it belongs. He considers that its phenomena of arrangement and drift belong to the epoch of that upheaval, and betoken the agencies of powerful diluvial currents, set in motion, and contemporaneously assisted by the dislocations known to abound in this part of our island; and without the aid of which no satisfactory conclusion, in the author's opinion, can be deduced respecting the drifts and the other phenomena of the denudations and surface-changes here exhibited.—*Literary Gazette.*

RAISED BEACHES IN ARGYLESHIRE.

COMMANDER J. E. BEDFORD, R.N., has communicated to the Geological Society a paper on this subject, in which he described two examples of Raised Beaches in the Lunga Island and one in Kerera, all having an altitude of 40 ft. 8 in. above high-water mark. Other raised beaches were noticed,—one in Oronsay, at 38 ft. 6 in.; and three in Jura, at 34 ft. 8 in., 42 ft. 1 in., and 105 ft. 5 in. respectively. During the autumn, Capt. Bedford kindly supplied some further notes and another highly finished map, comprising the raised beaches of Jura. He observed that these old beaches of the Western Isles were remarkable for their uniformity of level, their uniform horizontality, their vast extent of shingle, varying from highly-polished pebbles to great rough blocks, and for their perfect state of preservation.

PHENOMENA IN THE MALVERN DISTRICT.

THE Rev. W. S. Symonds, in a paper read to the British Association, treats of the origin of the Haffield conglomerate, and the means by which the Cambrian boulders have been imbedded therein. Professor Ramsay's glacial theory, he remarked, could hardly, in his opinion, account for their presence. He suggested that after the period of elevation of the Malvern, the Cambrian rocks, of the Longmynd series, formed the shingle on the beach of the sea which at that period washed the base of the Malvern Hills. He also showed a small mollusc, which he stated was Permian, from the Keuper.

Professor Phillipps, in a few remarks on the subject, gave a qualified support to Mr. Symonds's suggestions, and called on Professor Ramsay to give some observations on Mr. Symonds's theory. Professor Ramsay replied, in support of his theory, that the Haffield conglomerate was deposited by glacial action.—*Athenæum.*

SYENITE OF THE MALVERN HILLS.

A SPECIMEN of the "Rowlay Rag" has been sent by the Rev. H. Thompson to the Malvern Naturalists' Field Club. The Rowley Ragstone is an ancient basalt, and when melted in a powerful furnace, and quickly cooled, it becomes a beautiful black vitreous mineral, which can be run into moulds, and thus form works of art; but when slowly cooled after melting, it assumes its original basaltic character. This has led to a curious circumstance in connexion with the great bonfire on the Malvern Hills, on the 10th of January, 1856. At the request of Sir William Jardine, Mr. Thompson examined if the rocks on the summit were vitrified by the fire, as is the case in some parts of Scotland, where ancient fire-beacons have been kindled. Now the Malvern summit was *not* vitrified, yet the heat from the fire had been so concentrated upon the foundation rocks by the powerful wind bearing down the flames, that they were much roasted and altered. A quarry at the back of News Wood, at the western base of the Herefordshire Beacon, which Mr. Thompson had visited with M. de la Harpe, a distinguished Swiss geologist, displayed a remarkable section of trap and greenstone dyke, intersecting syenite, and the syenite in contact with the greenstone was not to be distinguished from that *roasted* by the Malvern bonfire, thus showing the heated state of the greenstone when inserted among the syenite.—*Abridged from the Worcester Journal.*

SPONGEOUS ORIGIN OF THE SILICEOUS BODIES OF THE CHALK FORMATION.

MR. J. S. BOWERBANK attributes the whole of the numerous strata of nodular and tabular flints to vast quantities of spongeous bodies that existed in the seas of those remote periods,—the elective attraction of the animal matter of the sponges inducing the deposit of the silex, which in the first instance is always in the form of a thin film surrounding the skeleton of the sponge, and from which successive crops of calcedonic crystals proceed, until the solidification of the whole is effected. The tabular form is accounted for on the presumption that the sponges originating the deposit grew on a more consolidated bottom than the tuberous ones, and that they therefore developed themselves in a lateral direction instead of in an erect position, and on approximating each other were cemented together, and thus formed continuous beds of considerable extent; and the author illustrated this portion of his subject by the production of four recent sponges of the same species, which, by being placed in contact while in the living state, became firmly united to each other within eighteen hours, ultimately forming one sponge. The occurrence of the shells of Echinoderms and of bivalve shells filled with flint was accounted for on the same principle; and the author produced recent bivalve shells, in a closed condition, completely filled with recent sponges of the same species as the sponges of commerce. The loose specimens of the fossil sponges included in the Wiltshire flints were explained on the principle that, although sponges of the same species readily adhere to each other when placed in contact, those of different species never unite, however closely they may be pressed together. The author concluded his paper by applying the same principles to the siliceous deposits of the whole of the geological formations which were of aqueous origin.—*Proc. Brit. Assoc.*

STRATA OF HASTINGS CLIFFS.

BETWEEN Hastings and Cliff End, to the eastward, the sea has considerably modified the aspect of the cliffs since Mr. Webster described the strata of this coast in detail; and Mr. S. H. Beckles having devoted much time and labour to the search for fossils in these cliffs, has been enabled to work out the relations of some beds of sandstone and clays subordinate to the conglomeratic shale and ironstone which Mr. Webster described as the lowest strata visible in the series. The above-mentioned shale and ironstone contain remains of Insects (discovered by Messrs. Binfield in 1853) and Saurians, together with *Cyrenœ* and *Unionidœ;* and the ironstone is full of fragmentary plant-remains. In the sandstone beneath are also *Uniones*, and the natural casts of great foot-tracks, already described by Mr. Beckles. In the next succeeding bed are beautiful Zamia-like plant-remains, together with a large *Unio* or *Anodon*, and a *Paludina*. Beneath these is the clay, in which *Hybodus*-spines were the only fossils found.

FUNGUS IMBEDDED IN FENS OF CAMBRIDGESHIRE.

FUNGI are so rare in a fossil state, if indeed any undoubted cases occur before the post pliocene period, that no apology need be made for recording so trifling a matter as the present. Moulds are occasionally well preserved in amber, and a diligent search would probably detect species of other groups among the vegetable relics of the London clay. In the museum at Kew, there is a specimen of *Polyporus fomentarius*, Fr., communicated from the fens of Cambridgeshire by the Rev. Mr. Hailstone, where it occurred with bog oak, and must have been buried for many centuries. The specimen is so perfect, that it shows the particular substance of the pileus in admirable condition, both as regards colour and texture. It may be remarked that the specimen, which is attached by the centre, and ungulate, is far more strongly lanate than any British individuals which have passed through my hands, and in fact accords perfectly with one which was gathered in Sikkim by Dr. Hooker, and which may be seen in the same compartment of the museum. It must have been dependent from some large branch, a situation in which the species seldom if ever occurs in Great Britain, and was probably surrounded by a moister atmosphere, in consequence of the prevalence of extensive forests that exist at present in the same or neighbouring districts.—*Berkeley Journ. Prov. Linn. Soc.*, June, 1856.

PROBABLE PERMIAN CHARACTER OF THE RED SANDSTONE OF THE SOUTH OF SCOTLAND.

MR. E. W. BINNEY, in a letter to Sir Charles Lyell, F.G.S., states that, during a late visit to the South of Scotland, he came to the conclusion that the Red Sandstones of Canobie on the Esk, Lockerbie, Corncockle Muir, Dumfries, Thornhill, Sanquhar, and Mauchline, as well as those of the West of Scotland generally, with the exception of the Annan beds, containing tracks of the Labyrinthodon, will have to be classed as Permian instead of Triassic. The Permian beds of the north-west of England, as described lately by the author in the *Manchester Memoirs*, consist of—1. Red and variegated marls (gypsiferous in the north, and calciferous in the south of the district), 300 feet thick; 2. Magnesian limestone, 10 feet; 3. Conglomerate, 350 feet; 4. Lower new red sandstone, 500 feet. The conglomerate of the above list is represented, according to the author, by the breccia of the South of Scotland underlying red sandstones. The conglomerate or breccia consists of a cement, similar throughout the whole region, and of fragments of rocks which vary in their character according to the localities; the imbedded fragments having been in every case derived from the local rocks. The circumstance of the large track of the South-west of Scotland hitherto mapped as Trias proving to be Permian will be of great importance to the ironstone and coal districts of the vicinity; since in some instances these latter deposits will probably be followed beneath it.

CRYOLITE OF GREENLAND.

MR. J. W. TAYLOR has communicated to the Geological Society a paper "on the Cryolite of Greenland." At Evigtok, on the shore of the Fiord of Arksut, in South Greenland, is a mass of cryolite, 80 feet thick, 300 feet long, and dipping southward, at an angle of 45°, between two planes of the including gneiss, to an unknown depth. The upper or roof gneiss is separated from the cryolite by a thin layer of quartz, crystals, and a rich vein of argentiferous galena, associated with some copper and iron pyrites and sparry iron ore. The same minerals, together with fine crystals of tantalite, are diffused on the upper part of the cryolite to the depth of a few feet. The mass of cryolite is quite pure until within 10 feet of the under or floor gneiss, when again similar minerals are disseminated in it. The cryolite is separated from the under gneiss by a vein of dark purple fluor spar. The central cryolite mass, when exposed at the surface (to which the sea has access), is quite white; but when penetrated to a depth of 10 feet, although free from other minerals, it is of a darker colour, and at 15 feet depth becomes nearly black, and more translucent than the outer portion of the mass or bed. The author finds that the black-coloured cryolite, when heated to a dull redness, loses about one per cent. of moisture and acid, and becomes less translucent; and he considers that the cryolite was originally dark-coloured, and that the white and somewhat less compact and more opaque variety has resulted from the action of some external cause; possibly, he thinks, in this case the agency of overlying igneous rocks. Two vertical trap-dykes traverse the cliff near by, one on either side of the cryolite; and, although no such rocks now overlie the spot in question, the author thinks it quite probable that the known powerful effects of the atmospheric agencies in the Greenland climate may have removed all traces of the overlying eruptive rocks, to the former existence and influence of which he refers the change of condition seen in the superficial cryolite.*

THE DEAD SEA.

MR. H. POOLE, a short time since, went to this district to look for nitre, which was reported to have been met there; but he met with none, and found reason to suppose that the report was unfounded. He noticed bituminous shales at Nebidlousa, and sulphurous earths both there and at El Lisan on the Dead Sea, but the sulphur was not found in any large quantity. The author has exhibited to the Geological Society a series of these deposits, and of rock-salt and

* Aluminium has been obtained from cryolite. See page 117 of the present volume.

other minerals in the neighbourhood of the Dead Sea, together with recent natural history specimens, volcanic and other rock specimens, and some tertiary and cretaceous fossils from the district visited.

MICROSCOPICAL STRUCTURE OF MICA SCHIST.

MR. H. C. SORBY, in a paper read to the British Association, has described the peculiar microscopical structures, chiefly confining himself to such as throw light on the metamorphic theory. These consist in the form and manner of arrangement of the quartz and mica, which give rise to two very distinct varieties: one analogous to a simple stratified rock, without slaty cleavage, in which crystalline changes had occurred, which he terms *stratification foliation;* and the other as if the rock had previously been compressed, so that it developed slaty cleavage, which he calls *cleavage foliation*. These, especially the latter, present such characters as, he contends, could not possibly be explained, except by supposing that the rock was originally analogous to clay slate, and had afterwards been altered by crystalline processes. He argued that these had taken place when water was present; for the quartz contains great numbers of minute closed cavities, still more or less full of water, which had been shut up in the solid crystals when they were formed; and that, therefore, the metamorphism had been produced by an aqueous process, probably accompanied with an elevated temperature, and not by a purely igneous action of partial fusion.

A NEW DIAMOND.

Two French chemists, Messrs. Wohler and Deville, have succeeded in crystallising the well-known substance Boron, which has hitherto been known only as a greenish brown powder, or in combination with an acid, and they have submitted specimens of the crystals to the Paris Academy of Sciences. These crystals possess a brilliance and refractive power which nothing equals but the diamond; and they rival even that in hardness, being capable of scratching corundum, which, next to diamond, is the hardest substance known. The specimens yet obtained are very small, and have a shade of red or yellow, but the colour is believed to be accidental, and it is hoped that further experiment will enable the chemist to procure it colourless. Boron agrees with silicon in many of its properties, and is considered as intermediate between it and carbon. This discovery may soon put us in possession of a factitious diamond, which the most experienced eye will be unable to distinguish from the genuine.—*Scotsman.*

AN EXTRAORDINARY DIAMOND

HAS been sent from Rio, consigned to Messrs. Devoy and Benjamin, who have submitted the same to the Queen. It weighs 254½ carats, and is alleged to be likely, when polished, to exceed in size and brilliancy the Koh-i-noor.—*Times.*

THE BRINE SPRINGS OF CHESHIRE.

A "SALT MANUFACTURER," in a letter to the *Times*, writes.—

"I have been connected with the salt trade of Cheshire upwards of 50 years, and for a considerable length of time have been a manufacturer of salt. I have within the last two years sunk two new brine shafts at my works. A shaft had been sunk in 1829, which continued good until 1853. In 1854 I sank another shaft near to the old one. The brine proved to be of an inferior quality, and in 1855 I sank a third shaft, at some 100 yards' distance from the others. This brine, however, was good only until September in this year. We find at the depth of 54 or 60 yards from the level of the river a very hard, earthy matter, commonly called the 'flag,' of the thickness of two feet, under which there are rock salt and brine. This bed of rock salt varies in its thickness from 10 to 12 yards, and contains fully 20 per cent. of impurities. Brine is made by the passing of water over this bed and becoming saturated with the rock, whence it is pumped up into cisterns to be converted into salt. As the bed of rock salt is dissolved and made into brine, the earth will naturally sink and follow the wasting away of the rock; accordingly, we find that many places, both about Winsford and Northwich, which but a few years ago were high land, are now submerged many feet in water. Under this first bed of rock salt is found a stratum of very hard stony matter, containing no particles of salt, and perfectly impermeable to water. It varies in thickness from eight to ten yards. Beneath this stone the second bed of rock salt lies, a little better in quality than the first, and continues to 110 yards, at which depth we arrive at what is called the 'lower mine,' or best rock, which is our export rock.

From close observation, it has been found that as the upper rock wastes away, our brine is reduced in strength. This may be accounted for by the sinking of the land and the accumulation of dross or earthy matter preventing the free action of the water upon the rock. Were we to attempt to make the lower bed of rock into a brine shaft, our efforts would be a failure, having no brine or water whatever below the second stone to dissolve the rock into brine, and to run water down would, in a very short time, eat away the pillars that support the eye of the mine, and the result would be that the shaft would fall in. We had proofs of this half a century ago, and it is not an uncommon occurrence in the neighbourhood of Northwich at the present time. The only way of obtaining salt from the lower bed is by raising the rock and dissolving it in cisterns; this would be attended with considerable expense. I am strongly of opinion that the time is not far distant when we shall experience a very great diminution in the strength of our brine. I went round the entire saltworks at Winsford on Saturday last, and tested every brine shaft, and I did not find one the brine of which was the same strength it was only three weeks ago. Can this be wondered at, when we consider the vast drainage that is daily taking place? At our present rate of working we are consuming 400,000 cubical feet of brine at Winsford alone every day."

ARTESIAN WELLS.

THE first Artesian Well, it is believed, ever bored in Norwich, has been completed at the brewery of Messrs. Morgan, King-street, by Mr. Thomas Clarke, the artesian well engineer to Her Majesty's dockyards. For 38 feet below the surface a 6-feet cast-iron cylinder was sunk : at about 30 feet from the surface, and, of course, projecting 8 feet into the cylinder, a shaft or cast-iron pipe, 12 inches in diameter, commences its descent. For 12 feet the borings were found to be through loose flints, decidedly impregnated with sewerage deposits : to this, for about 16 feet, succeeded a kind of yellow marl, varying much in colour. The borings, after this, were through white chalk, with layers of flint at intervals of three feet, and this continued (the flint layers becoming harder, and the chalk more and more pure) until, at the depth of 200 feet from the surface, a copious supply of water was obtained. The borings were continued 38 feet further, to insure perfect freedom from the slightest impurity or turbidity. When the bore-pipe was removed, the water flowed into the cylinder at the rate of 500 gallons per minute. The water fills 8 feet of the cylinder, at the bottom of which is a 4-feet layer of concrete and cement, and from this, by means of force-pumps and other machinery, the supply is derived. After the steam-engines had pumped for twelve hours, the quantity of water was not reduced in the cylinder more than 4 inches. The flow of water is about 150 gallons per minute. The water, according to the *Norfolk Chronicle*, has been found, on analysis, to be of the very purest character, and admirably adapted for brewing purposes.—*Builder*, No. 721.

The boring of an Artesian Well, at Kentish Town, has proved unsuccessful. It now appears, from particulars published by the Geological Society, that the work was abandoned when the borings had reached a depth of 1302 feet, no water having been met with. This unexpected result disappoints and astonishes those who, with Mr. Prestwich, hoped for and predicted a copious supply of water from the lower greensands. The lower greensands are naturally expected to occur immediately below the gault; but in the present instance, the gault was found to be succeeded by "176 feet of a series of red clays with intercalated sandstones and grits." It is a fact which sets our geologists pondering. Has it any relation with Mr. Austen's theory, that carboniferous rocks may possibly be met with under the chalk in this part of England? is one among other interesting questions now discussed. The level of the London wells has sunk 50 feet since 1822, and falls at the rate of 18 or 24 inches a year. An Artesian well has been for some months in progress in the Bois de Boulogne, near Paris. It is a mètre in diameter, and when finished will be 700 mètres deep—150 more than the famous well of Grenelle. Mr. Kind, the engineer, carries on the boring by means of the Chinese method of percussion, which has the merit of being simple and expeditious. To give a notion of it: pine-rods five mètres in length are provided. A "monkey" with iron teeth is attached to the first of these rods, and this to a twenty-four horse-power steam-engine, which, by a succession of lifts and falls, twenty times a minute, speedily sends the monkey into the ground beneath. So the boring goes on, other rods being screwed on as the depth increases ; water is soon met with ; the hole fills, and the rods being of the same specific gravity as the water, their weight ceases to be felt. Every twelve hours the rods are unscrewed, the monkey is raised, and a large bucket with a valved bottom is let down into the pulpy mass at the bottom, where, having filled itself, the valves close, and it is brought up full. This method is thus seen to present important advantages; it effectually obviates the slowness and impeding weight of the iron borer. Mr. Kind is confident of success. He has already sunk a well 730 mètres deep, and has one or two others in progress besides the one here noticed ; and with a large iron cylinder contrived for the purpose, he brings to the surface huge specimens of every stratum through which the sinking passes.—*Chambers's Journal.*

EXPERIMENTAL RESEARCHES ON THE GRANITES OF IRELAND.

THE Rev. Professor S. Haughton, A.M., F.G.S., has communicated to the Geological Society this paper. The first part described the granites of the south-east of Ireland, which are reducible to three types, depending on their chemical and mineralogical composition. The granite of the first type, which Mr. Haughton proposed to call "Potash-granite," is found in the main granitic chain of Wicklow and Wexford, and also at Carnsore, at the extreme south-east of Ireland. The granite of the second type, which is a "Soda-granite," occurs at Rathdrum and Oulart, and is distinguished from the former by a diminution of silica, and an increase of lime and soda. The third granite is peculiar, and found only at Croghan Kinshela, near the gold-mines of Wicklow. It consists of quartz, albite, and chlorite; while the potash-granites of the main chain consist of quartz, orthoclase, and margarodite mica.

The second part of the paper described the three granitic districts of the north-east of Ireland, known as the Mourne, Carlingford, and Newry granitic districts.

The granite of the Mourne district consists of quartz, orthoclase, albite, and a green mica, probably similar to margarodite.

The Carlingford granite is a potash-granite, in which hornblende replaces mica. At the junction of this granite with the carboniferous limestone of the neighbourhood, a remarkable change takes place in the granite on penetrating the limestone in dykes. From being originally a compound of quartz, orthoclase, and hornblende, it is converted by the addition of lime into a compound of hornblende and anorthite, which latter mineral was noticed for the first time as entering into the composition of British rocks.

The Newry granites belong to the "soda-granite" type, and resemble in many respects the secondary granites of the Wicklow and Wexford districts.

IRON DEPOSITS IN THE HIMALAYAS.

SPECIMENS of the recently discovered Iron deposits in the Himalayas, Northern India, have been exhibited at the Institution of Civil Engineers, by Mr. W. Sowerby. These deposits were found in the lower range of hills, called the Bhabur, at a general elevation of about 500 feet above the adjacent plains; and they were more or less continuous from the Sada river, on the confines of Nepal, to the river Ganges, a few miles above the head of the grand Ganges Canal, at Hurdwar, being about 150 miles in length.

There are six different beds of iron-stone, one above the other, of varying thickness and quality. The lowest bed was a rich red ironstone associated with clay, and its thickness was, in many places, upwards of fifty feet. They contained on an average nearly fifty per cent. of metallic iron. The following was the analysis of these ores:—

Water and carbonic acid	2·00
Earthy matter	22·40
Arsenic	0·91
Lime	2·60
Peroxide of iron	73·50
	101·41
Excess	1·41
	100·00

Metallic iron 50·96 per cent.

The other beds were chiefly a compact brown clay ironstone, about fifteen to twenty feet in thickness, containing about forty per cent. of metal. There were also yellow hydrates and siliceous ironstones, of less thickness, and of poor quality. Masses of the richest ironstone, many tons in weight, were found lying on the hill slopes, and the beds were in numerous places seen exposed in high escarpments and deep ravines.

The enclosing rocks of the beds were micaceous sandstones, not unlike the sandstones of a coal formation; thin seams of lignitic and slightly bituminous coal had been found outcropping. Mountain limestone, of excellent quality for flux, formed part of the adjacent hills.

The district in which the iron ore was found was a dense primeval forest of Saul, Huldoo, Kya, Jamin, and other hard woods, in inexhaustible quantity, and peculiarly suitable for making charcoal. The number of small streams and large rivers issuing from the hills would afford ample water-power for any amount of machinery.

The government of India decided on erecting a small experimental work during the cold seasons of 1855-6, which was intrusted to Mr. Sowerby; specimens of the iron produced were exhibited, and were so conclusive, as to have determined the question of the extension of the works.

The interior of the hills were also stated to contain immense deposits of rich hematite, specular, and magnetic iron ores; likewise copper, galena, and other minerals. Views of the locality, and of the work erected, were also shown.

Specimens of coal, iron, copper, galena, &c., discovered by Mr. Sowerby in South Eastern Africa, were likewise exhibited. The coal-beds were in the territory of Natal, and were traced from the sea-coast to the Kathlamba Mounts, a distance of about 150 miles; they varied in thickness from a few inches to fourteen feet at the outcrop. Iron, copper, &c., were found in great abundance and variety in various districts.

GOLD AT THE CAPE OF GOOD HOPE.

Mr. A. Wyley, in a Geological Report upon the Gold District in the neighbourhood of Smithfield, says:—"Taking into account the similar circumstances of two pits, sunk through the same stratum only five yards apart, it was very improbable that one should contain twelve separate grains of gold and the other none, and that in three or four other pits alongside no trace of the metal should be found. I became now convinced that, in the case of this particular pit, some deception had been practised, by whom it was impossible to say. One thing was now pretty clear to me, that there was not the remotest chance of the Smithfield gold workings succeeding as a commercial speculation. Gold does occur, I have reason to believe, in greater quantity to the northwards in the Free State, but there is very much question whether it will even there be found in remunerative quantity. The conditions under which gold has hitherto been found to occur are singularly uniform. In all the noted gold districts we have the *older slates* penetrated by masses of *greenstone*, and mostly, if not always, granite near. As I have already shown, in the case of the tract under consideration, two out of three of these conditions are wanting. The rocks are of comparatively modern age, and there is not granite nearer than some hundreds of miles beyond the Vaal River. The fact, then, of gold occurring in so limited quantity, accords with past experience, vindicates the truth of geological theory, and the uniform and consistent workings of nature."

GOLD IN ARGYLESHIRE.

Mr. Andrew Smith, "mining engineer, and late from California," writing to a contemporary, from Dunoon, says:—"The auriferous hills of Argyleshire attracted my attention while staying at this place last autumn. The foreshore along the front of this town, and the rock which the landing pier is built upon, is composed of gold bearing quartz, along with a slaty formation shelving in the usual manner, identically the same as I have observed in all the gold quartz countries that I have visited. Those indications induced me to trace a gold-bearing quartz-vein a considerable way inland till I arrived on the south side of a hill of considerable height. The face of this hill is richly impregnated with gold, copper, and some other minerals, but no indications being on the north side. Having provided myself with proper prospecting implements a few days since, I washed out some dirt which I found to be auriferous, and picked up a few small nuggets, two of which I send for your inspection."

POSSIBLE ORIGIN OF VEINS OF GOLD IN QUARTZ AND OTHER ROCKS.

MR. L. L. B. IBBETSON, F.R.S., having mixed a solution of gold in nitromuriatic acid with five times its weight of water, and placed it in a Berlin evaporating dish on a thick sheet of copper over a gas-lamp, the author observed a crack in the basin, which was increasing. On transferring the solution to another basin, he found that the crack presented a vein of gold; the pure gold forming small nodular masses along the fissure, both inside and out, and resembling veins of gold in auriferous quartz-rocks. Under the circumstances of the low temperature at which the solution was being evaporated, the diluted state of the solution still left unevaporated, and the difference of the appearance of the nodular form of the gold-vein from the usual appearance of the metallic gold obtained by evaporation from such a solution, the author thought it worth while to describe and exhibit the specimen to the meeting.—*Proceedings of the Geological Society.*

GENERAL STATISTICS OF GOLD.

IN 1848, the total amount of gold in use in the world was estimated by the best authorities at about 600,000,000*l.* sterling, and the annual supply was believed to be between eight millions and nine millions sterling. From the recent extraordinary influx consequent on the opening of the gold fields of California and Australia, we may compute the amount now in hand at about 820,000,000*l.* sterling. The data in this estimate are as follow:—

From a table in Westgarth's *Victoria,* it appears that these two regions have produced as follows:—

	California.	Australia.
1849	2,000,000	None.
1850	9,000,000	None.
1851	13,000,000	1,000,000
1852	15,000,000	14,000,000
1853	20,000,000	20,000,000

Or California an addition of	£659,000,000
Australia do	35,000,000
All other sources in the five years	40,000,000
To those add the present product of £50,000,000 per annum from all quarters for two years	100,000,000
	£834,000,000
From this deduct for waste, estimated at £2,000,000 per annum for seven years	14,000,000
	£820,000,000

This net product now in the world is equivalent to about 205,000,000 ounces troy, or 8542 tons. Great as the amount seems, it could be all contained in a cubic block of gold only 23 feet in diameter.

The gold coinage in Great Britain, France, and the United States, amounted in 1843 to 4,200,000*l.*, and in 1853, it was 41,800,000*l.*, or nearly tenfold as large.—*Edin. New Phil. Journal,* No. 7.

ON FOSSILS FROM THE CRIMEA. COMMUNICATED TO THE BRITISH ASSOCIATION BY MR. W. H. BAILY.

THE fossils which formed the subject of this communication belong, with one exception, to the Invertebrata, and were principally collected in the southern part of the Crimea, by Captain C. F. Cockburn, of the Royal Artillery: comprising a series from the Monastery of St. George, and gorge of Iphigenia, consisting of fossils from the Jurassic and oldest deposits; from the tertiaries resting immediately upon them, and from the volcanic or eruptive rocks which have disturbed and broken up some of these strata, together with a set of well-preserved newer tertiary mollusca from the Quarantine Harbour. The musuem of Practical Geology has also received, from Major Cook, of the Royal Engineers, a suite of somewhat similar forms of steppe limestone fossils from the Redan and near the dockyard of Sebastopol, and some interesting Jurassic Brachiopoda from Balaklava; also from Lieutenant-Colonel Munro, and Lieutenant-Colonel Charles Lygon Cocks, of the Coldstream Guards, other specimens of the steppe limestone, containing fossils obtained from the ground before Sebastopol upon which the allied armies were encamped, and volcanic and mineral specimens from the sea-coast. These instructive collections, including a series of fossils from the various strata of the Crimea, formerly presented by the Imperial School of Mines at St. Petersburgh, enables us to add to the published lists of fossils from that country seventy-four species.

The geology of this peninsula having been described in detail by M. Du Bois de Montpereaux, M. Huot in the work of Demidoff, M. Hommaire de Hell, and by Sir R. Murchison and M. De Verneuil in the *Geology of Russia and the Ural Mountains*, a slight sketch of the formations represented in that country only is necessary. The most ancient deposits of the Crimea are those at the base of the Jurassic formation, described as black schists, composed of hard, soft, and ferruginous beds, which are probably equivalent to the trias or New Red Sandstone, appearing in the Valley of Baidar and other localities; and on the coast being superimposed by the lias; overlying the schists of the lias are the Jurassic rocks, which extend along the southern sea-coast from Balaklava to the vicinity of Theodosia or Kaffa, a length of about 100 miles. This mountain chain of hard and crystalline limestones, pierced and broken into by volcanic eruptions of greenstone, porphyry, &c., is, with its associated strata, analogous to that of the Caucasus, and proceeds in a direction E.N.E. to S.S.W., its highest point being at Tchatir Dagh or Tent Mountain, at an elevation of 5135 feet. The Bay of Balaklava is enclosed on both sides by steep and rugged rocks of the Jurassic formation, composed of compact red and grey limestones, in which are clefts filled with a reddish clay; these limestones and clays contain numerous organic remains, the most abundant of which are corals and Echinodermata. At the foot of the chain towards the north the lower division of the cretaceous series, or "*Neocomien*," may be well observed, its horizontal beds resting unconformably either upon the Jurassic limestones or upon the shales at their base, the intermediate snbdivisions being absent. Upon these beds repose the upper cretaceous series, composed of shales (probably equivalent to the gault), upper greensand, chalk marl, and white chalk. On the eastern coast the hippuritic and Senonian sub-divisions rest immediately on the disturbed Jurassic beds, the intermediate subdivisions being absent.

The cretaceous formation does not occupy much space in the Crimea, being inclosed between nummulitic deposits and the Jurassic limestone, taking the same direction, and extending from Kaffa to Cape Chersonese on the S.W. coast. The soft calcareous rock of Inkermann, from which the beautiful white stone used in constructing most of the public buildings of Sebastopol was obtained, is very easily worked, but becomes harder and more durable by exposure to the atmosphere. From comparison of its fossils, it appears to be identical with the upper chalk. The Lower Tertiary or Eocene is represented by the nummulitic formation; which, like the cretaceous series, is elevated by the mountainous region of the coast, and disposed in long bands following its contour. This formation commences in the environs of Theodosia, continuing to the north near to Karasubazar, Simferopol, and Baktchi Serai, terminating at the S.W. coast, near Sebastopol. The Upper Tertiary formation includes the older and newer Caspian or Steppe limestone, the former of which subdivisions, or older Caspian, occupies the northern and greater portion of the peninsula at Eupatoria, Sebastopol, &c., including the chief limestones round Kertch, and the deposits of the cliffs of Kamiesch, Boroun, and Taman. These limestones and sands, associated in some localities with volcanic ashes, tufa, &c., occur in various conditions, as shelly and oolitic limestones of marine and fresh-water origin, being more or less fossiliferous. The Heracleotic Chersonesus is, as it were, a shred of the steppe limestone; the Bay of Sebastopol exhibiting a succession of formations from the most recent of these tertiaries, through the nummulitic limestone and chalk. The newer Caspian occupies the still more northern extremity of the Crimea, extending to Perekop, Kherson, and the shores of the Sea of Azof. The environs of Kertch and Taman are the most favourable localities to observe its characters, and here the fossils are in good preservation. The existence of coal deposits has been often rumoured, but on examination proved to be lignite of very ordinary quality.

THE GASTORNIS.

PROFESSOR OWEN has read to the Geological Society a paper "on the Affinities of the great extinct Bird (*Gastornis Parisiensis*, Hébert) from the lower Eocene near Paris."

Professor Owen communicated the results of his comparisons of the fossil tibia of the *Gastornis Parisiensis*, Hébert,—a large bird from the lower Eocene deposits at Meudon, near Paris—with the tibiæ of known recent and fossil birds.

The tibia of the *Gastornis* presents the same median position of the supra-tendinal bridge as in the Albatross and the lamellirostral web-footed birds ; but, as the same position of the bridge occurs in the *Notornis*, the Gallinule, the Raven, and some accipitrine birds, that character is not conclusive of the affinities of the *Gastornis* to the Palmipeds ; and it is further invalidated by a difference in the aspect of the plane of the lower outlet of the bridge. In the Albatross (*Diomedœa*) and the Lamellirostres, the foramen or outlet looks directly forwards ; its plane is vertical. In the oblique aspect of that outlet, the *Gastornis* more resembles the large Waders (*Grallœ*) and the *Dinornis* tribe. Amongst the *Gallinaceœ*, the Turkey (*Meleagris*) nearly resembles the *Gastornis* in the position of the bridge ; and more nearly resembles it than does the Albatross or the Swan in the low tuberosity external to the bridge above the base of the outer condyle, as well as in the shallow groove dividing that tuberosity from the bridge. The depression on the fore-part of the tibia above the distal condyles, if natural to the *Gastornis*, is a structure not precisely repeated in any of the *Grallœ*. In the *Ciconia Argala* the anterior interspace of the condyles forms a cavity, bounded above by the tubercle and ridge developed from the bridge, and by the oblique converging upper borders of the condyles below. The canal of the bridge opens below into the concavity. In the *Grus Antigone* the lower border of the outlet of the bridge defines, with a tubercle external to it, the shallow supracondyloid cavity ; but there is no definite fossa, like that in the *Gastornis*.

In the *Notornis*, the breadth of the lower end of the tibia a little exceeds the depth or fore-and-aft diameter of the condyles. The supra-tendinal bridge is of moderate breadth, is transverse, and median in position ; its lower outlet looks forward just above the wide and shallow intercondyloid space. The extinct *Aptornis* chiefly differs from the *Notornis* in the less median position of the bridge, and in the more shallow canal leading to it. In the *Dinornis*, the breadth and depth of the condyles are equal ; the outer condyle is the broadest, the inner one is the most prominent ; their articular surfaces are so continuous as to leave no space answering to the intercondyloid space in the *Aptornis*, *Notornis*, &c. The bridge is situated nearer the inner side of the bone, is subtransverse, rather narrow, with a widely elliptical lower outlet opening above the inner condyle.

The *Gastornis* was a bird of the size of the Ostrich, but with more bulky proportions, and in that respect more resembling the *Dinornis* : it appears to have had nearer affinities with the wading order, and therein, perhaps, to the *Rallidœ* ; but the modifications of its tibia indicate a genus of birds distinct from all previously known genera.

FOSSIL APES.

M. Fontan has discovered, in the south of France, a new Fossil Ape, allied to the Chimpanzee or Ourang-outang, to which the name of *Dryopithecus Fontani* has been given. It is supposed to have been frugivorous, and to have inhabited trees. There are thus six fossil apes in Europe:—two in Britain, *Macacus eocenus* and *Macacus pliocenus* of Owen; three in France, *Pliopithecus antiquus*, *Dryopithecus Fontani*, and *Semnopithecus monspessulanus* of Lartet, which latter is probably the same as the *Pithecus maritimus* of M. de Christol; and lastly *Mizopithecus pentelicus* of Wagner or *Semnopithecus pentelicus* of Lartet, the ape of Pikermi in Greece.—*Edinburgh New Philosophical Journal*, No. 8.

ICHTHYOSAURUS.

A BEAUTIFUL and almost perfect specimen of the Ichthyosaurus has been found in the quarries of Mr. Ephraim Cross, quarry-master, in the village of Street, near Bath. The length of the fossil is exactly seven feet, and there does not appear to be a single bone, even of the most delicate character, wanting. The ribs, the numerous bones forming the fins, the jaws, the sockets from which the eyes once glared fiercely upon its prey, are all wondrously perfect. Only in one instance, about the middle of the vertebral column, does any defect appear: this is a little displacement, or huddling together of the bones, doubtless caused by the tremendous weight of the superincumbent mass, which had stopped him in his career of life. This specimen was found at a depth of only three feet from the surface of the earth.

THE DINORNIS.

(*See the Vignette on the title-page of the present volume.*)

PROFESSOR OWEN has read to the Zoological Society a Memoir (No. VII.) on Dinornis, being a description of a new species, the *Dinornis elephantopus*, Ow. Mr. Walter Mantell having deposited in the British Museum his extensive collection of remains of great wingless birds from New Zealand, and Professor Owen having, at the request of Mr. Waterhouse, undertaken the examination of the collection with a view to determine the bones and the species to which they belong, the Professor had discovered a species distinct from, and more extraordinary than, any that he had previously seen and described. For this species, which he regarded as the most remarkable of the feathered class for its prodigious strength and massive proportions, he proposed the name of *Dinornis elephantopus*. The parts of its skeleton selected for the subject of the evening's discourse were the femur, tibia, fibula, metatarse, and phalanges of the three toes; the Professor having been able to recompose an entire lower limb of the elephant-footed bird. Its title to that name may be judged of by the proportions of some of these bones. In the *Dinornis giganteus*, *e. g.*, described by Professor Owen in 1843, the length of the metatarsal bone is eighteen inches and a half, the breadth of its lower end being five inches and a half; in the *Dinornis elephantopus*, the length of the corresponding bone is nine inches and a quarter, the breadth of the lower end being five inches and one-third. The extraordinary proportions of the metatarsus of this wingless bird will be perhaps still better understood by comparison with the same bone in the ostrich, in which the metatarsus is nineteen inches in length, the breadth of its lower end being only two inches and a half. From the materials accumulated by Mr. Mantell, the entire skeleton of the elephant-footed Dinornis have been recon structed; a worthy companion of the Megatherium and Mastodon in the gallery of fossil remains in the British Museum. The *Dinornis elephantopus* appears to have been restricted to the Middle Island of New Zealand. No bone or fragment of bone indicative of this species had ever reached the author from any part of the North Island of New Zealand. The specimens described, together with many other bones of the *Dinornis elephantopus*, were discovered by Mr. W. Mantell at "Ruamoa," three miles south of the point called the "First Rocky Head" in the Admiralty charts of the island. Bones of the entire leg and foot of the new *Dinornis*, together with the reconstructed foot of the *Dinornis robustus*, described in a previous memoir, were displayed, and their characters pointed out by Professor Owen. This we believe to be the only specimen of any species of Dinornis in which the skeleton has been reconstructed from the actual bones of one and the same individual bird. The rich collection of remains of this singular extinct bird of New Zealand, brought over in May last by Mr. W. Mantell from the Middle Island, and purchased by the Trustees of the British Museum, has enabled this unique example to be added to the illustrations of the gigantic extinct creations of a former world.—*Literary Gazette.*

EARTHQUAKES IN 1856.

THESE phenomena have been remarkably numerous and destructive during the past year.

San Francisco has experienced the severest shock of earthquake ever known in this vicinity since the settlement of California by Americans. Every building in the city and vicinity shook to its foundation; and in some quarters (say the reports) the houses swayed and rolled as vessels in a heavy sea.

India.—The Punjab has been visited by a succession of earthquakes, but fortunately little or no damage has been sustained by the people, the vibrations being in most places slight.

China.—Letters detail the destruction of the town of Yoo-Tching, on the north-western frontier of the Celestial Empire, by an earthquake, on the 17th of August. Several days previously some shocks of the earth were felt throughout the southern districts of the province of Pe-Tchi-Li. The 16th of August passed quietly, but at three o'clock in the afternoon of the next day came a tremendous shock, which continued for two minutes. The town of Yoo-Tching, where it was most violently felt, and several of the neighbouring villages, were reduced to ruins, and some hundreds of people lost their lives.

Cairo.—On the morning of Oct. 11, a severe shock of the earth was felt at Cairo, at Suez, and Alexandria: it lasted between fifty and sixty seconds. The official Report announced that two mosques were entirely down in Cairo, and many others partly so, or greatly damaged; 120 houses down or partly so in Cairo, and several in

Boulac; 10 persons killed. In Alexandria it was also felt very severely. In Suez it was accompanied or followed by a severe hail-storm.

Schemeka, in the Caucasus.—On the morning of the 11th July a heavy rumbling noise was followed by a violent shock of the earth, which although it lasted only about thirty seconds, 300 houses, and more than 100 shops, were thrown down; only one person was killed, and five were wounded.

Malta.—On the 12th October, at eleven minutes before two, A.M., the islands of Malta and Gozo were visited by violent shocks of an earthquake. In the city of Valetta scarcely a building escaped injury. At Floriana, and in each of the three cities, as well as in the harbour, the shocks were felt with considerable vigour; and at Senglea, Cospicua, and Vittoriosa, many of the buildings are injured. At Civita Vecchia, all the churches, monasteries, nunneries, and hospitals sustained damage. Malta, after the earthquake, was deluged by rain: according to the *Malta Times*, 21 inches of rain had fallen from October 17 to November 16.

Rhodes.—Mr. Consul Campbell has communicated to the Geological Society some details of a severe shock of the earth felt at the island of Rhodes on the 12th of October, at about three o'clock, A.M. The shock was felt also in the adjacent islands of Halki, Scarpantos, Cassos, and Symi; also at Marmarizza on the coast opposite.

Candia.—On the night of October 11, the town of Canea, the chief port of the isle of Candia, was almost entirely destroyed by an earthquake, only 18 remaining out of 3620 dwelling-houses. The number of persons killed is stated at 720.

Palermo.—Professor Ragona, the Director of the Royal Observatory at Palermo, reports two shocks to have been felt in that city at 1 h. 59 min. 24 sec., A.M. (true time), on Oct. 11, strong, undulatory, of long duration, and remarkable for the amplitude of the oscillations. The first shock continued nearly 8 seconds, and the second (with an interval of 2 or 3 seconds), 9 to 10 seconds. The above shocks were also felt at Puzzuoli, Castelamare, Bari, Avellino, Tera di Lavor, Capitanata, Basilicata, the two Principalities, Otranto, and Calabria.

Wiltshire.—On March 14, at about 4 o'clock, P.M., a loud report was heard similar to the explosion of a powder-magazine, and at the same instant the ground shook with considerable violence, the concussion being felt throughout the villages of Sedgehill and Knoyle in South Wilts: house-bells were set ringing, chairs and crockery were shaken.

VESUVIUS

Has been in eruption in the past year, 1856. The *Athenæum* publishes a letter from Vincenzo Cozzolino on this subject:—"On the night of the 11th and 12th of October," he says, "I was on Vesuvius with a French family, and such was the noise it made, that the whole of the crater trembled, and the mountain was riven to its very centre in the direction of Torre del Greco, so that the funnel in this direction was filled up. From the 23rd to the 27th ult. three streams of lava were seen to issue from three mouths which were formed within the new crater. These three mouths throw out large and small red-hot stones beyond the crater. In the crater of 1850 a mouth has been formed which throws out red-hot ashes as though it were a display of fire-works: its action is unceasing, and the effect is wonderfully beautiful to those who are on the summit. I asked my family if they had heard anything at Resina on the night of the 11-12th, and they answered that they heard as though it were the noise of an earthquake. This report is signed by Cozzolino, the 28th of October; and perhaps every other night at intervals, the mountain makes some mighty efforts, and throws out a brilliant mass of fire. Vesuvius is so capricious, that one would scarcely like to risk his prophetic character by predicting anything regarding its movements, but appearance would certainly justify the expectation of a considerable eruption within the crater. It is now in full eruption, and at times, as I have announced, the ashes, stones, and flames are thrown high into the heavens, forming a grand display. Such were some of the signs which preceded the last great eruption."

Mr. F. D. Hartland has described to the British Association the great eruption of May 1, 1855, when Vesuvius was invisible at Naples, and it was not till the afternoon that the fact became known that the eruption had commenced. A rush was made for Santa Lucia, the side of Naples from which the mountain can best be seen, and here the truth became apparent, as the mountain was blazing from several parts. Upon accomplishing the ascent, and after passing the Hermitage, the intense heat betrayed the approach of the burning element; and after leaving various cascades of fire, down which half melting blocks of lava were dashing at a pace to overcome all resistance, the current of the eruption was reached, and resembled a liquid fiery river rushing from the side of the cone, and apparently fed from an orifice about half way up it, which, amidst flames of fire, was throwing out stones to an immense height, accompanied by volumes of dense smoke, whilst all below was clear, and the lava at times even assumed a bright phosphoric blue. This was the most magnificent part of the scene, as the ascent of the cone did not repay the risk and trouble. During this scene daylight dawned, and so earnest had been the attention given to it by the thousands assembled on the mountains, that although a perfectly visible eclipse of the moon occurred during the time, it passed, with few exceptions, unobserved. The eruption continued till near the end of the month, and before its close, eleven cones were in active operation, the discharge from which was so great that at one time a total falling in of the mountain was dreaded. The discharge, almost unaccompanied by the ejection of stones, was the peculiarity of this eruption.

VOLCANIC ERUPTION IN THE MOLUCCAS.

An eruption of the active volcano on the island of the Great Sangir occurred on the 2nd of March. The lava streamed downwards with irresistible force in different directions. The hot springs opened up and cast a flood of boiling water. The sea lashed the rocks with frightful violence and dashed upon the shore. Thousands of trees were torn up and carried away. A black column of stones and ashes then shot up from the mountain to an immense height. Large stones were hurled through the air, crushing whatever they fell upon. Houses and crops which had not been destroyed by fire sank and disappeared beneath the ashes and stones. This lasted some hours. About midnight it ceased, but on the following day burst out again; and an eruption on the 17th destroyed many fields and a great number of trees on the Tabukan side. The loss of life has been estimated at 3806 persons.

A SUBMARINE VOLCANO.

CAPTAIN C. H. NEWELL, of the whaling bark, *Alice Frasier*, describes the action of a Submarine Volcano which sprang into existence in the Straits of Onnimah, in lat. 54° 36′, long. 165°, on the 25th of July, 1856. There were five or six vessels in company at the time when the volcano burst forth with vast clouds of dense black smoke, and threw an immense body of water to a tremendous height; after which it emitted lava and pumice-stone on the decks of the vessel. The captain then heard a long rumbling roar, and felt several partial shocks of the earth. After about twelve hours' calm, there sprang up a light breeze from the south, but then came the worst of all. The winds, acting upon the dense body of smoke, blew it flat down upon the surface of the water, making it for more than 100 miles, as I ascertained from others, an almost total eclipse, shutting the land under it entirely from sight. The ashes fell, covering everything from deck to truck under one grey mantle of cinders, almost blinding the people exposed, and growing dense and more dense, nearly to suffocation. As the breeze increased, the captain worked his way to the westward, leaving the scathing, suffocating mass rolling away to the north upon the eastern board.

As the breeze built up into a dashing wind, along came four other ships; when, just as they got fairly in with the north base of the mountain, there followed a long low rumbling directly beneath them, and there sprang instantly a vast terrific volcano among the very ships. First, the waters boiled and rose tumultuously; then sprang, as by an effort of some vast fountain, to a great height. This gradually dissipated. Then from earth to heaven, with a thundering sound, there sprang a burst of smoke and flame. Following this was the casting up of lava and pumice-stone, from the size of a pebble to that of a boulder, covering all the vessels with lesser fragments of each. The eruption then sank almost as suddenly as it came, when the waters rolled into the chasm with the rush of a whirlwind, meeting in the centre from every direction.

GREAT ERUPTION OF MAUNA LOA, IN HAWAII.

THE Eruption of 1855 was described in the *Year-Book of Facts*, 1856, p. 270. In a letter dated January 9, 1856, the British Consul, Mr. Miller, states that the lava-stream originating in the eruption which broke out in August, continued flowing to the date of his letter, at which time it appeared to have been arrested in the forest at a distance of about ten miles from Hilo. In a later communication, dated March 1, 1856, Mr. Miller describes the lava-stream as being sixty miles in length, and as having now reached within five or six miles of Hilo. There still intervened about three miles' width of dense forest between it and the open ground towards Hilo, Byron's Bay. It had burnt its way through the forest at the rate of about one mile in two weeks. In a letter dated July 12, 1856, Mr. F. A. Weld gives a detailed account of his ascent of Kilauea and Mauna Loa, with observations on the craters and on the condition of the lava-stream which had lately been ejected from a lateral opening on the latter mountain. Mr. Weld remarked also that a slight shock of the earth had been felt on the island of Maui, which is also of volcanic formation.

NEW VOLCANIC CRATER NEAR ROME.

THE Roman Correspondent of the *Daily News* describes this phenomenon from a visit to the site in company with Professor Ponzi, who occupies the geological chair at the Sapienza University.

At sixteen miles' distance from Rome we left the valley of the Tiber, and ascending the high ground northwards, arrived, after four miles of clayey cross road, at the village of Leprignano, immediately looking over the valley of the Capena, in which the volcanic eruption took place. This event occurred on the 28th of October, towards sunset. A countryman observed the earth sinking down for a space of nearly an acre, when the ground opened with a tremendous explosion, and vomited forth a dense column of sulphurous smoke, masses of earth and stones being thrown up at the same time. The eruption was at its greatest height about an hour after sunset; and on the following morning it was found that the matter ejected had left a circular orifice, or crater, filled with turbid water, through which gaseous exhalations were still escaping. The activity of the crater subsequently gradually died away, and the calm surface of the little lake is now only occasionally ruffled by the appearance of a few bubbles from below.

On examining the locality it became evident that the whole basin, through which the volcanic force has now created an orifice, was formerly occupied by a lake, whose alluvial deposits formed the uppermost stratum. The character of the soil, in common with that of all the Campagna di Roma, is volcanic, but eminences of travertine formation rise around the basin and skirt the valley formed by the stream called *fosso di gramiccia*, or more classically, *capena*, which descends from Mount Soracte. The existence of this lake at no very distant period is confirmed by the denomination of the spot, "*lago puzzo*," which has probably been handed down from those who had seen it formerly. Indeed, the addition of the word *puzzo*, or stinking, appears to allude to water of a sulphurous nature. Such is not the character of the little lake now formed, which is of sweet water, and about the same temperature and level as the neighbouring springs, showing evidently that the imprisoned volcanic gases, in escaping upwards, had merely opened a new way for some veins not far from the surface of the soil. The circumference of the crater, or lake, we found to be about three hundred mètres, the distance from the surface of the soil to the surface of the water five metres, and the depth of the water in the crater twenty-five mètres, a depth which diminishes constantly in proportion to the masses of earth which fall in from the sides.

Astronomical and Meteorological Phenomena.

THE ROYAL OBSERVATORY.

THE Annual Visitation of the Royal Observatory was held on June 7, Lord Wrottesley, as President of the Royal Society, presided at the Board of Visitors. We select the more striking facts.

During a recent examination of the four official copies of the National Standards of Length and Weight lodged in the Observatory, it was discovered that the acid of the oak wood, composing the exterior box in which they were placed, was acting prejudicially upon them. Its operation appeared rather capricious: in some places (but not in all) it had acted powerfully on the brass, especially that of the plugs in the division-wells, which was covered with a thick layer of sap-green colour; it had also very slightly touched the bronze of the standard-bar; while the iron was untouched, and in many places shining brilliantly. Mr. Airy has now substituted a box of mahogany. This action of the oak-wood is remarkable, as in the case of the official Standard of Length, in the possession of the Royal Society, which is enclosed in a box of oak, no injury has arisen to the metal.

The Signals in connexion with the galvanic apparatus for clock movements, which now constitute a very important feature in the Observatory, has undergone some alterations.

The clock is employed solely to pull a detent (the same which drops the time signal-ball, if the ball is raised), and makes a pull at every hour. The motion of this detent acts in the way of relay to complete circuits of independent batteries to the South-Eastern Railway (for Deal at one o'clock, and for other lines of the South-Eastern Railway at other hours) and to Lothbury, for extensive distribution on railways, and for regulating the post-office clocks, dropping the Strand ball, &c. Probably before long other circuits will be completed by the same detent motion. The Astronomer Royal states that the entanglement of wires and of the relation of circuits is materially diminished by this alteration.

The Astronomer Royal recommends that the Observatory should be equipped with an equatorial telescope, and mentions a 13-inch object-glass by Merz as a desirable acquisition for the purpose; the whole cost to be about 2000*l*. The Observatory still maintains its pre-eminence for meridional and lunar observations, and the magnetical and meteorological observations are kept up with praiseworthy diligence. Two noteworthy facts are mentioned in the Report: one is, that the hill on which the Observatory stands is in a state of tremor, whereby the trough of mercury in which stars are observed by reflection, is so much agitated as to make observation impossible. To overcome the difficulty, a well ten feet deep was dug, and filled with "incoherent rubbish," on which the trough was placed, resting on stages suspended by strips of caoutchouc, "leaving the image practically," as Mr. Airy says, "almost perfect." The other is, that fluctuations were found to occur in the zero of the altazimuth circle, and simultaneously with a sudden and marked change of atmospheric temperature—a phenomenon which the Astronomer Royal cannot account for, "except by supposing that in sudden atmospheric changes the gravel rock of Greenwich Hill does suddenly change its position."

After observing that the work of the Observatory is conducted as appears best for the interests of science, and especially for those interests which will be involved when in some distant century an appeal to the observations of this time may be required for settling grave questions of future science, Mr. Airy adds:—"No Observatory possesses, in an equal degree with this, the power which is given by tradition and organization for keeping up standard meridional observations and lunar observations: these also are most likely to possess the greatest permanent interest, and these, therefore, must in any case be maintained in vigour and in accuracy. The fundamental determinations of magnetism and meteorology have claims of a somewhat similar nature. The various classes of extra-meridional and scrutinizing observations of astronomy receive so much attention from other observers that it is scarcely necessary to give a thought to them here; still, in viewing the uncertain duration of that attention, it is well that this Observatory should be prepared, in instruments and in habits, for taking up them also. Lastly, there are employments which connect the scientific observatory with the practical world: the distribution of accurate time, the improvement of marine timekeepers, the observations and communications which tend to the advantage of geography and navigation, and the study, in a practical sense, of the modifications of magnetism; a careful attention to these is likely to prove useful to the world and conducive to the material prosperity of the Observatory, and these ought not to be banished from our system."

ASTRONOMICAL OBSERVATIONS ON TENERIFFE.

THE following is an extract of a letter from Professor C. Piazzi Smyth, dated "Orotava, August 26."—"After occupying upwards of a month very satisfactorily at my station on the Guajara, about 8000 feet high, I ascended to Alta Vista, on the Peak, and have begun forming a station there, where I hope finally to get the great Pattinsonian telescope carried, by subdividing the packages, although declared to be impossible by the islanders. The results on Guajara were as follow:—Seven nights out of ten gave superb definition, even with the Sheepshanks telescope. Though I had gazed in vain with it in Edinburgh for *a* Lyra's companion, for instance, I see it here whenever I look for it; and, furthermore, have seen other stars up to the fifteenth magnitude, according to the Bedford cycle. The chief feature of the climate at this elevation is excessive dryness, so that everything made of wood is split to pieces—a warning against uniting wood and glass in making instruments. Our lips and finger-nails are much in the same condition of brittleness. We had some rain one day, but it plainly belonged to a higher region ; for the difference between the wet and dry bulb thermometers was 15° while the drops were falling. At our new station, however, we have risen above the greatest dryness ; for though we have 21° or 22° by day, it goes down to 10° or 11° at night. In the absence of the great telescope, much has been done on the radiation of the sun and moon. Some hundreds of observations were made with Sir J. Herschel's actinometer, but then it gave way to the weather ; as many or more with Mr. Airy's black bulb vacuum thermometers, though all the day was a blank, from the mercury rising above the top of the scale which ended at 180 degrees. The moon was found to be at work also, as several hundred observations on two nights left no doubt on the subject, though only Mr. Gassiot's thermo-multiplier would show it ; one-third the heat of a candle when fifteen feet distant. A good deal has also been done in the spectrum lines with Fraunhofer's and with Stokes' apparatus. Several drawings were obtained that show considerably more of the spectrum than was before exhibited. Photography, moreover, has been employed on the subject, and I have some pictures on glass plates of several of the lines beyond H, which was the usual limit of vision."

THE AUGUST METEORS.

M. COULNIER GRAVIER, who has studied this phenomenon for some years, has been again at his post, and has not been disappointed. Dividing the period from the 22nd of July to the 14th of August, into seven periods of three days each, and watching the heavens from two to five hours nightly, he reports the number of falling stars *per hour* to be as follows :—

In the three nights ending				
	July 25.	July 29.	August 1.	August 4.
Falling stars per hour,	9½	14½	13	13½
	August 7.	August 11.		August 14.
Falling stars per hour,	16½	45¼		17

No observations seem to have been made on the 8th of August, probably owing to a clouded sky. It will be observed that the increase was not gradual but sudden, and was literally confined to three days at the precise date noted in previous years as the period of their recurrence. Sir John Herschel observes that, though less brilliant, they are more *certain* than the November meteors, which sometimes do not appear for years. The hourly number varies a little, but in 1855 it may be said to have been identical, being 45. The whole meteors seen by M. Gravier in the twenty-one nights were 1374, and of these sixteen were luminous globes or balls (*bolides*), and eight, or one-half, of these fell on the 9th, an important fact, as it identifies the two classes of bodies as parts of one system.—*Scotsman.*

CYCLONIC HURRICANES.

A CURIOUS and interesting Table of Cyclonic Hurricanes, which have occurred in the West Indies and the Atlantic Ocean, has been recently published by Mr. A. Poey, of Havanna. The examination of these phenomena extends over a period of 362 years—from 1493 to 1855,—and the monthly distribution of 365 hurricanes was as follows:—January, 5; February, 7; March, 11; April, 6; May, 5; June, 10; July, 42; August, 96; September, 80; October, 69; November, 17; December, 7. Mr. Poey observes, that although nothing is known of the causes which produce hurricanes or gales in any part of the world, yet it has now been proved by the examination and careful analysis of perhaps more than a thousand logs, and of some hundreds of storms, that wind, in hurricanes and common gales on both sides of the equator, has two motions; and that it turns or blows round a focus or centre in a more or less circular form, and at the same time has a straight or curved motion forward.—*Athenæum*, No. 1497.

SATURN AND HIS RINGS.

IN a recent work, entitled *The New Theory of Creation and Deluge*, among other startling predictions, it is stated, that it is probable the rings which surround Saturn are composed of water, snow, or ice, which, in some future time, may descend and deluge the planet, as ours was deluged in the days of Noah. Sir David Brewster writes thus: "Mr. Otto Struve and Mr. Bond have lately studied with the great Munich telescope, at the Observatory of Pulkoway, the third ring of Saturn, which Mr. Lassels and Mr. Bond discovered to be fluid. These astronomers are of the opinion, that this fluid ring is not subject to rapid change; and they have come to the extraordinary conclusion, that the inner border of the ring has, since the time of Huygens, been gradually approaching the body of Saturn, and that we may expect, sooner or later, perhaps in some dozen of years, to see the ring united with the body of the planet.

The Rev. Mr. Main, in a paper read to the Astronomical Society, effectually disproves the above hypothesis by M. Otto Struve, that the rings are gradually approaching the ball of the planet. The materials upon which his investigation is based consist of a considerable number of measures, executed by himself, with a double-image micrometer during the years 1852 3-4 5. 'Measures of Saturn with the Astronomer Royal's Double-Image Micrometer,' presented to the Society by Mr. De la Rue, also seem to corroborate the views of Mr. Main respecting the dimensions of the rings.

OCCULTATION OF STARS BY SATURN.

THE Astronomer Royal has communicated to the Astronomical Society the following notes:—Mr. Winnecke, of Berlin, had pointed out that the planet Saturn would probably occult the star Lalande 13545, Bessel's zone 279, on the 9th of September, 1856, at 8 h. 20 m. Berlin mean time. Mr. Airy remarks that this occultation will not be visible in Europe. The positions of the Sun and Saturn at that time are nearly as follows:—Sun's R.A. 11 h. 13 m.; N.P.D. 84° 57′. Saturn's R.A. 6 h. 53 m.; N.P.D. 67° 46′. The sun is then west of the meridian of Greenwich by 7 h. 29 m., and Saturn is west of the same meridian by 11 h. 49 m. "A great circle," says the author, "drawn through the centre of the Sea of

Okhotsk and passing a short distance east of the eastern coasts of Australia defines the line on which the sun is rising. A great circle passing a little to the west of Calcutta and a little to the west of the western coasts of Australia defines the line on which Saturn is rising. Between these two great circles the phenomenon may be seen. The limits which I have indicated do not include Bombay or Madras, but they include Calcutta and every British settlement east of Calcutta, especially Singapore, the coasts of China, and the whole of Australia."

PLANETOIDS.

Two additional little planets, Daphne, the 41st, and Isis, the 42nd, belonging to the group between Mars and Jupiter, were discovered by M. Goldschmidt at Paris in May, and Mr. Hodgson at Oxford in June. They resemble stars of the 11th or 12th magnitude.

THE LUNAR SPOT "COPERNICUS."

A DRAWING of this Lunar Spot has been presented to the Royal Society by P. A. Secchi, Director of the Astronomical Observatory of the Collegio Romano, accompanied by a letter, from which the following is an extract. Dated Rome, March 13, 1856:—

"As to the drawing of the spot of the moon, it is a first attempt to obtain an accurate representation of the interesting spot 'Copernicus.' In such large dimensions, photography directly taken with the telescope has been impossible; I therefore made first an accurate triangulation of the spot with the micrometer, and the principal points were thus laid down on the chart, after which operation the rest was filled in by the eye alone. The power used has been always either 1000 or 760. As it was impossible to carry through such a work in a single night, on the first night of good opportunity a general outline was taken, and on the other evenings particular drawings were made, and all these parts, taken in different grades of light and shadow, were afterwards harmonized together and compared with the moon when the point of light was seen to be the same as on the first night. So this work occupied more than six months, that is, all the favourable positions (two at each lunation) which could be obtained. I do not pretend it to be yet accurate enough to be transferred from photography* to any kind of engraving, but I am watching every good occasion to make it complete. But before bestowing more time and labour, I should be glad to know the impression such a work may make among the scientific men of England. I must observe that the most distant outliers of the crater have not been included," &c.

The following notes on the above drawing have been communicated to the Royal Society by John Phillips, Esq., F.R.S.

Of the few attempts which have been made of late years to prepare drawings,† on a large scale, of selected lunar mountains, this contri-

* The figure presented to the Society is a photographic copy of the original drawing.

† As distinct from mere *plans*. The drawings must, however, be based on exact plans.

bution from the Roman Observatory appears to be one of the most successful. It is on a scale of magnitude (about 10 geographical miles to one inch) such as only the larger modern telescopes can command, and characterized by such firmness of definition as to do honour alike to the maker of the instrument and to the artist engaged in the delineation. It may assist those who have not attempted, with their own hands, any drawings of this kind, and desire to form a right judgment of the value of this work of P. Secchi, if I send for comparison a drawing of Gassendi, executed from my object-glass of 6¼ inches (Cook), with a focal length of 11 feet. The drawing is on a scale of 20 geographical miles to an inch, and Gassendi thus appears of half the linear dimension of Copernicus, being really almost of the same diameter.

Placing together the two drawings, and remembering the appearance of Copernicus, as I have seen it through telescopes, some reflections arise which it may be permitted me to express, in the hope that we are now fairly entered on the long career of discoveries in the moon, to which the attention of astronomers has been of late systematically drawn by the Earl of Rosse and a Committee of the British Association.

In proportion as the power of the telescope rises, the seemingly simple "ring mountains" of the moon exhibit as much diversity of outline and structure as the larger terrestrial volcanoes when accurately mapped. Thus while Gassendi 40° from the central meridian of the moon, and 17° south* of the equator, has the obliquely elliptical contour due to a circle in that position, Copernicus 20° from the central meridian, and 10° north of the equator, has its most conspicuous peripheral crest formed of seven principal nearly straight elements, approaching to equality in length, and meeting in points which are situated almost exactly in a circle of 24 geographical miles radius. Here is a very important partial difference, coupled with a very important general agreement.

While Gassendi, with peaks 9000 feet high, projects like a huge narrow wall into the Mare Humorum, and hangs over the interior plain in precipices as steep and many times as high as those over the Atrio del Cavallo, Copernicus, seated in the midst of broad land, on a base of 120 geographical miles, rises in many broken stages, bristling with a thousand silver-bright crests,—a perfect network of rough and complicated ground, crossed by lights and shades, which have a history of their own,—and toward the inside falls off by many irregular terraces, down to an interior plain, as if the whole area had yielded, and the surface had been formed by enormous land-slips. Four sharp notches are traced across the narrow ridge of Gassendi, cutting it deeply, like the hollows left by decomposing lava dykes 500 feet broad; one deeper and broader opening unites the inner plain with the outer Mare Humorum, and one far wider opening leads to an accessory crater, over whose awful depth the cliffs, 10,000 to 12,000 feet high, spread black shadows round some central

* The Poles being named after the type of Mädler's noble work, "Der Mond."

rocks. In these particulars, Copernicus offers a very different aspect. Its high crest, of 10,000 feet, is only cut through by one straight narrow meridional groove, though broken by numerous fissures in other parts, and is in all parts so irregular. partially undulated, and varied with small crateriform points, and enclosed areas, resembling craters, as to offer little analogy to any truncated cone of eruption. The highest summit, on the left-hand (west) side—a huge rock—is conspicuous by its broad, deep and extended shade. What suggests a vast lava current, is equally remarkable on the northern slope. Regarding now the central plains of these mountains, we remark in each several low ridges of rather sinuous forms, and several small mounds (half a mile or more across), of which *three central digitated masses, not pierced by craters,* are the most elevated, and catch the earliest lights of morning which glance over the rocky borders of the basin. Had the drawings been executed at the instant of sunrise on the central meridian line of the basin, these points would have stood up on the soft edge of the light and shade, as bright as the Swiss mountains at sunrise or sunset, but not like them reddened by the optical property of the atmosphere. Gassendi has *at least two* (I have somewhere a memorandum of more) small craters within the central plain. None such appear in this drawing of Copernicus. In many other lunar mountains the centre is occupied by a crater-formed hill, as Vesuvius stands within Somma; in others the hill remains a smooth rounded mass, but its crater is lost; and a fur her stage of decay seems to be seen in Gassendi and Copernicus, where the central mass is broken into fragments and sculptured by ramified hollows. May we ascribe these effects to the former action of a lunar atmosphere, now absorbed in the oxidated crust of the moon? If so, the lunar mountains have a history of water, as well as records of fire, and we must look on the sinuous ridges of the Mare Humorum with eyes accustomed to the gravel mounds of Norway and Ireland; study the degraded craters after the models of the Eifel; and map the "rillen" with reference to valleys of erosion as well as of eruption.

In questions of this kind we shall find such drawings as this of the Roman astronomer of priceless value. Studied, scrutinized, enriched with new discoveries, it may be the model for all time to come in this line of research. It may be followed by two other drawings of the same mountain, one at the moment when the sun is antemeridian of the central hillock, *to show the light streaks,* which hide themselves when the sun is low, and another in the clear afternoon of the lunar day (as much after midday, as this drawing was taken before noon) when every little crack and cavity becomes again distinct, *but greatly altered in aspect,* and the whole landscape changes under the eye of the observer; the plains growing greyer and softer, and revealing many minute low undulations; the hills looking more and more rugged, and burning with narrower, brighter, and more angular tracts of silvery light.

METEOROLOGY OF 1856.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the year 1856, under the Superintendence of the Astronomer Royal.

Months.	Mean Reading of Barom.	Mean Tension of Vapour.	Mean Pressure of Dry Air.	Temperature of Air. Dry Bulb Therm.	Self-Reg. Therm	Mean for Month	Highest.	Lowest.	Range.	Mean Daily Range.	Temperature of Evap.	Evap. below Air.	Dew Point below Air.	Dew Point.	Rain. No. of Days.	Amount in Inches.	Weight of Vapour in Cubic ft. of Air.	Mean additional Weight required to saturate a cubic foot of Air.	Mean Degree of Humidity. Saturation = 100.	Mean Weight of a cubic foot of Air.
	In.	In.	In.	°	°	°	°	°	°	°	°	°	°	°		Ins.	Grs.	Gr.		Grs.
Jan.......	29·468	·215	29·253	39·4	39·3	39·4	54·0	24·3	29·7	8·5	38·2	1·2	3·0	36·4	18	2·6	2·6	0·3	91	547
Feb.......	29·899	·227	29·672	41·9	42·1	42·0	58·0	27·5	30·5	9·7	40·3	1·7	4·2	27·8	10	1·1	2·7	0·4	87	552
March..	30·011	·188	29·823	39·1	38·5	38·8	52·0	24·7	27·3	12·4	36·6	2·2	5·7	33·1	6	1·2	2·2	0·5	82	558
April....	29·615	·235	29·380	47·0	46·6	46·8	73·0	30·6	42·4	19·1	43·0	3·8	8·1	38·7	13	2·3	2·7	1·0	74	542
May......	29·647	·276	29·371	49·7	49·2	49·5	72·0	29·8	42·2	16·5	46·2	3·3	6·6	42·9	18	3·5	3·1	1·0	77	539
June ...	29·877	·374	29·503	58·5	58·6	58·5	83·1	41·1	42·0	20·8	55·0	3·5	7·5	51·0	7	1·6	4·2	0·7	79	536
July ...	29·831	·425	29·406	61·2	61·0	61·1	87·5	44·0	43·5	20·9	57·6	3·5	6·6	54·5	13	0·9	4·8	1·6	79	529
Aug......	29·746	·453	29·293	63·6	63·6	63·6	89·8	45·0	44·8	21·2	59·6	4·0	7·4	56·2	10	2·4	5·0	1·5	78	525
Sept. ...	29·652	·328	29·324	55·1	55·3	55·2	72·5	40·0	32·5	17·9	51·2	4·0	7·8	47·4	17	2·8	3·7	1·2	75	533
Oct.......	29·991	·330	29·661	51·6	51·9	51·7	66·0	31·4	34·6	13·7	49·6	2·1	4·1	47·6	10	1·9	3·8	0·6	87	543
Nov.......	29·902	·223	29·679	40·7	40·7	40·7	57·7	19·4	38·3	11·7	39·2	1·5	3·4	37·3	10	1·3	2·6	0·4	88	554
Dec.......	29·646	·223	29·423	40·3	40·2	40·2	58·9	18·5	40·4	9·8	38·9	1·3	2·9	37·3	12	1·8	2·6	0·3	90	550

EXPLANATION.

The cistern of the barometer is about 159 feet above the level of the sea, and its readings are coincident with those of the Royal Society's flint-glass barometer. The observations are taken daily at 9 A.M., noon, 3 P.M., and 9 P.M.; the means of these readings are corrected for diurnal ranges by the application of Mr. Glaisher's corrections, as published in the *Philosophical Transactions*. Part I., 1848, and from the readings of the dry and wet bulb thermometers, thus corrected, the several hygrometrical deductions in columns 3, 15, 18, 19, 20 and 21, are calculated by means of Mr. Glaisher's Hygrometrical Tables. *Second Edition.*

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of the column of mercury which balanced the whole weight of atmosphere of air and water; the numbers in column 3 show the length of a column of mercury balanced by the water mixed with the air alone; and the numbers in column 4 show the length of a column of mercury balanced by the air alone, or that reading of the barometer which would have been had no vapour been mixed with the air.

[*Concluded on next page.*

The numbers in columns 5 and 6 are determinations of the mean temperature of the air by different instruments and methods—those in column 5 by the readings of a simple thermometer, taken at the times before-mentioned, and those in column 6 by the readings of self-registering thermometers daily. The numbers in column 12 show the mean temperature of evaporation, and those in column 15 give the mean temperature of the dew-point, or that temperature at which the vapour in the air is deposited in the form of water.

The reading of the barometer was above its average value in February, March, June, July, Oct., and Nov., and in defect in the remaining months of the year.

The mean reading of the barometer for the year, at the height of 160 feet above the mean level of the sea, was 29·790 inches, being about the average value.

The mean temperature of the air in January was in excess of the average value of 85 years by 3½°; February, by 4°; March, in defect, by 2°; April, in excess, by ¾°; May, in defect, by 3°; June, in excess, ½°; July, in defect, by ½°; August, in excess, by 3°; September, in defect, by 1°; October, in excess, by 3°; November, in defect, by 2°; and in December, in excess, by 1°: according to Mr. Glaisher's determination of the mean temperature of each month.

The mean temperature of the air for the year was 48°·7; that of evaporation was 46°·3; and that of the dew-point was 43°·3. The mean degree of humidity was 82, complete saturation being represented by 100. Rain fell on 144 days; the amount collected was 23·3 inches.

Till January 8, the weather was very warm, and the mean daily excess of temperature was 6½°; from the 9th to the 15th, the amount of defect was 3¼°, when another warm period began, and to the 27th the mean daily amount of excess was 7¼°. February was also warm: till the 4th it was 4½° in defect, to the 16th 8¾° in excess; till the 22nd 4½° in defect, and on to the end of the month was 10½° in excess. March was cold throughout, being 3° in defect daily. April was 8½° in excess to the 15th, and 2½° in defect to the end of the month. May was cold, being 3½° daily in defect. The first two weeks of June were 1° in excess; to the 24th 4° in defect, and 4° in excess to the end of the month. Till the 18th of July the temperature was in defect to the mean daily amount of 4°, when, till the 16th of August, it was 4½° in excess; and in excess and defect alternately till the end of September. The quarter ending September 30th is only to be noticed as regards the warm period at the end of July and beginning of August; the maximum temperature being on the 2nd of August 89°·8; and the mean temperature for that day 74°·2. Till the 24th of October the temperature was a mean daily amount of 3° in excess, and 4½° in defect to the end of the month. November 1 and 2 were in excess; from the 2nd to the 20th, 4° in defect; the next 5 days 7° in excess; and to the 4th of December was 9½° in defect. The next ten days were very warm, being to the mean daily amount of 9½° in excess; the daily temperature to the end of the year was in excess and defect alternately.

The last quarter was remarkable for the sudden changes in temperature, more particularly at the end of November and the beginning of December. The mean temperature of the last day of November was 28°·5, and that of the 7th of December 56°·0, giving a range of mean temperature of 27°·5 in 8 days. And at the end of the month of December we had another cold period, the mean temperature being 44°·1 on the 22nd, and 25°·7 on the 28th, giving a range of 18°·4 within 6 days.

During Nov. and Dec. there were great vicissitudes in atmospheric pressure.

Wheat was cut on the 1st of August at Patrixbourn, in Kent; on the 3rd at Helston, in Cornwall; on the 4th at Newport, Isle of Wight; Bicester, in Oxfordshire; at Hartwell, in Bucks, and at Cardington, in Bedfordshire; on the 5th at Guernsey; on the 11th in the Midland Counties; on the 8th at Hawarden, North Wales; on the 15th at Clifton, near Bristol; and on the 26th at North Shields.

Barley was cut on the 2nd of August at Helston; on the 3rd at Hartwell; on the 8th at Hawarden; and between the 18th and 23rd in the Midland Counties.

Oats were cut over the country between the 2nd of August and the 15th.

DESTRUCTIVE TYPHOON IN THE PHILIPPINE ISLANDS.

A LETTER from Manilla, dated November 4, and published in the Paris *Moniteur*, states that, on the 27th of October, a violent Typhoon made almost a complete devastation in the Philippine Islands. All the suburbs of Manilla and neighbouring villages were reduced to heaps of ruins. The number of houses destroyed at that place alone was above 3500, and official returns show that more than 10,000 houses were demolished within a circuit of about eight leagues around Manilla. The disastrous effects of the hurricane were felt throughout the other districts of the island, where the crops and the orchards were torn out of the ground. Six foreign vessels in the roads of Manilla were cast ashore, and many small boats were also lost. It was the most terrible typhoon ever remembered.

Obituary.

LIST OF PERSONS EMINENT IN SCIENCE AND ART. 1856.

The VERY REV. DR. WILLIAM BUCKLAND, Dean of Westminster, one of the leading English geologists; Professor of Geology in the University of Oxford; and one of the founders of the Museum of Practical Geology. Among his works are his *Reliquiæ Diluvianæ*, illustrating the bone caverns of Kirkdale; his Bridgewater *Treatise on Geology and Mineralogy;* and his *Geological Evidence of the Deluge.*

DANIEL SHARPE, President of the Geological Society in 1856.

COLONEL MADDEN, President of the Botanical Society of Edinburgh.

The Commendatore LUIGI CANINA, veteran architect, the author of numerous elaborately-illustrated works on the Vitruvian science of all ages.

PROFESSOR ZEUSS, the eminent linguist, who, by his *Grammatica Celtica* and other works referring to Celtic language and antiquity, has made himself a a name of European celebrity.—*Athenæum.*

WILLIAM YARRELL, F.L.S., the able naturalist. Mr. Yarrell, as an ichthyologist, in conjunction with Mr. Jesse, solved the problem which had perplexed naturalists from the days of Pliny, as to the history of the eel. He clearly proved that they are oviparous, have scales, and breed for the most part in the brackish water at the mouths of rivers—thus removing many doubts and difficulties on this curious subject. "Mr. Yarrell's purely intellectual character is seen in his works. The part which the author himself always took most credit for was the geographical distribution of the several species of birds. He always considered that, in treating it as he had done, he smuggled in a certain amount of geography in the garb of ornithology. For the high qualities of accuracy, terseness of description, and felicity of illustration, they speak for themselves."—*Edin. New Philos. Journal,* No. 8.

FRANCIS WISHAW, civil engineer, inventor of various improvements in Telegraphs; some time Secretary of the Society of Arts, and one of the originators of the Great Exhibition of 1851. Mr. Wishaw was also the inventor of the Hydraulic Telegraph, which preceded the Electric Telegraph, and is described in the *Arcana of Science* for 1838.

DANIEL LAING, F.S.A., architect of the Custom House.

VON BIELA, the celebrated astronomer. He was a major in the Austrian army. In 1826, whilst quartered with his regiment at Josephstadt, in Bohemia, he made the interesting discovery of the Comet (called after him) circulating round the sun, between that luminary and the orbit of Saturn. Having retired from the army, he spent the last years of his life in the study of his favourite science—astronomy—and in constant correspondence with Maedler, Argalander, Humboldt, and other *savans* of celebrity.

MRS. LEE, formerly Mrs. Bowdich, who wrote an excellent Memoir of Cuvier, and several works on Natural History.

D. E. BRAUN, an excellent antiquary, and illustrator of Roman history and topography.

BARON CHARLES DE STEUBEN, the celebrated painter.

DAVID DYSON, of Manchester, one of a class of naturalists for which that district of England has become remarkable.—*Athenæum,* No. 1521.

THOMAS SEDDON, painter of Oriental life and scenery.

HUGH MILLER, the geologist, principally known in science by his very able work, *The Old Red Sandstone.*

The REV. DR. HARRIS, Principal of New College, London, who possessed an extensive acquaintance with the natural sciences, which he brought to bear on his theological views.

Dr. John Ayrton Paris, President of the Royal College of Physicians, and founder of the Royal Geological Society of Cornwall, one of the earliest societies devoted to the study of Geology in England. Among his works are *Elements of Medical Chemistry*, and a *Life of Sir Humphry Davy*.

Baron Von Hammer, the great Oriental scholar. He was ex-President and Senior Member of the Vienna Academy of Science, and is said to have won the decorations of twenty different orders, and to have been a member of almost every literary society in the world.—*Literary Gazette.*

Christoph Friedrich Otto, late Director of the Royal Botanic Garden at Berlin. He was employed first as a journeyman gardener, and afterwards, at the recommendation of Willdenow, was made Sub-Curator of the Royal Botanic Garden. He received the fourth class of the order of the Red Eagle, in testimony of his services. He published several botanical works, and edited, in connexion with Dr. Albert Dietrieh, the *Allgemeine Gartenzeitung*. A genus of umbelliferous plants is called *Ottoa*.

Professor Tineo, Director of the Botanic Garden at Palermo.

Paul Delaroche, the greatest modern painter of France.

Thomas Ellis, English Oriental scholar.

Joseph Haydn, compiler of a very useful *Dictionary of Dates*, for which he received a Civil List pension of 25*l*. per aunum (9*s*. 7*d*. a week)—a great meanness of a great nation!

The Rev. Dr. Gray, Professor of Natural Philosophy in Marischal College, Aberdeen.

Sir John Stoddart, who wrote an able Treatise on Universal Grammar.

Sir William Hamilton, the distinguished metaphysician, who for many years held the Chair of Logic and Physics in the University of Edinburgh.

Rear-Admiral Sir John Ross, K.C.B., our earliest modern Arctic navigator, as well as one of our latest; for he was chosen to command Lady Franklin's private expedition in search of her lamented husband. Sir John Ross entered the Navy in 1786. His published work include *A Treatise on Navigation by Steam*, *Letters to Young Sea Officers*; and, best known of all, his *Voyage of Discovery*, and his *Second Voyage of Discovery to the Arctic Regions*.

Sir Richard Westmacott, R.A., a pupil of Canova, a veteran sculptor, a bold and powerful draughtsman, and an able lecturer.

Professor Bojer, the well-known botanist of the Mauritius. At the time of his death he was engaged in drawing up an illustrated monograph of the genus Mangifera.

Mr. James Bremner, civil engineer and shipbuilder. Mr. Bremner's share in removing the steam-ship *Great Britain* off the strand in Dundrum Bay is well known: he was then almost constantly employed night and day for about three months.

Elijah Galloway, civil engineer.

Mr. James Renton, of Newark, New Jersey, United States, the inventor of a method of making malleable iron direct from the ore.—*Scientific American.*

James Meadows Rendel, the eminent civil engineer. Among his great public works were the Floating Steam-bridge near Dartmouth; the Docks at Birkenhead, in Cheshire, the Great Grimsby Docks; the Harbours of Refuge of Holyhead and Portland; the New River improvements; and the direction of the East Indian and Madras, the Ceylon and Pernambuco Railways. He was a man of great energy, clear perception, correct judgment, and sound practical knowledge, and occupied a very high position in his profession.

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