THE

YEAR-BOOK OF FACTS

IN

Science and Art:

EXHIBITING

THE MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS OF THE PAST YEAR;

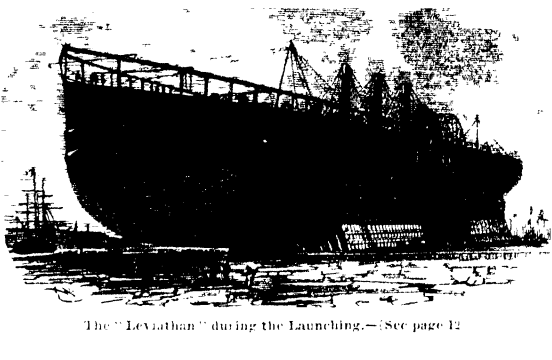
IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND MINERALOGY; METEOROLOGY AND ASTRONOMY.

By JOHN TIMBS, F.S.A.

AUTHOR OF

"THINGS NOT GENERALLY KNOWN FAMILIARLY EXPLAINED."

"Science is not on the decline; and its cultivators have not been gligent in their high calling." —*Address of the Rev. Dr. Lloyd, President*



The "Leviathan" during the Launching.—(See page 12

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JOHN SCOTT RUSSELL, C.E., F.R.S., &c., BUILDER OF THE "LEVIATHAN" STEAM-SHIP.

(*With a Portrait.*)

The great event in the mechanical science of the past year has been the rapid completion of the *Leviathan* steam-ship, by Mr. John Scott Russell, whose portrait, therefore, very appropriately faces the title-page of the present volume of scientific records of 1857.

The antecedents of Mr. Scott Russell show that in very early life he displayed that genius and love of enterprise which prepared the possessor for great and original undertakings. He was born in the Vale of Clyde, in 1808, and is the eldest son of the Rev. David Russell, of the family of Russell of Braidwood. He received a University education, and graduated with honour, at the age of sixteen. He evinced a very early predilection for practical mechanics, to encourage which his father first permitted him to employ himself in the workshop of an engineer; and afterwards assisted him to prosecute his studies in mechanics, physics, and the higher mathematics. In these he had made such advances, that when Sir John Leslie, the Professor of Natural Philosophy in the University of Edinburgh, died at the commencement of the winter of 1832, the young engineer, Scott Russell, was elected to supply, temporarily, the vacancy, and delivered a complete course of lectures on Natural Philosophy to the students, who attended in unusual numbers the prelections of one much younger than themselves. From this time his course as a practical engineer became decided. In a few years he succeeded Mr. Caird, of Greenock, as the manager of one of the largest engineering establishments in Scotland, and there he continued for some years. Well do we remember Mr. Scott Russell's able communications to the Scottish Society of Arts, of which several of our *Year-Books of Facts* bear record; and to us their salient points were the presage of a life of activity and skilful enterprise to be developed in the metropolis of England, whither Mr. Scott Russell removed in the year 1844.

Meanwhile, the practical man had not neglected his science, but had well applied its doctrines to the mechanical arts. He became a ship-builder, and was then led to investigate the laws by which water opposes resistance to the motion of floating bodies; he subsequently established the phenomenon in hydrodynamics known as "the wave of translation," and invented a new form for ships, which possesses the quality of the least resistance, and on which he founded his "*wave system*" of construction, introduced into practice about 1835. Steam-vessels built on this system have risen from the former usual rate of ten miles an hour to the high velocities of twelve, sixteen, and seventeen miles an hour. A memoir on these discoveries was read by Mr. Scott Russell before the Royal Society of Edinburgh in 1837, and obtained for him the large Gold Medal; when he was also elected a Fellow of the Society, and immediately placed upon the Council. Ten years later he was elected a Fellow of the Royal Society of London, and Member of the Institution of Civil Engineers. He has been also for many years an active member of the British Association for the Advancement of Science; and in 1847, in conjunction with Sir John Robison, Mr. Scott Russell conducted an important series of experiments on Waves, which are recorded in the Society's Reports.

Mr. Scott Russell has been long a very efficient member of the Society of Arts: he was for some time its secretary, and in 1845 was one of a committee appointed by the Society to organise a National Exhibition of Works of Industrial Art; for this purpose Mr. Scott Russell subscribed money, and gave his untiring efforts, but without success. Of these preliminary proceedings he has published a Narrative. Meanwhile, the Prince Albert, as President of the Society of Arts, was cognizant of these proceedings; Mr. Scott Russell and his coadjutors, Mr. Francis Fuller and Mr. Henry Cole, persevered in their good work; but the Government would in no way assist them; and it was not until 1849, when the plan had been so far matured as almost to ensure success, that the Prince President took the subject of the Great Exhibition under his own personal superintendence. To Mr. Scott Russell must therefore be awarded the merit of having been one of the three originators of the Exhibition of 1851. He was one of the two Secretaries to the Royal Commission originally named by Her Majesty in the commission issued Jan. 3, 1850; and he had, during the previous six months, planned and organized the preliminary arrangements.* It is interesting to trace the precise share which Mr. Scott Russell had in this great industrial display; for there is a kindred — a sort of family tie between the Great Exhibition of 1851, and the Great Eastern Steam-ship of 1858.

Of the energy and ability of Mr. Scott Russell as a labourer in the great field of mechanical science during the last quarter of a century, the reader may satisfy himself by glancing through the series of *Arcana of Science* and *Year-Book of Facts* for that period. He combines the advantages of a mind well stored with facts, and great power of reasoning and conviction, with urbane and gentlemanly manner. Mr. Scott Russell married, in 1837, Harriette, second daughter of Sir Daniel Toler Osborne, Bart., and of the Lady Harriette, daughter of the first Earl of Clancarty.

The accompanying portrait has been ably engraved by Mote, from a photograph by Mayall and Son, Regent-street.

We shall next describe the most colossal and important undertaking in which Mr. Scott Russell has been hitherto engaged, and which has established his fame as the most advanced shipbuilder of the day—namely, the steam-ship *Leviathan*.

* See the Account of the Great Exhibition in the Extra *Year-Book of Facts*, 1851, by the Editor of the present volume.

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THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

THE "LEVIATHAN" STEAM-SHIP.

THE origin and mechanical structure of this stupendous ship cannot be better described than in the paper, read to the Mechanical Section of the British Association* by her builder, Mr. John Scott Russell, who said:

He was not, as was generally supposed, an advocate for large ships, but the contrary; and it was the peculiarity of the *Great Eastern*† that she was the smallest ship that could be built capable of doing the work which she was intended to perform. It had been found that a steam-ship could not be profitably worked which was of a less size than a ton to a mile of the voyage she was to perform, carrying her own coal. The voyage to Australia and back was 25,000 miles. The burthen of the *Great Eastern*, according to this principle, ought to be 25,000 tons, whereas her actual tonnage was only 22,000. Mr. Brunel first started the idea of building a vessel capable of performing the voyage to India or Australia and back, and the result of his suggestion was the great ship now fast approaching completion.

Mr. Russell then stated that the *Great Eastern*, as far as her lines were concerned, was a child of the Mechanical Section of the British Association. It was formed on the Wave principle, which, at the former meeting of the Association in Dublin, twenty-two years ago, he had first propounded, which, after a careful investigation by a Committee of the Association, had been found to be the right principle, and was now universally adopted. When a vessel was about to be built, intended to attain a certain speed, from ten miles an hour upwards, reference to the table of the wave principle informed them of the length which the bows and stern must be, and of the peculiarity of construction necessary in order to procure the desired result. According to this principle it was necessary, in order to acquire the speed which this vessel was to attain, that the length of her bow should be 330, the length of her stern 250, of the midship 120, which with 10 feet for the screw-propeller, gave an entire length of 680 feet. He showed that, while increasing the carrying or paying power of the ship to an immense extent, its mode of construction was such that the increase in the resistance of the water was in a much lower ratio, so that the vessel, notwithstanding its enormous size, could be worked as economically as a smaller one.

He next entered into a detailed description of the various improvements which he had introduced into the building of iron vessels, which were at first constructed in close imitation of the model of wooden ships with cumbrous timber frames, which gave no strength, but entailed great expense. He could not always build ships upon the improved principles, because owners insisted on having them made in the old-fashioned way. All improvements, which Mr. Scott Russell detailed at great length, were introduced into the *Great Eastern*, together with the cellular system, which had been so successfully applied in the construction of the Britannia Bridge, and which presented the greatest amount of strength that could possibly be procured against any crushing or resistance

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* At the Annual Meeting held in Dublin, in August and September, 1857.
† Subsequently the name of the ship was changed to the *Leviathan*.

she might accidentally encounter. In fact, there was nothing new in the structure of this ship, save the cellular system, as the principles applied in her construction had been repeatedly tested and fully established as those which should be adopted in the building of iron ships, so that the *Great Eastern* presented the combined result of sound science and the best practical experience. Mr. Russell concluded by stating, that the vessel would be propelled by a screw and two paddles, giving her a nominal horse-power of 2500. He wished he could tell them the speed at which the *Great Eastern* would go, but this secret for the present was only for the owners.

Mr. Fairbairn expressed his approval of the principle on which the vessel had been constructed; and he believed that it would be successful, and realize all the expectations that had been formed of it.*

In the spring of last year, the great ship had so far approached completion as to be exhibited to the public; and it was upon the occasion of Mr. Scott Russell's name being mentioned in the *Times* exclusively in connexion with the ship, that he addressed a letter to the above journal, in which, with an honourable regard to the rights of others who have largely shared in the merits or responsibilities of the undertaking, Mr. Russell communicated the following facts:

"My share of the merit and responsibility is that of builder of the ship for the Eastern Steam Navigation Company. I designed her lines and constructed the iron hull of the ship, and am responsible for her merits or defects as a piece of naval architecture. I am equally responsible for the paddle-wheel engines of 1000 horse-power, by which she is to be propelled.

"But Messrs. James Watt and Co., the eminent engineers of Soho, have the entire merit of the design and construction of the engines of 1500 horse-power which are to propel the s

"It is, however, to the Company's engineer, Mr. I. K. Brunel, that the original conception is due of building a steam-ship large enough to carry coals sufficient for full steaming on the longest voyage. He, at the outset, and long before it had assumed a mercantile form, communicated his views to me, and I have participated in the contrivance of the best means to carry them into practical effect. I think, further, that the idea of using two sets of engines and two propellers is original, and was his invention. It was his idea also to introduce a cellular construction like that at the top and bottom of the Britannia-bridge into the construction of the great ship. It will be seen that these are the main characteristics which distinguish this from other ships, and these are Mr. Brunel's. Her lines and her structure in other respects are identical with those of my other ships, which are constructed like this on a principle of my own, which I have systematically carried out during the last twenty years, and which is commonly called the 'wave' principle. In other respects, also, her materials are put together in the manner usual in my other ships.

"I think, too, there are others whose names and services in this matter the public should not forget whenever the great ship is mentioned. The mercantile difficulty appeared at the outset—and this has proved itself since—to be quite as great as the mechanical difficulty of the undertaking. So unusual an enterprise could not have been carried out without ability, enterprise, and prudence, to the credit of which the board of directors, represented by their chairman, Mr. H. T. Hope, and their secretary, Mr. John Yates, are entitled in a high degree. And there was one of them who bore the burden and heat of the day, and at the outset of this undertaking was one of its most able and zealous supporters, the late Mr. Charles Geach. I think I am justified in saying that without him it would never, as a mercantile speculation, have been undertaken by many of those

* A notice of the ship, communicated by Mr. Scott Russell to the British Association, in 1854, will be found in the *Year-Book of Facts*, 1855, pp. 60—62; and a previous notice at pp. 37 and 38 of the same *Year-Book*.

who have undertaken it; that on his aid and exertions many of us probably, and certainly myself, relied mainly for the successful issue of the undertaking, and that his untimely death materially increased the difficulties of that undertaking, both to the directors and to the constructor of the ship. Let not, therefore, his share of any merit that may belong to the undertaking be forgotten.

"In conclusion, permit me to add that my share of the merit and responsibility ends with the construction of the hull and of the paddle-wheel engines, which have now (April) been nearly completed by my assistants, Mr. Dickson and Mr. Hepworth. The launching of the ship, the rigging and masting of the ship, her cabins and her outfit, are not mine, but are executed entirely under Mr. Brunel, Captain Harrison, and the other officers of the Company."

The *Leviathan* is of nearly five times the tonnage of the largest ship hitherto built in the world; and is capable of stowing at one time sufficient fuel to carry her round the world, and thus avoid the necessity of stopping at the intermediate stations usually resorted to by steam-propelled vessels making long voyages, where the high price of coals, and the delay attending their shipment, have hitherto been found to be the great drawbacks on making colonial steam-ships remunerative to their owners. The building of the vessel was commenced on May 1, 1854,* at Millwall, from lines laid down by Mr. Scott Russell, and was so far completed as to be prepared for launching by November, 1857.

The following are the relative dimensions of the *Leviathan* and large steam-ships:—

	Length.	Breadth.
Great Western, 1838 (first Atlantic steamer)	236	36
Great Britain, 1844 (first ocean screw-steamer)	322	51
Himalaya, 1853 (largest screw-steamer)	370	44
Persia, 1856 (largest paddle-steamer)	390	45
Duke of Wellington, 1855 (largest war-steamer)	240	60
Leviathan, 1858	680	83

The hull of the *Leviathan* is built entirely of iron, and is 692 feet in length over all; 680 feet between the perpendiculars; 83 feet beam, and 58 feet depth of hold. She is divided transversely into ten separate compartments of 60 feet each, rendered perfectly water-tight by bulkheads, having no opening whatever lower than the second deck, whilst two longitudinal walls of iron, 36 feet apart, traverse 350 feet of the length of the ship. She has no external keel: the true keelson, an iron plate 2 feet wide, and 1 inch thick,

* In the *Builder* of this year a comparison made between the big ship and the houses in Tavistock-square first gave the general public any notion of its enormous size and capacity. It consists of more than 10,000 plates put together with 3,000,000 of rivets. The decks and iron walls form it into about 80 enormous boxes. According to a published statement, its four paddle-engines are to give a nominal force of 5000 horse-power, and the screw-propeller of 6500—11,500 horse-power in the whole! The engines, when in full work, will swallow up 250 tons of coal each day; yet the cellar is large enough to hold a supply for a voyage to Australia and back! Why, the iron shaft to connect the propeller with the engine is three times as long as a good ten-roomed house is high—namely, 160 feet—and each wheel is 56 feet in diameter. Just imagine this enormous work, the conception of Brunel and the production of Scott Russell, completely fitted up with every necessary of life, and dashing across the ocean with 4400 human beings on board, at a continuous speed and with an ease never before attained (and this it is confidently anticipated will be the case), and you will have before you the most extraordinary result of engineering science and constructive skill that the world has yet seen.

runs the entire length from stem to stern, and from it the frame of the ship is raised. The bottom and sides, ascending from this, are made of plates three-quarters of an inch thick, and 2 feet 10 inches space intervenes between the outer and the inner skin of the ship, which is carried throughout her to the height of her deepest water-line, and is made of plates of similar thickness to those used in the outer hull. Between this double skin, at intervals of 6 feet, run horizontal webs of iron plates, which materially increase the powers of resistance of the inner and outer walls of the ship, and giving, in the event of the outer skin being pierced, additional safety to the vessel. Again, should the ship require ballast at any time, 2500 tons of water can be admitted into the spaces before mentioned. Besides the principal bulkheads, there are in each compartment second intermediate bulkheads, forming coal bunkers, which can, on an emergency, be closed. There are no openings under the deep water-line, through the principal bulkheads, except two continuous tunnels, through one of which the steam-pipes pass, so constructed as to remain closed, the opening of them being the exception. The floor of the ship is perfectly flat, the top of the keelson being rivetted to the skin of the inner vessel; the upper deck is similar in construction to the lower part, cellular, and formed of half-inch iron plates, which run the entire length of the ship; this deck runs flush and clear from stem to stern, for a breadth of about 20 feet on either side, affording magnificent promenades for the passengers, the circuit of this part of the ship being upwards of a quarter of a mile. This deck is planned to be of such strength, that, if supported on its extremities, it would sustain the entire weight of the ship. Upwards of ten thousand tons of iron plates have been used in the construction of the hull, and 3,000,000 rivets in securing them together.

As before mentioned, the *Leviathan* will be propelled by both paddles and screw. The paddle-engines have been manufactured by Messrs. Scott Russell and Co., and are of the nominal power of 1000 horses: they consist of 4 oscillating cylinders of 74 inches diameter of bore, 14 feet stroke, and each weighing 28 tons. Their motive power is supplied by 4 boilers, each having 10 furnaces; both engines and boilers are made on the disconnecting principle, and can be used jointly or separately. The paddle-wheels are 58 feet in diameter, with 13 feet floats, which is considerably wider than the circus at Astley's. The screw-engines are by Messrs. James Watt and Co., of Birmingham, and consist of 4 direct acting cylinders, of 84 inches diameter of bore, with a stroke of 4 feet, each cylinder weighing 30 tons, with a total nominal power of 1600 horses; 6 boilers, fed by 12 furnaces each, supply the steam; the weight of these engines alone is 500 tons. The screw-propeller is 24 feet in diameter, and 37 feet pitch: it weighs 60 tons, has 4 blades, and is connected with the engines by a shaft 160 feet long, and weighing upwards of 60 tons; it was forged at the works of Messrs. Mare, at Blackwall, by Mr. Hardy. She is also fitted with several auxiliary engines, for hoisting sails, working the screw when disconnected from the larger engines, anchoring, weighing, &c. &c.

The registered capacity of the vessel is 18,500 tons, estimated burthen 23,000 tons, and she is expected to achieve a speed of eighteen miles per hour. She is constructed to afford accommodation for 800 first, 2000 second, and 1200 third-class passengers, who will be located in the central divisions of the ship, completely isolated from the machinery by a strongly arched roof of iron, above which, and below the lowest saloon deck, the coals will be stowed, preventing all sound from reaching the passengers above; abaft of the paddle wheels she will carry two small screw steam-vessels, of 100 feet long, and 70 tons burthen, and about twenty large life-boats; in addition, she will be furnished with ten of Trotman's patent anchors, which, with their stocks, will weigh nearly 60 tons, and require 800 fathoms of chain cable, weighing nearly 100 tons; the capstans and warp weigh 100 tons—making the total weight of her anchoring appliances upwards of 250 tons. The compasses will be placed at a height of 24 feet above the deck, on a staging upon the mizen mast. Gas will be manufactured on board, and laid on to all parts of the ship, and she will also carry the electric light.

The probable weight of the *Leviathan* in tons—without the crew, the passengers, the provisions, the personal effects, the water, or the coals—is estimated thus:

	Tons.
Iron hull of the ship	7316
Timber-work, fittings, &c.	1576
Masts, rigging, and sails	358
Anchors, chains, &c.	300
Paddle-engines	519
Boilers for ditto (empty)	206
Screw-engines	607
Boilers for ditto (empty)	362
Paddle-wheels	185
Paddle-boxes and sponsons	250
Screw-shaft and bearings	153
Screw-propeller	37
Total	11,869

With the full complement of everything intended by her owners, this stupendous floating fabric, on a voyage to Australia, would weigh little short of 30,000 tons.

Next came the *Launching* of the 12,000 tons. If launched endwise, as usual, "this," said Mr. Brunel, "would have involved raising the fore part of the keel, or the forefoot, about 40 feet in the air, and the forecastle would have been nearly 100 feet from the ground; the whole vessel would have been, on an average, 22 feet higher than if built on an even keel.

"The inconvenience and cost of building at such a great height above ground may easily be imagined;" besides, "the angle required for the inclined plane to ensure the vessel moving by gravity being, say 1 in 14, or even if diminished by improved construction in ways to 1 in 25, is such, that the end first immersed would become waterborne, or would require a very great depth of water before the fore part of the ship would even reach the water's edge."

The water being too shallow, the vessel too long, and the stream too narrow for launching endwise, Mr. Brunel resolved to adopt the novelty of broadside on. The length of the vessel being parallel with the course of the river, and about 300 feet beyond the line of low-water mark, the ship had to be slid down this distance before touching water; for the launching had to be effected while the tide was flowing out, instead of the hour of high-water, as is the usual manner. Hence the muddy strand or beach had to be prepared for the support of the enormous mass of 20 or 30 millions pounds' weight. To effect this were built by Messrs. Treadwell, of Gloucester, two launchways—each a quadrangular platform, 300 feet long by 200 feet wide, and the distance between the two ways being 120 feet. Each was constructed of enormous piles of timber, some driven to a depth of 30 feet, and on these piles were bolted balks of timber one over another, longitudinal and transversal. Each way inclined gently from the ship to the water, at a slope of about 1 in 12; consequently the upper end was 25 feet higher than the lower, which inclination was to give descensive power to the ship. The floor of timbers was covered with concrete, and on it were placed railway irons, of the same form as those of the Great Western Railway; they were placed 18 inches apart from end to end of the launchways, each having about 80 lines of parallel rail.

To adapt the ship to this novel railway, under the vessel were built two enormous timber *cradles*, corresponding in position with the two launchways: that is, one between the head and the midship, and one between the midship and the stern—220 feet from centre to centre of the cradles. The bottom of each cradle consisted of a surface about 120 feet by 80, inclined to the horizon at the same angle as the upper surface of the launchways—that is, 1 in 12; and the rest consisted of a solid mass of timber, closely packed around and under the hull. The bottom of each cradle was shod with long plates of iron with rounded edges, and their lower surfaces ground smooth, so as to avoid scraping the metal of the rails during the descent. Thus, instead of wood sliding upon wood, as in ordinary launches, the *Leviathan* had to slide iron upon iron, the plates being at right angles with the bars. The cradles, though close to the hull, were totally distinct from it; it rested on them, but was not fastened to them.

To provide against too great a speed, or too little, Mr. Brunel constructed two powerful drums, to which the cradles were attached by cast-iron sheaves or pulleys, weighing 5 tons each. One sheave was fastened to each cradle, and wrought-iron chain-cables of the largest size connected these with two other sheaves, each of which was secured to the drum, which payed out the chain. The shape was that of an ordinary reel, the axle of which was formed by beams of timber and strips of wrought-iron bound together so as to form a drum about 20 feet long and 9 feet in diameter. At each end of the cylinder were the wheels of the drum or discs, 16 feet in diameter, each of solid iron, and weighing upwards of 20 tons, so that the weight of each drum was more than 60 tons in all. The axle of the disc was set in a frame of iron, while around its outer edges passes a band of wrought-iron to work in the manner of a friction clutch or break. This, with the aid of strong iron levers 20 feet long, brought such a pressure to bear upon the discs of the drum as to lower its rate of revolutions, or entirely stop them in case of the chain being payed out too fast. The drums were set in a solid bed of wood, formed upon piles. This was bound together with iron, and strong shores passed from the cube of piles to the bed of piles on which the launching-ways were built. One of these drums was built opposite each cradle — the chains used between them and the cradles being the chain cables of the great ship itself, which are 2¼ inches in diameter, or about 60 lb. the link.

To start the cradles in motion, powerful *hydraulic rams* were used, which were capable of acting so as to push them about 3 feet forwards. If more force than this were necessary, it was provided for by three means :—A strong cable was passed round the extremity of the shaft of the Archimedean screw at the after part of the ship, carried out into the midst of the river, passed round a block in a lighter firmly moored, and brought back again to the shore, where a small stationary steam-engine was placed to haul it in, and bring any reasonable amount of pressure to bear upon it. Another steam-engine and similar apparatus was used for a cable firmly fixed to the bow of the ship. Lastly, cables were fastened to the middle of the ship, and carried out to four lighters moored in mid river, with mechanical apparatus on board them, well manned, to drag the centre of the ship forward if necessary. Each of these four lighters was capable of applying a strain of 60 tons. Two lighters were also moored at the stem and two at the stern of the vessel. The chains passing from the ship to these latter were returned again on shore, so as to be worked with a double purchase. Small stationary engines on land were used to haul in these, and made the whole force available to pull the vessel off the shore upwards of 600 tons. The hydraulic rams that were to "start" her, gave, at the forward end, a pressure of 600 tons; the one at the stern, a pressure of 1000 tons.

The first attempt to launch the ship was made on Nov. 3, in the presence of, it is stated, 100,000 spectators. After Miss Hope, the accomplished daughter of Mr. H. T. Hope (the chairman of the Great Eastern Steam Navigation Company), had, with due ceremony, named the vessel the *Leviathan*, the launching operations commenced.

A loud united shout was heard, and the head of the vessel slid quietly and easily some little distance down the ways. Scarcely had this motion ceased when the ship quivered from stem to stern, and its after part followed the lead of the head with a grinding crash, and a sullen roar, and in two seconds it had slipped suddenly 6 feet

one of the windlasses hurled some unfortunate men in the air.

of men at the opposite windlass, with redoubled efforts, pulled up the 12,000 tons, moving down an incline of 1 in 12 at the rate of 6 feet in two seconds—the sudden shock being felt throughout its length and breadth. The engines stopped, and the injured men were picked up by their fellow-workmen, and carried to the nearest hospital: two of the poor fellows died.

An hour elapsed, and then the operation was again carried on; but in a short time one of the drawing-chains snapped under extreme tension, the hydraulic pressure pump got out of order, and Mr. Brunel, very reluctantly, ordered the operations to be suspended.

The second launching attempt was made on November 13, when the abutments of the piles, against which the bases of the hydraulic rams rested, gave way to a great extent, and at last in some places broke entirely, and the work was again suspended.

The third attempt was made on November 28, when the *Leviathan* was gradually lowered down the launching-ways some 25 feet in a slow and beautifully regular manner.

The fourth attempt was made on November 30, but had again to be suspended, owing to the bursting of one of the hydraulic rams.

On December 3 (the rams being repaired), the launching was recommenced, and the ship slipped suddenly away from the rams, gliding down 6 feet 7 inches with very little noise, at the rate of six inches in a second. On the 4th of December the ship completely quitted every part of the old foundations on which she was built, and the entire of her vast bulk rested on the new launching-ways alone. On this day the *Leviathan* moved again directly the pressure was applied, and 31 feet were made by drops of 6 to 12 inches each time. The afternoon's tide placed about four feet of water under her keel, which had the effect of lightening the ways of about 1500 tons of her dead weight. But it now became almost impossible to make the vessel move at all, and in the efforts to do so, hydraulic rams, windlasses, and chains were broken in succession, till scarcely anything of the apparatus was left to continue work, without producing the slightest effect in the way of moving the vessel. Afterwards, a trifling movement of three inches was brought about, when the vessel appeared to wedge herself as firm as a mountain.

The *Leviathan* had reached the reduced gradient, and this exercised a retarding influence: the iron cradles and the railway metals of the "ways" were considerably rusted, and the resistance of iron against iron was calculated at 45 per cent. Still the ship was moved 35 inches by a sudden start. The hydraulic rams were then taxed to the very utmost, and at the sides of one of them 10 inches in diameter the water was forced through the pores of the solid iron like a thin dew, until the whole cylinder ripped from top to bottom with a noise like a dull under-ground explosion. At the same time the drum of the windlass was also crushed. At length, a movement of 3 inches was gained; but two of the rams were then broken, and the launch was once more given up. With all this strain, for a month, the ship did not show the deflection of a hair's breadth, but "with her 17,000 tons of dead weight, had stood through it, all erect on her two pigmy perches, with her keel as straight as a line."

At last, success came. On Jan. 2, 1858, 21 hydraulic rams were placed—11 against the aft, and 10 against the fore cradle of the ship; the launch was resumed, but, by an accident, the barge with its windlasses and gear was sunk. Nevertheless, on January 6th, the accumulated strength was brought to bear, and the *Leviathan* ground slowly down the launching-ways at the rate of *an inch* [illegible] *minutes*; she again took to short slips from 2½ inches to 5 inches in length; but the iron drum of the windlass was now crushed.

On the 7th, the operations were resumed. The rams were all put simultaneously in movement, and the ship was now completely under control; she made daily, without the slightest accident, 20 feet or more; and on January 12th, a boat was rowed all round the *Leviathan*, the water on the inside of the ways sufficing to float over all. On January 14th, the ship was pushed down the ways to the full extent she was required to go before the final launch, fixed for the spring tides of the 29th or 30th January. All the preliminary operations were therefore complete.

These interesting details have been abridged from the *Times*—"*Leviathan* Number." The most faithful portraits of the ship yet produced (in the opinion of Mr. Scott Russell, the builder), are those in the *Illustrated London News*, drawn by Edwin Weedon, and engraved by F. J. Smythe; the artists also of the Vignette in the title-page of the present volume.

THE INSTITUTION OF CIVIL

THE Annual General Meeting was held on Dec. 15. The Report of the Council for the past session, which was read, stated that the Indian mutiny had, for the moment, interrupted the progress of public works in that country, whilst the monetary crisis throughout Europe and in the United States had arrested nearly all professional occupation. Under these circumstances there were, comparatively, but few events to notice. Allusion was, however, made to several undertakings which had occupied the attention of civil engineers during the preceding twelve months, including the unfortunate failure in the attempt to lay the submarine electric telegraph cable between this country and the United States; and the hope was expressed that this daring enterprise would be completed next year.

Meanwhile the electric cables between Cagliari and Malta, and between Malta and Corfu, had been successfully submerged, in spite of the great depths of the channels, and thus another considerable step towards shortening the period of communicating between Great Britain and her Indian possessions had been accomplished.

Another great work was the *Leviathan* steam-ship, constructed by Mr. Scott Russell (M. Inst. C.E.), under the direction of Mr. Brunel, V.P., which, being now within reach of the water, there was good reason to believe, would be safely floated off the "ways" during the next high tides.

It was stated that, during the vacation, it had been determined to recognise the services of Mr. Charles Manby (as the Secretary during eighteen years) to the Institution, by the presentation of a testimonial. The proposition was eagerly received, and such an amount was promptly subscribed as enabled the Committee to devote a portion to the purchase of a clock and pair of candelabra, which, with a cheque for two thousand pounds, were presented to Mr. Manby by the President, in the presence of the members, in the Theatre of the Institution. In returning thanks for this mark of friendship and good will, Mr. Manby requested permission to devote some portion of the amount to the establishment of an annual premium, with which he begged that his name might be associated. He had accordingly transferred to the Institution the sum of two hundred pounds, in 5 per cent. debentures, the interest of which (10*l.* per annum) it was proposed to award to the authors of papers read at the meeting, to be denominated the "Manby Premium."

The thanks of the Institution were unanimously voted to the President, Vice-Presidents, and other members and associates of Council; to the auditors and scrutineers, for their services. A special vote of thanks was accorded to Mr. C. Manby, Secretary, for the manner in which he had performed the duties of his office, his constant attention to the individual wishes of the members, and for his liberal donation to form a fund for an Annual Premium.

THE MANCHESTER ART TREASURES EXHIBITION BUILDING.

The sheme of holding an Exhibition of Art Treasures at Manchester, in 1857, originated with Mr. Peter Cunningham, F.S.A., and Mr. J. C. Deane, by whom it was submitted to a private meeting held at the Town Hall, on the 26th March, 1856, when it was unanimously agreed that the proposal should be carried into execution, and a guarantee fund, amounting to 70,000*l.*, was immediately entered upon. Old Trafford was chosen as the site. The plans sent in by Messrs. C. D. Young and Co., of London, were accepted with some modifications. These plans were for a spacious building of iron, wood, and glass (with façade of red and yellow brick), the design being by Mr. William Dredge, C.E., who was acting as engineer for Messrs. Young and Co., and who likewise superintended its erection. The façade was designed by Mr. Edward Salomons, architect to the Executive Committee.

On the 18th of August, the first base of a column was laid by Mr. Fairbairn. From this time the work proceeded with great despatch, and during the first week after the base was laid, not less than 1200 tons of material were placed on the ground. Altogether, not less than 1400 tons of iron, and 125,000 cubic feet of timber, and 2,500,000 bricks, were used in the construction of the building. The building was nearly finished by the 18th of February last.

We quote the following brief description from the *Builder:*

The building itself is, in external form (disregarding some projecting buildings at each end), a parallelogram, of about 3½ squares of its width; that is, it is three and a half times as long as it is broad. The exact dimensions of the square are 656 feet in length, and 200 feet in width. But its length is increased by the two projecting portions of the east façade, flanking the grand entrance; and at the other end by the farthest rooms of the water-colour gallery. Each of these end buildings adds 24 feet to the entire length of the whole, so that the extreme length from end wall to end wall is 704 feet. The east façade is composed of—palace, 200 feet; railway corridor, 150 feet; and offices, 96 feet; in all presenting a front 446 feet in length. The entrance-front, which shows three large arches, is of cream-colour bricks, with red brick dressings and panels; the face of the arches themselves, filled in with glass, are of wood, painted cream-colour and red. It is not very handsome, but squat and ugly.

The internal form, so far as it can be seen at once—say from the centre of the transept—is that of the Latin cross, but reversed as to the cardinal points of the extremities; the upper end or summit of the cross being the west end.

The dimensions of the principal divisions of the building are the following:—

	Feet.
Length of great hall	632
Extreme width of hall	104
Length of north and south transepts	200
Width of transepts	104
Length of each range of picture-galleries	452
Width of each range of ditto	48
Length of water-colour gallery	200
Width of ditto	24
Length of smaller ditto	104
Width of ditto	24

The general construction will be understood by describing a section through the main part of the building. The central portion of the section will be the Great Hall, 104 feet across; this is divided by rows of coupled columns (at distances longitudinally of 16 feet apart) into three spans, the middle span formed by arched principals of wrought iron, without any cross tie-rods, springing from the tops of the coupled columns, and rising in a semicircle to the height of 56 feet 6 inches at the crown, the span being 56 feet across. The two sides are each spanned by a hipped roof of 24 feet across. On each side of the Great Hall are picture galleries of the width of 48 feet, covered by a semicircular roof, the principals of which are trussed by tie-rods and struts. The height of the crown of the roofs to the picture galleries is 50 feet 6 inches. The height of the coupled columns in the Great Hall is 28 feet 6 inches.

Thus far, the constructive details of the Building.

We shall not be expected to describe the interior of this vast Palace of Art, or its treasures. The walls of the nave held the British portrait gallery, 387 pictures; the galleries on the south side contained the works of the ancient masters, arranged by Mr. Scharf, 1098 in number; and the galleries on the north side, paintings by modern masters, the English school, about 600 in number.

The Manchester Palace was opened May 5, by Prince Albert, with a ceremonial imitative of that of the Great Exhibition inauguration in 1851. The collection was visited by the Queen on June 30. The building was closed in the autumn, and the Art-Treasures were then returned to their respective owners.

MALLET'S THIRTY-SIX INCH MORTARS AND SHELLS.

About the latter end of 1854, the attention of Mr. Robert Mallet, C.E., was directed to the mathematical consideration of the relative powers of Shells in proportion to their increase of size or of diameter —which, strange to say, had never been attempted by any author on military science—and his inquiries resulted in a memoir presented by him to Government, in which he investigated the increase of power in shells with increase of diameter, under the heads of—1. Their penetrative power; 2. Their increased range and greater accuracy of fire; 3. Their explosive power; 4. Their power of demolition, or of levelling earthworks, buildings, &c.; 5. Their fragmentary missile power; 6, and lastly, their moral effect—in every case viewing the shell not as a weapon against troops, but an instrument of destruction to an enemy's works. The result so convinced Mr. Mallet of the rapid rate at which the destructive powers of a shell increase with increase of fire, that he was induced to propose to Government the employment of Shells of a magnitude never before imagined by any one—namely, of a yard in diameter, and weighing, when in flight, about a ton and a quarter each; and to prepare designs in several respects novel and peculiar, for the construction of Mortars capable of projecting these enormous globes. Like every proposal, however, that far outreaches the previous thoughts of ordinary thinkers, this was ill received by the then Ordnance authorities. What was in 1854, however, a presumed official impossibility, has become in 1857 an accomplished fact. On the 19th of October last, the first of those colossal mortars constructed from Mr. Mallet's design was fired on Woolwich Marshes, with charges (of projection) gradually increasing up to 70 lb.; and with the latter charge a shell weighing 2550 lb. was thrown a horizontal range of upwards of a mile and a half to the height of probably three-quarters of a mile, and falling penetrated the compact and then hard dry earth of the Woolwich range to a depth of more than 18 feet, throwing about cartloads of earth and stones by the mere splash of the fall of the empty shell.

The explosive power, it is obvious, is approximately proportionate to the weight of powder; but, by calculations, of which the result only can here be given, Mr. Mallet has shown that the total power of demolition, that is to say, the absolute amount of damage done in throwing down buildings, walls, &c., by one 36-inch shell, is sixteen hundred times that possible to be done by one 13-inch shell, and that an object which a 13-inch shell could just overturn at one yard from its centre, will be overthrown by the 36-inch shell at 40 yards distance.

No bomb-proof arch (so called) now exists in Europe capable of resisting the fall of one of those huge shells upon it, whose energy of descent may be represented as equal to about eight hundred tons, against the tremendous fall of such masses, still more against the terrible powers of their explosion, when 480lb. of powder, fired to the very best advantage, puts in motion the fragments of more than a ton of iron. No means or precautions are possible in a fortress, no splinter proof—no ordinary vaulting, perhaps no casemate exists capable of resisting their fall and explosion, either of which would sink the largest ship (even the *Leviathan*) or floating battery. And as no precaution could save either garrison or town from such shells, so their moral effect would be paralysing. Other great and special uses have been pointed out for them by their proposer, both for attack and defence, which we cannot enter upon.

A single 36-inch shell in flight costs 25*l*., and a single 13-inch 2*l*. 2*s*., yet the former is immeasurably the cheaper projectile; for to transfer to the point of effect the same weight of bursting powder we must give—

	£	s.	d.
55 shells of 13 inches, at 2*l*. 2*s*	£115	10	0
Against 1 shell of 36 inches	25	0	0
Showing a saving in favour of the large shell of	£90	10	0

and this assumes that 55 small shells, or any number of them, could do the work of the single great one.

The mortars are, with the exception of one part (the base), and the elm timber ends, formed wholly of wrought iron, in concentric rings, and each entire mortar is separable at pleasure into thirteen separate pieces, the heaviest of which weighs about 11 tons, so that the immense weight, when all put together (about 52 tons), is susceptible of easy transport, on ordinary artillery carriages, over rough country, or can be conveniently shipped, stowed, or landed. Special mortar rafts for the use of these mortars at sea have been designed by their inventor, and novel and more precise methods of pointing, especially at night, than hitherto practised.

The two mortars which have been constructed were made partly at Liverpool, by the Mersey Steel Company and by Messrs. Fawcett, Preston, and Co., engineers, but chiefly at the Thames Iron Works late C. J. Mare's, Blackwall).—*Abridged from the Engineer.*

THE NAUTILUS SUBMARINE MACHINE.

THIS American invention was described in the *Year-Book of Facts*, 1857, p. 19, from the report of operations at New York. The apparatus has since been employed in the works at the Victoria Docks, in the Thames, with great success, as testified by a large company of scientific gentlemen assembled to witness the operations. The Report states:—

Having steamed round these magnificent docks, we found the "Nautilus" floating on the water, connected by small hose with the machinery contained on board a barge, or scow, floating near. The "Nautilus" is nearly cylindrical, with a spherical top. On board the barge was a steam boiler, a cylinder or reservoir, and a condensing or air pump, of novel construction, the main feature of its improvements being its refrigeration or absorption of the latent heat evolved by the rapid condensation of air at high density. A description of the details of the machine would require too much space. The general principles involved in its working are, that while at rest and floating at the surface a cover on the top is raised, and on entering a chamber and closing the top again water is admitted through a pipe into two chambers on either side of the machine. The assumption of weight by the entrance of water destroys the buoyancy incident to the displacement of the water by the mass itself. As soon as a sufficient quantity of water or ballast is assumed, the machine descends below the surface, until the bottom is reached. While descending, air is drawn to the chamber in which the men are situated through the hose from the reservoir in the barge. As soon as the air thus drawn is sufficiently condensed to resist the entrance of water, a cover to the bottom is raised, and communication is obtained with the bottom. In order to apply the power of the machine to lifting weights, &c., as soon as the machine (which may be moved by the men inside) is moved to the position of a stone, it is affixed to the same, and the supply of condensed air being thrown from the reservoir into the water chambers, and the water being expelled, the machine exerts a force until the weight is overcome. In this way weights of any size may be lifted, and transported in the shortest time. Stones of four tons have been picked up in 25 feet water, brought to the surface, moved 30 feet, deposited on the bottom, and a return to the surface made, the whole occupying eight minutes.

Many of the *savans* present descended in the machine, and examined the details of its construction, as well as the arrangements for the supply of air. It was clearly demonstrated, not only that several persons could remain in it under water for a considerable time, but that even if the tube communicating with the reservoir at the surface should accidentally become disconnected, no danger would ensue to those in the machine, as they were able, by means of the compressed air within the bell itself, to expel a portion of the water and thus to rise to the surface.

Mr. Robert Stephenson stated that this was a machine of which almost every civil engineer had felt the want; and whilst the use of the old diving-bell was confined to certain conditions not always to be obtained, this was universally applicable and ready for use in the most difficult cases. The engine and condensing pump, which he had inspected, were scarcely inferior in ingenuity and completeness to the diving apparatus itself. He expressed his conviction, from a personal examination of the capabilities of the machine, that he had never witnessed one so perfectly adapted to the purposes for which it had been designed. He had it from the resident engineer of the docks that the same amount of work that had, previously to the introduction of the Nautilus, been performed in three weeks and four days, had been got through by its means in two days and two hours, with the same number of men employed.

THE VICTORIA BRIDGE AT MONTREAL.

THE Victoria Bridge has been, not inappropriately, designated the greatest engineering work of modern times. It is tubular, and is built on the principle of the Britannia Bridge, which spans the Menai Straits near Bangor.

It will, we believe, be, when finished, the longest bridge in the world—its length from bank to bank being only 176 feet less than two miles.

The Menai Bridge is 1880 feet long. The Victoria Bridge is, therefore, nearly five and a half times longer; or, to illustrate its length by an example familiar to most English persons—Waterloo Bridge, London: this structure is 1362 feet long.

The place where it crosses the St. Lawrence is about half a mile to the westward of Montreal, a short distance below the "Lachine" Rapids, and about nine miles from St. Anne's.

There will be 24 piers, which, with the two abutments, will leave 25 spaces or spans for the tubes. The centre span will be 330 feet wide, and each of the other spans will be 242 feet. The width of each of the piers, except the two at the centre, will be 15 feet. The two centre piers will each be 18 feet wide. This difference is very evident in the beautiful model of the bridge, which now forms a prominent object of attraction in the Canadian department of the Crystal Palace at Sydenham.

The western faces of the piers—that is, those towards the current (which flows here at a rate varying from seven to ten miles an hour)—terminate in a sharp-pointed edge, and the fore-part of each pier presents two beautifully smooth bevelled-off surfaces. They are so shaped in order that the least possible resistance may be offered to the avalanches of ice that come along at the departure of winter, and that would hurl away every impediment, less solid than massive rock, that might be opposed to their progress; for it should be remembered that not only is the whole length of the St. Lawrence, from its first receipt of lake water at Kingston to tidal water at Quebec—a distance of 360 miles—solidly frozen over in winter, but the 2000 miles of lake and upper river, together with the tributaries of the St. Lawrence (one of which, the Ottawa, has herself tributaries, several of which exceed the Thames in length, depth, and in volume of water), likewise send down their defiant masses, all to aggregate in the immediate vicinity of Montreal. The "piling" of the ice is sometimes as high as thirty, forty, and even fifty feet, and on several occasions great damage has been done by it to the massive stone buildings which line the quays, and form the noble river front for which this city is celebrated.

The stone used in the construction of the piers and abutments is a dense blue limestone, partly obtained from a quarry at Pointe Claire, on the Ottawa, eighteen miles above Montreal, and partly on the borders of Vermont, United States, about forty miles from Montreal. The piers close to the abutments will each contain about 6000 tons of masonry. Those to support the centre tube will contain about 8000 tons each.

The total amount of masonry in the bridge will be about 3,000,000 cubic feet, which, at thirteen and a half feet to the ton, gives a total weight of about 222,000 tons.

Scarcely a block of stone used in the piers is less than seven tons weight, and many of those exposed to the force of the breaking-up ice weigh fully ten tons. The blocks are bound together, not only by the use of the best water cement, but each stone is clamped to its neighbours, in several places, by massive iron rivets, bored several inches into each block, and the interstices between the rivet and the block are made one solid mass by means of molten lead.

At the present time (December, 1857) fourteen of the piers are completed; eight (including the two centre ones) will be finished next year, leaving only two to erect in 1859.

Each of the abutments is 242 feet long and 90 feet wide. The north shore of the St. Lawrence is connected with the northern abutment by an embanked causeway, faced with solid masonry towards the current, 1400 feet in length. The causeway from the south bank of the river to the southern abutment will be 700 feet long. The distance between this outer or river end of one abutment to the outer end of the other is 8000 feet.

The clear height of the ordinary summer level of the St. Lawrence above the under surface of the centre tube will be 60 feet, and the height will diminish towards either side with a gradient at the rate of 1 in 130, or 40 feet in the mile, so that at the outer or river edge of each abutment the height will be only 36 feet above the summer level.

The navigation of the river through the Lachine Rapids is limited to steam vessels only, and they will pass exclusively between the two centre piers, as the river is unsuited for navigation at the site of the bridge, except between these two points.

The tubes will be 19 feet high at each end, whence they will gradually increase to 22 feet 6 inches in the centre. The width of each tube is to be 16 feet, or 9 feet 6 inches wider than the rail track, which is 5 feet 6 inches—the national railway gauge of Canada.

The total weight of iron in the tubes will be 10,400 tons. They will be bound and riveted together precisely in the same manner and with the same machinery as at the Britannia Bridge. The tube connecting the northern abutment with pier No. 1 is now completed. The material for the second tube has reached Canada, and preparations are in progress for the despatch from England of eight more tubes early next year, so as to ensure their erection during the summer.

Mr. Robert Stephenson and Mr. A. M. Ross are the engineers of this great work. The latter gentleman, having completed his duty as engineer-in-chief of the Grand Trunk Railway, now directs his skill and attention exclusively to this structure. The contractors are Messrs. Peto, Brassey, and Betts. The bridge will cost about 1,250,000*l.*

As regards the commercial importance of the Victoria Bridge, Mr. Robert Stephenson, in a report addressed to the directors in May, 1854, says:—

"The great object, however, of the Canadian system of railways is not to compete with the River St. Lawrence, which will continue to accommodate a certain portion of the traffic of the country, but to bring those rich provinces into direct and easy connexion with all the ports on the east coast of the Atlantic, from Halifax to Boston, and even New York, and consequently through these ports, nearer to Europe."—*From the Canadian News.*

DEMOLITION OF THE OLD BRIDGE AT ROCHESTER.

THIS specimen of the bridge building of our ancestors has been removed, to the regret of the lovers of the picturesque. The Royal Engineers, in destroying nearly one-half of the bridge, used in the first of the two experiments 300 lbs. weight of gunpowder, divided into six charges; wherewith a pier, 45 feet long, 21 feet deep, and 13 feet wide, was shivered to pieces, and the foundations were loosened. The pier was built on piles in the river bed. The object was to shake the whole without tumbling it into the river, a result completely effected. A still larger portion of the bridge was next demolished, consisting of the pier and abutment on which the large arch on the Strood side rested, and calculated to contain several thousand tons of masonry. The weight of powder used in the explosions was nearly 1000 lbs., and was divided into the same number of charges as in the previous experiments. The Sappers and Miners had been long engaged in sinking two shafts in this portion of the bridge, to the respective depths of 24 feet and 21 feet, one in the pier, and the other in the abutment. Captain H. Schaw conducted the work. At the base of each shaft sprang two galleries, each 9 feet in length, and in these were deposited the charges. The powder was contained in tin waterproof cases, enclosed in wooden boxes, 500 lbs. weight for the pier and arch, and 300 lbs. weight for the abutment. The charges in the arch were first exploded; the ground for some distance reverberated as if from an earthquake, while the pier crumbled to pieces, and disappeared. The charges in the galleries on the pier abutment were afterwards fired, and that portion of the bridge destroyed. The large arch of the bridge was blown into the river, and the abutment on the Strood side entirely removed, the sight of the massive stonework of the arch blown high into the air being very grand.

The new Bridges at Rochester are fully described in the *Year-* [illegible] 1857, pp. 17—19.

GREAT BLASTING OPERATION AT HOLYHEAD HARBOUR.

THIS great operation took place on January 16, 1857, under the personal direction of Mr. Charles Rigby, assisted by Mr. Reitheimer, the resident engineer of the firm. It is computed that above 120,000 tons were brought down and broken into masses ready for loading by this explosion. The aggregate charge in the four chambers, acting upon a face of 210 feet in length, 115 feet in height, with a line of least resistance of about 25 feet, was 16,000 lbs. of gunpowder. The voltaic battery was placed a short distance from the quarries, and the spectators were within a protected battery, or observatory in front of the mountain, at a distance of only 600 yards, from which they were enabled to witness the explosion without danger, not a stone having been propelled 100 yards from the face of the quarry. We may here mention that nearly 6,000,000 tons of stone have been already dislodged by this means for the construction of the harbour, without failure, and without accident. In the mining operations which take place for this purpose, the quantity of gunpowder used annually exceeds 500,000 lbs., or more than 250 tons, and the stone deposited in the sea, for the formation of the rubble foundations and embankment, exceeds yearly 1,000,000 tons. In addition to the agency which gunpowder affords for the rapid construction of this breakwater, there are employed upwards of 1200 men, a large number of locomotive engines, stationary engines, travelling cranes with steam power, and every modern appliance which mechanical skill can bring to bear to accelerate the completion of this important harbour of refuge.

The northern (or great) breakwater was, at the above date, about 7000 feet in length, or nearly one mile and a half, and will enclose an area of upwards of 800 acres of Holyhead Bay. The breakwater extends about a mile and a half from the Holyhead shore, a small portion of which is walled in and finished, the rest being a rough embankment covered with piles and scaffolding. The present cost to the country is about 700,000*l.* The water shelter now provided by the new harbour is about 370 acres, in which upwards of 200 vessels have at one time anchored. About 280 earth waggons and trucks, and 8 locomotive engines, are in regular use; and employment is given to about 1000 persons, at a cost of about 1000*l.* per week in wages. The consumption of powder is about 200 tons per annum; the quantity of rock thrown into the sea is about 4000 tons per working day, or over 1,000,000 tons per annum. The length of embankment already made is about 7000 feet, and it requires about 1000 tons of rock to extend it one foot into the sea.

SUSPENSION BRIDGE IN ST. JAMES'S PARK.

THE Board of Works have lately disfigured the lake in St. James's Park, by crossing it with a bridge of as tasteless design as anything to be found in the quaint conceits of "the willow plate," of Chinese celebrity. We find the bridge thus described in the *Builder*:— The anchor tunnels are founded on the London clay, which is met with 20 feet below the surface of ground. Above the clay lie beds of gravel and sand, about 10 feet thick in all, on which the columns of the bridge stand. The span is 140 feet between abutments, or 157 feet 6 inches between the highest points of the suspension chains. The bridge is designed for foot passengers only: the footway is 12 feet in clear width, and is to be covered with asphalte laid on two thicknesses of diagonal elm planking.

The weight of the suspended roadway will be 523 lbs. per foot run, or about 33 tons in all. The maximum load is taken at 1 cwt. per square foot, which is something over that due to a dense crowd of people. The total maximum load, therefore, upon the chains, exclusive of their own weight, will be 119 tons, uniformly distributed. This gives a strain of 12 tons on each pair of suspension rods. The maximum strain upon the chains over each pair of standards will be about 275 tons. The chains on each side of the footway are in bundles of six links, and have a section together of 56 inches. The maximum strain on the iron will thus be about 5½ tons per square inch of section. The strain on the anchor beams (tending to tear them up from the ground), on each side of the bridge is equal to 380 tons in a vertical direction, and about 554 tons horizontally. This strain is resisted by a large mass of material, principally concrete, placed in and about the anchor tunnels.

Cost of the bridge 4,500*l*. Messrs. Rendel are the engineers: the decorative portion was designed by Mr. Digby Wyatt.

THE RIVER THAMES.

A Report has been made to the First Commissioner of Works by Commander Burstal, R.N., on the state of the River Thames between Putney and Rotherhithe, dated the 27th of January, 1857. The Commander gives a scientific detail of the changes which have taken place, including the great alteration in the low-water surface of the Thames above London-bridge, doubtless consequent on the removal of the old bridge in 1832, which, with its large "starlings," performed in a great measure the part of a dam to the river, obstructing the free course of the stream. The present low-water surface at springs is at London-bridge 18 feet 11 inches below the Trinity *datum*, against 15 feet 4 inches in the year 1823. At Blackfriars-bridge the difference is that between 18 feet 3 inches and 14 feet 9 inches (1856 and 1823); at Westminster the difference is that between 17 feet 4 inches and 14 feet 5 inches; and at Putney-bridge the difference between 1856 and 1823 is that represented respectively by the figures 14 feet 1 inch (1856) and 12 feet 8 inches (1823) below Trinity *datum*. As regards the surface level of high-water, it is found from numerous observations taken between Blackwall and Putney when the weather had been long dry, that the tidal wave attained at all intermediate stations nearly the same level. By comparing the time and height of high-water at London Docks and Battersea with that of 1823, it appears that in 1856 the time of high-water at Battersea was 28 minutes later than at the London Docks, and that the surface attained nearly the same level, whereas in 1823 the time was 88 minutes later, and the surface 5 inches lower. It further appears that the bed of the river has deepened considerably since 1823, the average deepening at each station between Putney and London-bridge varying from 2 feet to 9 feet 6 inches. Certain deep holes or gullies near London-bridge have been filled up with rubble-stones and chalk. The greatest change noticeable in the river bed among the bridges is at Blackfriars and Westminster, and a strong disposition to the same is evidenced at Southwark. From two cross sections made on the site of the old London-bridge, it appears that the whole of its piers and foundations have been removed to a level of 29½ feet below Trinity *datum*, in a line with the centre arch, which corresponds with the depths of the present bridge, and as far as Allhallow's-wharf above it, and two feet higher than the general depths in the Pool, 600 feet below it. From these facts, and from the solid nature of the material of which the old foundations are composed, it appears evident that the natural scour of the river has been arrested at and near this point, and consequently the safety of the present structure preserved. Yet the ebb stream is so strong in the Pool as to cause a small and sufficient scour. The bulk of the volume is filled with a series of transverse sections.

TIDAL BASINS.

A PAPER has been read to the British Association, *On the Form of Entrances to Tidal Basins*, by Mr. B. Stoney. On examining the entrances of the numerous floating docks and tidal basins which had been constructed up to the present period, it was found impossible, owing to the great variety of their form, to reduce the principles upon which they appeared to have been constructed to any one definite or precise rule. Some dock entrances were formed at right angles to the river, a few sloping upwards against the stream, and others again sloping downwards, which latter form not only tends to prevent deposits, but greatly facilitates the entrance and departure of vessels. Mr. Stoney objected to the entrance being at right angles to the stream, on the ground that, though equally adapted for vessels coming from the interior of the country or from the sea, the number of vessels which entered a dock from the upper part of the river bore a very small proportion indeed to those whose traffic was seawards. It was usual to place the entrance at or near the centre of the dock or basin, which was parallel to the river; but when the entrance was thus placed, vessels lying at either side of the entrance had to be warped, at a considerable expense of time and labour, into a suitable position for passing through. The chief points to be aimed at in constructing a dock or tidal basin were—1. Facility of ingress or egress. 2. Freedom from silting up. To these may be added—3. Economy of quay room; and 4. Facilities for the land traffic in connexion with the shipping. These requisites were, he believed, in a great measure fulfilled in the form of basin and entrance which he now advocated, viz., a lozenge, or trapezium, or rectangle, whose width was equal to the breadth of two vessels together, with sufficient space between them for another vessel to turn with facility, say from 350 to 400 feet between the walls for vessels of ordinary length. The entrance was at the lower end, and sloped so that a ship or steamer could pass from the river into the dock without warping, or any such annoyance and delay. Similarly on leaving, a vessel, when once her head was turned round, could pass through with as much ease as at entrance, and without risk of being carried by the current against the lower pier head.

HOLCOMB'S SUBMARINE CARRIAGE WAY.

MR. H. P. HOLCOMB, C.E., of Winchester, Georgia, has designed a submerged viaduct or tunnel, adapted to the passage of rivers or other narrow waters, where the purposes of navigation or other difficulties render the common elevated bridge inconvenient or impracticable. This plan proposes a tube of either wrought or cast iron sunk in the water, and conforming somewhat to the general profile of the bed of the stream, being sufficiently low to allow shipping to pass over in the usual channel. As the tube approaches the shores it will ascend on an easy inclination, and pass out of the stream with its upper side at low-water mark, into abutments of masonry.

Mr. H. proposes a cylindrical tube of twenty feet diameter. About one-third of this would be occupied with ballasting of stone, which would, at the same time, form a double roadway for traffic in each direction, while in the curves of the cylinder on each side would be placed the footways, suspended by rods, attached to the cylinders above.

He proposes to place the abutments, say one hundred feet inland, at which point the depth of the open approach would not exceed fifteen feet, having reference to a tidal range of six feet. Mr. Holcomb, who is an experienced civil engineer, holds that the cost of this plan, as compared with tunnelling under the bed of a stream, as in the case of the Thames Tunnel, would be trifling, and greatly less than an elevated bridge adapted to such situations. The cause of the failure of the Thames Tunnel as a work of utility, is the great depth at which the termini were necessarily laid, rendering the approaches extremely costly, and ingress and egress very difficult—so much so, that the entrances for vehicles have never been constructed. The plan in question removes these difficulties entirely.—*Scientific American; Mechanics' Magazine*, No. 1768.

SUBMARINE TUNNEL BETWEEN FRANCE AND ENGLAND.

M. A. THOMÉ DE GAMOND, a well-known French engineer, has published a quarto volume, treating of a project for constructing a Tunnel between England and France. The idea was brought under the attention of the Emperor some time since, and a Committee formed to report thereon. A number of scientific gentlemen have lately formed themselves into a club at Paris, and M. Thomé de Gamond's submarine tunnel has constituted the first subject for investigation. It is proposed to cut a tunnel from Cape Grinez, on the French coast, to a point which is about midway between Folkestone and Dover. A coloured diagram, at the end of the volume, shows the character of the geological deposits of the bed of the channel; and M. Gamond believes he has discovered a stratum which would be admirably suited for piercing. According to the information obtained, the stratum consists partly of a white soft stone and argillaceous earths of three different ages—viz., a zone of Oxford clay, a zone of Kimmeridge clay, fifty metres thick, and a zone of weald clay, which on the English side is uppermost. Having satisfied himself as to the nature of the deposits he would have to cut through, the engineer shows how he believes the tunnel might be successfully constructed. An island occurs at the bottom of the sea, called the "Varne Star," and exclusive of this natural advantage thirteen artificial islands more are to be made in the channel along the projected line. These islands are to be composed of rock cemented with clay, the section of each presenting a trapezium, the lower base of which is about 220 metres in length, the altitude 65, and the upper base 40. Through these islands shafts are to be sunk to the level of the projected tunnel; and this done, the work of excavation may be commenced on twenty-eight points at once. The cost of the tunnel is to be 170,000,000 francs. The proprietor has evidently bestowed an immense amount of labour on his calculations before he satisfied himself of the possibility of executing a work which has formed the dream of many enthusiasts, none of whom, however, have brought to light so much geological information, and none of whom have dared to apply the advanced discoveries of science to new and gigantic difficulties. Whatever may be the result of M. de Gamond's splendid visions, he has contributed a most interesting volume to the engineering literature of the day.

GIGANTIC FLOATING LANDING-STAGE, LIVERPOOL.

THE large new Floating Landing-stage, which is constructed at the cost of the Liverpool Corporation for the accommodation of sea-going steamers, is 1002 feet long, or nearly three times longer than the United States' frigate *Niagara*, and 82 feet wide; and communication is obtained with the shore by means of four cast-iron bridges, each of which is 113 feet long, and 13 feet 6 inches wide from side to side. The bridges are constructed with ordinary tubular girders, on the principle of those forming part of the Britannia-bridge. The mode of construction is precisely the same as in the landing-stage for St. George's Pier. Upon a range of 63 rectangular pontoons, of immense size and strength, are placed five rows of quadrangular hollow-iron girders, or kelsons, each 1000 feet long, which act as supporting ridges and fixing points for the main timbers of the floor or deck, which latter has been constructed by Messrs. Thomas Vernon and Son, iron shipbuilders, on the beach at Tranmere. The four sections were launched, floated down the river at high tides, moored in their positions, and connected. Next, the bridges forming the means of communication with the pier were floated on a stage from the great float at Birkenhead to the new landing-stage, and successfully connected with the stage and the pier. The operation was cleverly performed. Three pontoons had first been taken into the great float, upon which a high staging was erected. The bridge, which had been brought in pieces from Manchester, where it had been manufactured by Messrs. Fairbairn, was put together on the staging, and, by the aid of steam-tugs, was floated to its place between the new landing-stage and the pier, the staging upon which it was resting being sufficiently high to allow one end of the bridge to be shipped on the crosshead on the pier, the pontoons supporting the staging sinking with the tide until the other end of the bridge was shipped on the crosshead on the landing-stage. The engineer is Sir William Cubitt; the contractors for the entire work are Messrs Cochrane, of Dudley; the estimated cost, 140,000*l*.

BRIDGES BUILT UPON BRICK CYLINDERS IN INDIA.

MR. J. B. BRUCE has described to the Institution of Civil Engineers a remarkable bridge built upon this system on the Madras Railway in particular, which has the City of Madras as its terminus on one side of the Peninsula, and Beypoor, near Calicut, on the other, and extending over a length of 450 miles. Eighty miles of this line have been opened for traffic, and the remainder was under construction by the railway company's own engineers.

The bridge is built over the river Poiney, about seventy miles from Madras, and consists of fifty-six arches, each of 30 feet span, a small-sized arch being best suited to the powers of the native workmen, and the character of the site of the bridge itself. The bed of the river being of sand, to an unknown depth, it was necessary to resort to some description of artificial foundation; in England the probable expedient would have been timber piling, but in Madras the expense of timber precluded its use in that way, and the usual native expedient of brick cylinders was resorted to.

Each pier is founded upon fourteen cylinders built of radiated bricks, of 2 feet 6 inches internal, and 5 feet external diameter, sunk to a depth of 15 feet below the bed of the river, and filled with broken stone and bricks. Besides the cylinders, immediately under the piers, there are two rows of cylinders stretching the entire length of the bridge, one under each of the inverts, to protect them against the effect of any scour through the arches, forming as it were two brick walls across the stream founded at 15 feet below the bed of the river.

The cylinders are placed as closely together as possible, and the interstices between them filled up with broken stone to as great a depth as it could conveniently be placed. The masonry was commenced at a depth of five feet below the bed of the river, on the top of the cylinders; this, it was believed, would prove sufficient precaution against the effects of the stream. Should there, however, be any tendency to undermine the foundations, this could be guarded against by throwing in an apron of rubble-stone on the down stream side of the bridge. The masonry is of gneiss rock, found in the neighbourhood, and quarried by the application of fire, which caused it to split off in regular layers, varying in thickness from three inches to one foot. The total cost of the bridge was about 14,000*l*., or 7*l*. per lineal foot. This bridge is engraved in the *Illustrated London News*, No. 892.

The author, in conclusion, observed, that the system of building on brick cylinders is similar in principle to that sometimes pursued in this country, where piers are built on large cast-iron cylinders; which, from the difficulty of procuring them, and their greatly increased cost, were not so well adapted for public works in India, and it is doubted whether any plans could be devised, which, for efficiency, readiness of execution, and economy, would be so well suited to the purpose as the brick cylinders of India.

Attention was directed to a paper by Captain (now Colonel) Goodwyn, B.E., read before the Institution in February, 1842, giving an account of a very similar method of obtaining foundations in Bengal.

CONSTRUCTION OF THE PONT DE L'ALMA, AT PARIS.

M. RENNIE, in a paper read by him to the Institution of Civil Engineers, has introduced the system advocated by Monsieur Gariel, the manufacturer of the Vassy Cement, of building bridges and other similar structures with Rubble-Béton, or Concrete, in the prosecution of which he has been very successful. After enumerating a long list of structures executed in this material, in all parts of France and Algeria, the author describes more minutely the construction of the Pont de l'Alma, traversing the Seine, immediately adjoining the lower end of the building of the Annèxe, and which being in progress during the period of the International Exhibition of 1855, had directed his attention to the subject.

The Pont de l'Alma consists of three elliptical arches ("en anse de panier"), whose spans are, for the two side arches 38·50 mètres (126·23 feet) each, and the middle arch 43· mètres (141·40 feet); the height or conjugate axis of the two side arches is 7·70 mètres (25·25 feet), and the middle arch 8·60 mètres (28·2 feet). The thickness of the arches at the centres is 1·50 mètre (4·92 feet); the breadth between the faces of the arches is 10·30 mètres (33·78 feet), and the total length of the bridge is 139·69 mètres (458·18 feet).

The peculiarity in this bridge is the mode of construction, the materials employed being, for the hearting, or body of the structure, rubble-stone, "pierre de meule," concreted by Vassy cement. The stones of the intrados of the arches were roughly squared and laid as voussoirs, whilst the rest of the structure consists entirely of rough stones, as they left the quarry, being only well washed with water to deprive them of any earthy particles adhering to their surface, which would have prevented the adhesion of the cement, in which they were well bedded, and which was poured in as grouting to fill up all the interstices. The outer faces of the bridge and of the piers are built in cut stone, very carefully tooled and finished, like all the other bridges in the French capital.

The bridge only occupied nine months in construction, and would have been finished sooner but for an accident which occurred to one of the piers during a heavy flood. This injury was stated to have been since repaired, by injecting a considerable quantity of Portland cement, which had consolidated the whole structure.

The method employed for striking the centres was simple and ingenious, and had been previously tested in bridges of considerable span. It consisted in supporting the centres on several cylinders filled with dry sand, which was permitted to flow very gradually through an aperture in the bottom of each, and thus to lower the pistons and centres, without risk of the inequality of motion arising from slackening the wedges, as in the ordinary system.

The author then noticed the labours of British engineers, architects, and others, in introducing the use of concrete, citing the names of Smeaton, Semple, Higgins, Barker, Frost, White, Walker, Rennie, Smirke, Brunel, and Pasley, and the Essay by Godwin, on the subject, which, though now somewhat ancient, had scarcely been improved upon. Their recorded labours in that branch commenced in 1774, when concrete was first noticed in the works of Smeaton, who gave the proportions which had been found practically the best, by Mr. Foster Nickoll. Copies were then given of the letter of Mr. T. Hardwick, and of the Report, in January, 1813, by Messrs. Rennie, Lewis, Cockerell, and Browne, advising its use for the foundations of the Penitentiary; thus clearing away the erroneous impression of Mr. (now Sir Robert) Smirke having introduced concrete into that building, upon which he was not consulted until December, 1817, three years subsequently to the report, which had in the mean time been acted upon.

In the discussion which followed upon Mr. Rennie's paper, the author gave some further details of the Pont de l'Alma. It was stated, that the material composing the arches was found originally to dry so irregularly, as to cause cracks in several places. This was first remedied, by forming large detached blocks of the concrete *in sitû*, and then cementing them together. But a further improvement was made. It was found, that in making an arch of nearly 5 feet in thickness, there was unequal expansion and contraction of the materials. To obviate this, a ring of small stones set in cement was first laid, on which the coating of Vassy cement concrete was spread. In fact, the arch was built in two rings. As regarded expense, it had been said that the Pont de l'Alma had cost 40,000*l.*, but it was believed that 50,000*l.* was more nearly correct. Now a bridge built at Liège, of dressed stone, of 550 feet in length and 30 feet in width, or 60 feet longer and half the width of the Alma bridge, had cost only 26,000*l.* This did not show any great economy in cost, in favour of the use of concrete; but as regarded time, the one was built in nine months, as stated in the paper, whereas the Liège bridge occupied three years in its erection.

NAPOLEON I. AND FULTON AND STEAM NAVIGATION.

NAPOLEON has frequently been reproached with having coldly received Fulton and his plan for the application of steam to the purposes of navigation. Marshal Marmont, in his memoirs, says that Bonaparte, who, from his education in the artillery, had a natural prejudice against novelties, treated Fulton as a quack, and would not listen to him. M. Louis Figuier also, in pp. 258 *et seq.*, the 3rd vol. of his work, writes that Bonaparte refused to place the matter in the hands of the Academy. The following letter from Napoleon, dated from the Camp at Boulogne, 21st July, 1804, and addressed to M. de Champagny, Minister of the Interior, proves the contrary. It is given on the authority of *Cosmos*:—

"I have just read the project of citizen Fulton, an engineer, which you sent me much too late, for it seems capable of *changing the face of the world*. At all events, I desire that you will immediately place the examination of it in the hands of a committee, composed of members of the Institute, for it is to them that the scientific men of Europe will naturally look for a decision on the question. A great physical truth stands revealed before my eyes. It will be for these gentlemen to see it, and endeavour to avail themselves of it. As soon as the report is made it will be sent to you, and you will forward it to me. Let the decision be given in a week, if possible, for I am impatient to hear it."

ROTARY ENGINES.

MESSRS. J. and W. COOKE, of Shrewsbury, have provisionally specified a new or improved Rotary Machine to be used as a steam-engine, water-wheel, fire-engine, or pump, which consists of a drum revolving on a shaft or axis. The said drum is contained in an iron ring, forming therewith a steam-tight circular passage. One or more pistons are fixed in the said steam passage. Loose or sliding pistons are placed on and work in the drum in the direction of radii, and are carried round with it in its motion on its axis. Fixed combs on the sides of the steam chest or passage engage with the sliding pistons, and draw them towards the centre as they approach and pass the fixed pistons. One of the sliding or loose pistons occupies the steam passage, while the other is being withdrawn to pass the fixed piston. The moveable pistons are carried round by the steam as it passes to the exhaust pipe, and carry round the drum and shaft to which they are connected. The machine is wholly covered by a steam-tight chest, or it may be enclosed in the boiler, excepting the exhaust pipe. Although only described as a steam-engine, it may be used as a water-wheel, fire-engine, or pump. When used as a machine for raising and forcing liquids, motion is given to the central shaft. When used with water as a motive-power engine, it is used essentially in the manner first described.—*Mining Journal.*

STEAM PENDULUM.

MR. E. A. BROOMAN, of Fleet-street, has patented a communicated invention, which consists in causing steam to act upon a pendulum to make it vibrate, and in communicating power to a crank through a connecting-rod affixed to the shaft of the pendulum. The pendulum is suspended from a shaft supported on bearings in a suitable frame, and has connected to it at opposite sides two pipes. At opposite ends of the frame, and near the end of the course of the pendulum, are two other fixed pipes, which are received by and enters into the pendulum pipes. Slide-valves, worked by projections upon a boss on the top of the pendulum shaft, admit steam into and cut it off from the fixed pipes. Steam being admitted into one of the fixed pipes, rushes into one of the pendulum pipes, and impels the pendulum towards the opposite fixed pipe, the steam escaping out of the pendulum pipe into the atmosphere. On the pendulum arriving near the end of its vibration, steam is admitted into the opposite fixed pipe, checks any shock, and drives back the pendulum, the vibrations being continued by the admission of steam alternately into the fixed pipes. A governor regulates the admission of steam to the fixed pipes. This invention is susceptible of several modifications; for instance, instead of the steam escaping directly into the atmosphere, the pendulum and fixed pipes might be made so long that they should continually work one within the other, and then the pendulum on its return vibration might be made to expel the steam which had served first to drive it through a passage to be opened by one of the slide-valves.—*Mining Journal.*

NATURE AND EFFECTS OF DEPOSITS IN BOILERS.

As opinion is much divided upon the nature and effects of Steam Boiler Deposits, and as the subject is one of great importance, we have much pleasure in publishing the following report of an analysis made by Dr. Edwards, of Liverpool, for Mr. C. Wye Williams, to test the heat-conducting power of such deposit. This is the first instance in which we have known boiler incrustations to be formally analysed.—*Mechanics' Magazine*, No. 1752.

Royal Institution Laboratory,
Liverpool, 26th Feb., 1857.

Analysis of crystalline deposit from boilers; very hard; whitish brown colour; crystallized in repeated layers of small prisms; inner surface (in contact with the water) rough and nodular; specific gravity, 2·82, at 60° Fahr., contains—

Sulphate of lime	78·00
Water of crystallizing action	14·00
Sulphate of magnesia	3·20
Sulphate of potassa	1·60
Silica	2·20
Organic matter and traces of chlorides	1·00
	100·000

The above analysis shows that the crystalline deposit consists chiefly of dihydrated sulphate of lime crystallized in prisms. The other salts appear to me to be deposited between each act of crystallization, which forms a layer of the saline constituents of the water adherent to the primary crystals of the sulphate of lime, and may thus be regarded as impurity, and of secondary importance; the definite crystallization of the gypsum would doubtless operate greatly in increasing its power as a conductor of heat.

With reference to the conducting power of this deposit, I experimented with a vessel, the bottom of which was formed of the same, half an inch thick. I found the heat passed rapidly through the material, and that the highest temperature attained by the outer surface during a continued boiling was 240° Fahr. Such a temperature cannot injure the iron boiler plates, and it seems to me that this species of incrustation is a sufficiently good conductor of heat to prevent the iron becoming injuriously heated.

A NEW BOILER.

MR. M. ATKINSON, of the Grove Boiler Works, Southwark, has designed this New Boiler principally for heating large quantities of air for warming and ventilating hospitals, churches, or other large buildings. The boiler is of the upright circular form, quite independent of brickwork, or chimney-stalk, and has no appearance of the ordinary furnace or stoking-hole about it. The fuel, coal or coke, is dropped through an aperture in the dome, into a small cockle furnace, in the centre of the apparatus, and is entirely surrounded by the water space. This water space is also surrounded, horizontally, by an annular air chamber, and this is again surrounded by another water space. These two water spaces are connected by means of a series of 2-inch iron pipes or tubes, passing through the air chamber, and radiating outwards and upwards from the central furnace, near to the surface of which the lower ends of the tubes are situated, thereby conducing to rapidity of circulation.—*Builder*, No. 729.

VENTILATION BY THE STEAM JET.

Mr. F. H. Pearce, of the Bowling Ironworks, near Bradford, thus applies the Steam Jet for the purpose of ventilating a coal mine, in a pumping-shaft 120 yards in depth, the ventilation of which had been stopped by the water rising at the bottom of the pit during the time some alterations were being made in the pumps. The water having stopped the air-courses, the pit, to within a few yards of the top, became full of the gas known to miners as black or choke damp, which appears to have been discharged freely from some old workings, and thus it was rendered an impossibility for the workmen to descend until the removal of the gas had been effected, and a constant current of pure air produced in the pit. Mr. Pearce has succeeded in maintaining so perfect a ventilation of the above-mentioned pit, simply by allowing a small jet of steam to issue into the atmosphere at a few feet from the top of the pipes through which the water is forced up when the pumps are at work, that the pit can be worked with perfect safety. The workmen were enabled to descend thirty minutes after the steam had been turned into the pipes. The principle is exceedingly simple. The jet of steam issuing from the top of the pipes, produces in them a partial vacuum, which draws the foul air up these pipes, and thence out of the pit, with very great velocity. The cost of supplying the steam jet in the above manner is very trifling; and this method of ventilation will doubtless be found a very safe and useful one in many instances, particularly in sinking deep shafts. In addition to other advantages, wood or any other kind of pipes may be used. It requires little or no attention, no machinery to get out of repair, produces a powerful current of air, and can be regulated at pleasure. As the steam is discharged into the atmosphere above the top of the pit, it does not interfere with the men working in the shaft.

HEAT IN AGITATED WATER.

Mr. George Rennie has communicated to the British Association his continued "Report on the Development of Heat in Agitated Water." Mr. Rennie, in alluding to his former papers on the subject, read before the Section in 1856, at Cheltenham, stated that the subject of the mechanical or dynamic force required to raise a given quantity of water one degree of Fahrenheit had long been the object of the research of philosophers ever since Count Rumford, in his celebrated experiments on the evolution of heat in boring guns when surrounded by ice or water, proved the power required to raise one pound of water one degree, and which he valued at the dynamic equivalent of 1034 lb. M. Moya was the first who announced that heat was evolved from agitated water. The second was Mr. Joule, who announced that heat was evolved by water passing through narrow tubes, and by this method each degree of heat required for its evolution a mechanical force of 770 lb. Subsequently, in 1845 and 1847, he arrived at a dynamical equivalent of 772 lb. These experiments had since been confirmed by other philosophers on the Continent. In the present paper Mr. Rennie stated that his attention was called to the subject by observing the evolution of heat by the sea in a storm, by the heat from water running in sluices. He, therefore, prepared an apparatus similar to a patent churn, somewhat similar to that adopted by Mr. Joule, but on a large scale. In the first case he experimented on fifty gallons, or 500 lb. of water, inclosed in a cubical box, and driven by a steam-engine instead of a weight falling from a given height, as in Mr. Joule's experiment; secondly, on a smaller scale, by 10 lb. of water inclosed in a box. The large machine or churn was driven at a slow velocity of eighty-eight revolutions per minute, and the smaller machine at the rate of 232 revolutions per minute, so that the heat given off by the water in the large box was only at the rate of three and a half degrees per hour, including the heat lost by radiation; whereas the heat evolved by the ten gallons of water contained in the small box agitated at 232 revolutions was fifty-six degrees Fahrenheit per hour. Thus the temperature of the water in the large box was raised from sixty degrees to 144 degrees, and the temperature of the water in the small box to boiling point. As an illustration, an egg was boiled hard in six minutes. The mechanical equivalent in the first case was found to approximate nearly to that of Mr. Joule, but in the latter case it was considerably above his equivalent, arising, very probably, from the difficulty of measuring accurately the retarding forces.

TUXFORD'S TRACTION ENGINE.

At the Smithfield Club Show, and the Agricultural Machinery exhibited there in 1857, we noticed the Portable Steam Engine of the Messrs. Tuxford and Sons, of Boston, Lincolnshire; this being the third year this eminent firm have held the first prize of the Royal Agricultural Society of England.

The Messrs. Tuxford and Sons were the pioneers of farmers' portable engines and combined thrashing-machines, and are now engaged in developing a new feature in agricultural mechanics—the Traction Engine, or Steam Horse—a sort of walking leviathan, more powerful than the elephant, yet as manageable as the farmer's best-bred cart-horse. A number of these self-moving machines are in course of construction, or are already completed, for some extensive sugar plantations in the West Indies. Senor Placidè Gener, of Matanzas, Cuba, a large landed proprietor and sugar-planter of that island, who holds the exclusive right for the introduction of the traction-engine into the Spanish West Indies, has been for some time in England superintending the manufacture of several of the engines, which he intends for ploughing, for drawing in cars the produce of the fields to the mill, for carrying the sugar from the mill to a railway some miles distant, and also for working as stationary engines when not otherwise employed.

In appearance, the traction-engine has a massiveness which, at first sight, leads to an inference that, from its weight, it is not adapted for travelling across grass-lands or over light soils. The reverse is the fact: the slippers or shoes, with the rails upon them, which are attached to the wheels, and over which the wheels themselves travel, offer to the surface of the land an area, with the whole weight of the engine upon them, twice as great as that presented by the feet of either horses or oxen when walking with their proportionate weight. Hence the simple downward pressure, or sinking into the soil, of the traction-engine will be only one-half of that of horses or oxen, when any of them are employed for traction purposes. This is an important fact, and must be borne in mind by every one before expressing an opinion as to the fitness or non-adaptation of so massive a machine for agricultural purposes. The very weight itself is essential for obtaining the end desired. With a heavy load behind it, and without a given weight upon the land from the engine as a resistance, the power of the engine would be expended without any forward movement.

The action of the endless railway-wheels is precisely that of walking; the slipper being the foot, its heel first touches the ground, and the toe last; the cycloidal iron at its apex forms the ankle, and the nave of the wheel the knee. The wheel, in its revolution, brings down six of these feet, to which there is but one common knee, the centre or nave.

It is not so much to this endless railway that attention here need be directed, as the credit of its invention belongs to Mr. Boydell; but it is to the mechanical combination by which the Messrs. Tuxford have been able to make these railway-wheels signally successful with steam-power. The difficulty hitherto experienced in making turns when travelling to either side has, in this engine, been surmounted; and the power from the two cylinders can be given off equally to each of the impelling-wheels, or a greater power given to one and a less to the other, or either of the wheels can be detached from the power instantaneously, and without the least shock or jar. This engine weighs altogether about twelve tons.—*Illustrated London News*, No. 893.

ROMAINE'S STEAM CULTIVATOR.

A TRIAL of this machine, the invention of Mr. Robert Romaine, a Canadian, took place lately in a field near Crosskill's Agricultural Implement Works, Beverley, where the Cultivator had been constructed. It differs from all others hitherto brought before the public for the purpose of applying steam power to the cultivation of the soil, in entirely dispensing with the use of ploughs, ropes, or auxiliary implements. It is a 14-horse portable steam-engine, capable of propelling itself, combined with, and giving motion to, a rotary digger, which is said to pulverize the land completely to any required depth. The engine and boiler are constructed in a similar manner to the portable agricultural engines now in common use, and are carried by a pair of high broad wheels, and by two smaller wheels in front. The large wheels are driven round by the engine, and the front wheels used for steering; but by a simple disengaging arrangement, the latter are left perfectly free when the machine has to be turned round, and by driving one of the large wheels while the other remains stationary, the implement can be turned completely round in its own length. The cultivating part of the machine is carried by a strong frame attached to the boiler, and consists of a hollow cylinder 6 ft. 6 in. long, and 2 ft. 6 in. in diameter, armed with knives or cutters on its outer surface. The cutters are of wrought iron, and sufficiently strong to enter the land, and encounter roots, stones, or other obstacles without injury; but in case of accident they can be readily replaced at small cost, and without delay, as each is secured separately by bolts to the outside of the cylinder.

The implement commenced operations at one end of a field of strong clay stubble, and traversed its entire length, transforming a breadth of 6½ feet into a perfect seed-bed, equal, it is said, to what could have been produced by twice ploughing and harrowing, or clod-crushing. On its arrival at the headland, it turned round in less space than would have been required by two horses with a common plough, and returned along the side of the work already done. The cultivation of the field was thus proceeded with, no vacant space being left except the two small headlands, which could easily be finished by the machine after the rest of the ground was done.

The machine is stated to be capable of cultivating from five to seven acres per day, at an expense (including engine-driver and assistant, coals, man with horse and cart to fetch water, and wear and tear of machine) not exceeding 35s. to 40s. per day.—*Mechanics' Magazine*, No. 1784.

NEW PORTABLE STEAM THRASHING MACHINE.

THIS machine, which has been worked on the farm of Balornock, near Glasgow, receives its power from a steam-engine somewhat resembling a locomotive, which is connected with, but does not form part of it. The machine is fed from the top, and the sheaf comes at once in contact with the drum, which is constructed of malleable iron of fine workmanship, and makes no fewer than one thousand revolutions in the minute. In the ordinary machine, as is well known, the head of the sheaf is introduced to the drum through a pair of rollers, the drum itself usually revolving at the rate of about 350 in the minute. In the new machine an armful is thrown into the mill, either sideways or whichever end comes uppermost, and the straw completely escapes the bruising and champing to which it is subjected by the rollers of the ordinary thrashing mill. Indeed, the straw is delivered so entire and unbroken that, but for the empty heads, it would not be easy to know that it had passed through the mill at all. This machine is a glutton for work. When we were present it was thrashing wheat at the rate of 17 bolls in the hour, or 85 quarters during a day of ten hours' work. In case of necessity it may, and often has been worked to produce 200 bolls a-day; but the modest Englishman to whom the machine belongs, and who superintends it, informed us that, though much depends upon the character of the grain, he considered 150 bolls an ordinary and fair day's work. The steam-engine is of eight-horse power, and consumes at the rate of about six cwt. of coal per diem.—*Glasgow Herald.*

THE UNITED STATES STEAM-FRIGATE "NIAGARA."

THE *Niagara* is one of twelve steam-frigates which a short time since the Congress ordered to be built, by way of a counterbalance to the enormous increase of the English and French marine. The construction of the *Niagara* was entrusted by acclamation to Mr. Steers, the builder of the celebrated clipper yacht *America*. In building her he had four conflicting purposes to reconcile,—to make her a good gun-boat, good sea-boat, good sailer, and good steamer. The result is the *Niagara;* in design a kind of compromise, and which leaves her the fastest sailer in the world, one of the fastest steamers, a fine sea-boat, and a very good man-of-war. The following details are from the *New York Times:*—

The hull is of live oak, varying in width and thickness from 22 inches by 14 near the keel, to 11 by 8 on deck. The keel is 320 feet long; length on deck, 345 feet; breadth of beam over all, 55 feet; depth of hold, 31 feet 6 inches. Four boilers and three horizontal engines of 1000-horse power, built by Pease and Murphy, of New York, constitute her propelling power. The cylinders are 72 inches in diameter (nearly the same as those of the *Leviathan*), and 8-feet stroke. All of this machinery, weighing over 500 tons, is applied to turn a single propeller of 18 feet diameter. To protect the machinery from shot in action, it is all enclosed by immense iron coalbunkers, over-arching and descending many feet below the water-line. Her chimneys are telescopic, and while she is under sail or in battle, may be lowered almost out of sight. The engine and fire-rooms are perfect in their way, and well supplied with ample ventilators. The *Niagara* will rely for speed mainly upon her sailing abilities; and although the fires will always be kept bedded, and everything in readiness for getting up steam at short notice whenever required, she will, unless in calms and on extraordinary occasions, be only a clipper frigate. Her model is that of a mammoth clipper, with shallow forefoot, sharp, high bow, and hollow water-lines. View her as we will, not a single straight line is presented. When under full sail she will spread about 14,000 running yards, or 7000 square yards of canvas; and it is anticipated that her speed under canvas will be 15 or 16 knots, and under steam 11 or 12 knots an hour. Her mainmast is 84 feet above deck, 111 feet in extreme height, 37½ inches in diameter; foremast, 74 feet above deck, 101 feet in extreme height, and 35 inches in diameter; mizenmast, 85 feet in height, and 30 inches in diameter. Her mainyard is 106 feet in length, and her foreyard 94 feet. One great feature in this vessel is her high and airy decks. Between the bottom or orlop and berth decks the height is 6 feet 6 inches; between the lower and main decks, 6 feet 8 inches; between the main and spar decks, 7 feet 8 inches. The main deck, on which the officers and most of the men live, is admirably lighted by a multitude of dead-lights, and thoroughly ventilated.

Upon her arrival in England, the *Niagara* had on board only four small guns; but when fully equipped for war, she will carry twelve Dahlgren guns, 11 inches diameter in the bore, and throwing a solid shot of the enormous weight of 270 lb. a distance of 7000 yards, or four miles. The shells for these guns will weigh 130 lb., and the guns themselves 14 tons. The engines must be more fully described from the *Times*:—

The whole motive power is placed amidships, and so carefully constructed as to occupy less space with regard to force employed than the engines of any ordinary vessel. Fore and aft the machinery in all its departments is bounded by two transverse water-tight compartments, which completely shut it in from the rest of the vessel. The engine-room is about 28 feet long by 26 wide, and nine staircases are so arranged as to make all parts of it easily accessible. There are three engines, all direct acting, 3 feet stroke, with connecting rods between the cylinders and cranks. The cylinders are placed horizontally across the vessel, so that the motion of the piston is from side to side. The shaft upon which the whole force is brought to bear is 119 feet long, 60 inches in circumference, and weighs nearly 50 tons. The propeller is of brass, with two fans, nearly 19 feet in diameter, and having a pitch of 32 feet. On the prominent parts of the machinery are placed admirably-contrived indicators, which mark at the same time the number of revolutions, pressure of steam, vacuum, temperature of the hot well, and pressure of the cylinder at all parts of stroke. The cylinders are all on the starboard side of the vessel, the condensers on the port. Each of the latter has within itself the air-pump and hot well. The air-pumps are double-acting, and work direct from the main piston-rod, as do also the force-pumps. A 6-inch bilge injection is attached to each condenser, and can be used at a moment's notice to free the ship from water. In addition to these there are two bilge-pumps, connected by the crank shaft to the engine, and in constant operation, so that at all times the hold is as dry as a chip. The fire-room or stoke-hole is unusually wide and lofty, though it seems but indifferently ventilated. There are four boilers on the vertical tubular principle. Each of them is 21 feet long by 11 feet deep, and 15 feet high, and has a total fire surface of no less than 17,500 feet, and a grate surface of 484 square feet. Working at a pressure of 20 lb. gives a power of 2000 horses, and at that force the revolutions are only 45 per minute. During the voyage from New York the consumption of coal was at some periods as low as 12 tons per day, and it never rose above 56! The average for full power may be taken at 50 tons per diem, or very little more than the consumption of some steamers in the English navy which cannot do their 10 knots an hour. The stowage-room of the *Niagara* for coals is rather limited, considering her immense capacity in other respects. A little over 900 tons is the most that can be carried. This, however, suffices for 16 days' steaming at full speed. Neither is the vessel provided with any apparatus for distilling fresh water for the crew, a rather serious drawback when the stowage is wanted for coals. The funnels are telescopic, and neither heavy nor unsightly, though only rising 32 feet from the deck. So admirably is the heat of the boilers economized, that even under full steam the temperature of these funnels is rarely above 100. The lower deck, which, for a lower deck, is one of the most lofty and best ventilated we have seen, is set apart for the stokers, firemen, &c. The main deck is used by the crew, and is no less than 8 feet 4 inches high. Here the seamen sling their hammocks, the extreme after-part being, of course, devoted to officers' cabins, and the fore to cooking for the ship's company. Every sailor on board has his locker, and each mess a very large locker for the mess kit. When in England, the crew was 514, exclusive of officers; but when fully armed, even this large complement is to be increased to 750 men—the crew of a 90-gun ship.

During the voyage across the Atlantic no attempt was made to effect a quick passage; on the contrary, the engines were mostly working at half-power. With full power she attained a speed of 13 knots, and under sail above 16. With a stiff breeze on her quarter she can count on 14 knots. Her present draught is 22 feet, but when armed, with all stores and coals on board, she will draw 25 feet. Each 100 tons brings her down three inches in the water

A fine engraving of this magnificent ship, ably drawn by Edwin

Weedon, and engraved by F. J. Smyth, will be found in the *Illustrated London News*, No. 862.

CUNNINGHAM'S SELF-REEFING SAILS.

MR. CUNNINGHAM has exhibited at Liverpool his beautiful little brigantine, the *Alfred*, for the purpose of showing the working of his system of Reefing. His plan of reducing the area of the canvas by rolling the sail up on the yard (the yard being fitted to turn round on the fixtures for that purpose) is generally known. In his invention he employs the gravitation of the yard and its appendages to produce the necessary rotation of the yard by the action of the chain or halyards in the bight of which it is suspended, and which being hoisted upon or lowered (one end being a fixture) produces a rotation of the yard, thus constituting the operation a self-acting one. If Mr. Cunningham had not discovered this principle, the necessity of applying manual force to the rotation of the yard would have been a serious difficulty to the attainment of the desired object.

The arrangement of Mr. Cunningham's system of self-reefing to the working of the top-gallant sails in such a manner as to dispense with the use of royals, is a feature which is well worthy of special notice. He employs a deeper top-gallant sail for the purpose, which, although not containing the collective area of the top-gallant sail and royal together, by being carried up square at the head and entire in its area, gives a powerful propelling sail, and is as effective as the two sails on the old plan. This large sail can also in a moment be reduced to a close-reefed top-gallant sail of the smallest size, and the weight of the royal yard, with all its gear, is dispensed with.

The ability to take in and make sail so easily and quickly cannot fail to afford the means of making quicker passages. Indeed, the fastest passages on record have lately been made by ships fitted with Mr. Cunningham's system. The ship *Imogene*, which made the remarkable passage of only forty-seven days from Algoa Bay to England was so fitted. The captain stated that the shortness of the voyage was owing to his being able to keep sail on his ship to the last moment, and apply it again on the least fall of wind. The advantages of making quicker passages—of saving in wear and tear of canvas—of the ability to proceed to sea with fewer regular seamen, meeting the growing want we have mentioned above—and the saving of life by Mr. Cunningham's arrangement—are considerations that have had, and to a still greater extent we trust will have, that weight with shipowners that the wants of commerce require. We would observe, in conclusion, that Mr. Cunningham's system of reefing is now applied to all new ships throughout the kingdom; and in Liverpool, with a just appreciation of its merits, its adoption is extending, and we can only express a hope that this valuable invention may, as we believe it will, become at last universal.—*Liverpool*

OF SHIPS BY STEAM.

MR. N. OGLE, R.N., of Jersey, proposes to dispense altogether with paddle-wheels and screw propellers, and employ solid metal pistons acting directly against the water at or near the stern of the ship. In connexion with each piston is a chamber, into which the air is admitted, and from which it is exhausted alternately, the exhaustion being effected by a steam-engine. The atmospheric pressure forces the pistons out against the water, thus propelling the ship; and when this pressure ceases (because of the formation of the vacuum), the pressure of the water returns the piston to its first position. The action of the air engine is also intended to aid in ventilating the ship by causing air to rush down into the engine-room to supply it. Ordinarily the inventor proposes to apply the stern propellers only, so that the ship will be propelled ahead only by them; where required, however, he would apply similar propellers to the bow. He considers the arrangement especially applicable to yachts, to be used as a source of auxiliary power in calms.

A NEW SCREW PROPELLER.

A Lieutenant in the French navy, M. Vergne, has invented a new steam Screw Propeller, which he calls the fluted screw. The improvement is founded on a very nice observation of the directions taken by the particles of the water displaced and repelled by the screw. The result of an official trial has shown a gain of 17 per cent. in speed with the new screw, and the almost complete suppression of that disagreeable vibration usual in screw steamers, and which in small vessels renders it necessary to make the hinder part of the ship heavier and more costly than it otherwise need be. As far as the invention has yet been tested, it seems well deserving the attention of our English naval engineers.—*Times.*

IMPROVED SHIPS' MASTS.

It is well known that wooden masts soon decay about the head, and down to the hounds and the truss hoop, in consequence of lodgments of moisture at such parts, induced by the cap, the rigging, and the top. It is also well known that iron masts are objectionable, on account of their rigidity, the difficulty of cutting them away to save a ship, &c. Mr. J. Brown, a mastmaker, of Liverpool, proposes to obviate these objections as follows:—He makes the top of the mast, from the cap to the truss hoop, in the form of a tube, of wrought iron, similar to an ordinary iron mast, and continues the metal downwards in the form of four tapered arms. The lower part of the mast is entirely of wood, and the upper end of it is fitted into the tube as far as the hounds, where it abuts against a strong iron cross plate formed in the tube. The tapered arms fit close to the wooden portion of the mast, to which they are securely fixed by iron hoops or otherwise.—*Mechanics' Magazine*, No. 1766.

NEW CODE OF SEA SIGNALS.

The Board of Trade have introduced an important improvement in addition to the substitution of letters for numerals by Sir Home Popham, some forty years since, in designating the 18 flags used in the authorized code. Being divided into two parts, the messages in the first intimated by three, and those in the second by four flags, a means of international communication is made available. The first part is composed of the messages, words, geographical names, latitude, longitude, compass signals, &c., which form the substance of all signal books, expressed without reference to alphabetical arrangement. These are classed into subjects, and every signal is intimated by the same letters placed against it. In all languages the signal will have the same meaning, and it can be made known either by the same or corresponding flags adopted by previous arrangement. The second part comprises a more extensive vocabulary; and the words being placed in alphabetical succession, it is applicable to national use only, or to nations such as England and America, using the same language. This forms also an index to the first part, for all the signals therein are enumerated in the second part, with the two or three letters which denote them, and can therefore be readily referred to. There are other advantages, such as the intimation of the nature of a signal by the shape of the uppermost flag; but the most important feature is the means which the vast scope of this code affords of giving to every individual vessel a distinctive signal, by the exhibition of which its identity can be made known, and concisely conveyed by letter or by electric telegraph, in order to be correctly reported in the shipping lists. The preparation and maintenance of a list of 40,000 or 50,000 merchant vessels renders necessary a separate book, which contains this and other matter interesting to nautical persons, and is published annually under the title of "The Mercantile Navy List." There are also monthly supplements to proclaim the names of vessels supplied with distinctive signals in the interval between the yearly publication of the book, in which they become eventually incorporated. An alphabetical index, available for reference to any particular vessel, the distinctive signal of which it is wished to ascertain, adds greatly to the utility of the scheme. These books, with the supplements, will be placed in ships of war, coastguard stations, and all government departments. They will also be supplied by shipping masters in every port to captains of vessels when making arrangements for a voyage; and owners of ships should provide the four particular flags which signify a vessel's name, and make it imperative that they shall be hoisted whenever opportunity offers.—*Times.*

NEW SIGNAL LIGHTS FOR SHIPS.

SOME important experiments with Signal Lights for ships in distress have been exhibited at Portsmouth by order of the Lords of the Admiralty. They are patent detonating and luminous signals, the invention of Messrs. Langford and Wilder, of Birmingham. They differ from those in use in the fleet in the brilliancy of their light and the expense of manufacture. The composition in the patent is enclosed in metal tubes, whereas the common light is enclosed in paper tubes. In the experiment, the light showed itself so brilliant and diffused at the distance of five or six miles from the point of observation that it presented the illusion of a ship on fire. Another trial took place on the glacis of Southsea Castle, when the great light burnt equally effectively, but the metal tubing drops as the flame burns, and being in a molten state, presents a "difficulty," as it is liable to burn the deck of a ship or be blown into the inflammable rigging, and thus cause as much distress as it is intended to obtain succour. This, however, the experimentalists state, can be prevented.

ELECTRO-MAGNETISM AS A MOTIVE POWER.

MR. ROBERT HUNT, F.R.S., has read to the Institution of Civil Engineers a paper on this inquiry. The author commenced by giving the progress of the investigations by which Oersted first proved the connexion between electricity and magnetism, and which led Sturgeon to construct the electro-magnet. The powers of this form of electric force, as developed temporarily in soft-iron, naturally induced the idea of employing it for the purpose of exerting mechanical motion,—*doing work*. The principles of the electro-magnetic machines of Dal Negro, of Botta, of Jacobi, of Armstrong, of Page, and others, were next described. It was shown that all engines acting by a direct pull, were inefficient, from the circumstance that the repeated blows received by the iron so altered its character, that it eventually assumed the quality of steel, and had a tendency to retain a certain amount of permanent magnetism. This induced Jacobi, after a large expenditure of money, to abandon arrangements of this kind, and to employ such as would at once produce a rotatory motion. The engine, thus arranged, was stated to have been tried upon a tolerably large scale on the Neva, and by it a boat containing ten or twelve people was propelled at the rate of three miles an hour. Page's engine, and that of Hjorth, which in 1851-2 excited much attention, was described as being in principle an electro-magnetic piston drawn within, or repelled from, an electro-magnetic cylinder. By this motion it was thought that a much greater length of stroke could be secured than by the revolving wheels, or discs. After having generally described the forms under which electro-magnetic engines had been constructed, the author proceeded to give, as the result of his experiments, confirmed by those of others, the difficulties which still stood in the way of the application of electricity as a motive power.

In the first place, it was pointed out, that the loss of power through space was very great, and that the lifting power of any magnet was not to be regarded as the power it was capable of exerting at a distance from its poles, howsoever short that distance might be.

In the second place, it was shown that,—supposing the reduced force exerted by two magnets, a few lines apart, was considered available for driving machinery,—the moment the magnets began to move in front of one another, there was again a great additional loss of power. As the speed of the engine increased, there was curiously a corresponding diminution of available mechanical power, a falling off in the *duty* of the engine as the rotations became more rapid.

In the third place, the conditions of the voltaic battery were considered,—the generation of electricity was dwelt on,—the mode by which it passed from one plate in a series to another,—and the loss of power consequent upon the resistances, in passing from a solid to a fluid, and again from a fluid to a solid, was explained. It was insisted, that under any circumstances, with the present forms of the voltaic battery, it was useless to attempt to utilize, in this direction, the chemical electricity generated. All study should be directed to the development of electricity by chemical action, so as to secure, if possible, the whole of the electricity developed by every change of form in matter. More emphatically the author endeavoured to enforce the law, that all mechanical force, of whatever kind, whether horse, or man-power,—steam-power,—or electrical power,—involved a change of the forms of matter, to produce that force. That to produce motion, it was essential to use matter, and that virtually, in all cases, it must be destroyed as a useful agent. Thus—that a man or horse moving a weight consumed muscle equivalent to that weight, and the space through which it moved. That a steam-engine drawing a train, pumping water, or impelling any machinery, consumed, in the production of steam, a quantity of fuel exactly representing the work done. That in producing motion by electricity, the element changing its form to produce that motion, was one of the solid agents employed in the battery, and the exciting fluid element used.

An equivalent of matter, in changing its form, would produce an equivalent of force, which might be rendered available:—but as there was a constant relation between the chemical combining proportion of any element, and its capability to produce mechanical power, the question of the application of electricity, as a motive force, was narrowed to the inquiry into the quantity of power produced relatively by fuel in the furnace, and by zinc or iron in the battery. It had been proved by experiment, that 6 grains of carbon in the fuel produced a motive power equal to 32 grains of zinc in the battery, and that, under the best possible conditions, an equal result would be secured, by the combustion of 6 pounds of anthracite coal,—the most carbonaceous fuel,—as by the conversion in the battery of 32 pounds of zinc into oxide. Another and a parallel form of putting the case was, that the 32 pounds of zinc burnt in the furnace, would develope precisely the same quantity of heat as that which would be obtained from burning 6 pounds of charcoal in the same furnace. That whether producing heat during combustion, or electricity during chemical change, the mechanical force obtained would be precisely the same. Hence the commercial question of cost was greatly in favour of steam, and adverse to the use of electricity as a motive power.

ALLAN'S ELECTRO-MAGNETIC MOTIVE ENGINE.

MR. THOMAS ALLAN, of Edinburgh, has constructed an Electro-magnetic Motive Engine, which, through the medium of Mr. Forbes Campbell, has been introduced to the Emperor Napoleon III., who immediately appointed a commission to examine and report on the invention; and this they have done so favourably as to lead them to consider Mr. Allan to have successfully solved the greatest problem of our time.

To convert the power of electro-magnetism into a motive force has long been an object of high mark. The Russian and American Governments have spent large sums in endeavouring to solve the problem; France still holds out a great reward to the one who can produce an electro-magnetic engine which only consumes nineteen ounces of zinc per horse-power per hour; and in that empire the idea that these moderate conditions will be fully attained is firmly believed. In Great Britain no official encouragement has ever been offered to such attempts; indeed, it would be difficult to name any scientific invention of importance to which the British Government has lent aid until its practicability has been established beyond doubt —and even then it has to be forced upon the administration. In the case of electro-magnetism as a motive power, the official coldness is, however, less to be expected than usual, for the notion has been much discouraged by our most eminent men of science. However, considerable advance towards success has been made of late, as we gather from a striking article in the *Times* of December 26, 1857, of which we quote the substance.

Among the objections have been, first, the cost of the power, and, secondly, the shortness of the space through which the power is exerted, or, in other words, the want of adequate stroke or motion in the force. The power of electricity, when applied in the form of an electro-magnet, is wonderfully great from comparatively small means, but its dynamic power decreases so rapidly through intervening space, being "inversely as some unascertained power of the distance much greater than the square," that the range of the *maximum* effect, or valuable portion of the motive force with a consequent *minimum* of consumption extends to so small a distance as to be of no real value in mechanics. The great problem to solve has been to contrive such an arrangement of parts as to convert this *maximum* of the motive force, through a range, although unavailable in itself, into stroke, or to give it such an extent of motion as to make it of practical value as a motive power. Mr. Allan's electro-magnetic engine has achieved many of these *desiderata*. He has utilized all his power—he has obtained length of stroke. By this invention the *maximum* portion only of the dynamic force is applied, and by the mechanical arrangement of parts successively and continuously brought into action in a direct form, in accordance with the laws of electro-dynamics. Thus applied, there is no loss of the primary force, and any amount of power and any length of stroke can be obtained. In fact, both mechanical and electrical conditions are very simply and beautifully complied with, and to this alone is the success of the invention due. The machine may be simply described as consisting of four galleries, each of which contains four groups of four electro-magnets which are alternately opposite in their polarities, and which therefore by induction naturally react upon and augment their collective power. Through these magnets pass rods connected by connecting rods and cranks to the shaft of the engine. Each of these rods has a disc or keeper suspended on shoulders above each group of magnets. The keepers are made with a hole in the centre, so as to slide easily upon the rod, and not impede the motion of the latter when it is receiving an impulse from a magnet applied to any of the other keepers or discs. The same kind of action is produced on each rod, so that as one completes its portion of the stroke the next one is commencing in the following manner :—At the commencement of the motion the upper keeper is placed so near the first set of magnets that when a current of electricity is applied to them they draw violently the keeper to them, and thus move the rod longitudinally through the space which separated them. The next keeper is by this means brought within the same distance from its magnet, and the current of electricity is at the same instant cut off from the former and applied to these, which thereupon draw their keeper to them, and so drag the rod through an additional space or distance equal to the first. The other magnets and their keepers beneath respectively act in a similar manner in regular succession, and thus complete the stroke of the rod, when the next row takes it up, and so on, until the four rods have worked in the same manner, and given the utmost both of power and length of stroke to the machine. Though the machines have as yet only been fixed vertically, yet it can easily be seen that the arrangement of the parts allows it to be readily adapted to all ordinary purposes, whether vertical or horizontal.

Thus, as far as the first conditions of power and length of stroke are concerned, the machine appears to have achieved great ends. One has recently been submitted to the Emperor Napoleon and the Directors of the Conservatoire as illustrating the first principles of the machine which, it is hoped, is to carry off the French national prize of 2000*l.*, offered to any who can solve the question of the practical utility of electricity as a motive power.* The success of the competitor there is to be attested by the cheapness with which he can produce his power. According to the average price of coals in Paris one horse steam power per hour can be obtained for eight centimes. The average price of zinc is eighty centimes per kilogramme, and the French conditions for gaining the prize are that

* By a decree of the 27th February, 1857, the French Government offers a prize of 50,000 francs, or 2000*l.*, to the individual who shall discover a method of rendering the voltaic pile applicable economically to industry as a source of *heat* or *light*, or to *chemical* or *mechanical* science, or to *medicine*. This prize evidently points to the question so often asked, how the world will be supplied with artificial light, heat, and motive power when its coal mines are exhausted? And though that period is yet distant for Britain, Belgium, the United States, and a few other spots on the globe where such mines exist, an early answer to the question will be of vast *immediate* service to the far more extensive regions where there are none, and which are too far off from the existing mines to benefit by them, such as Italy, Greece, Sweden, Russia, Persia, the greater part of India and China, Turkey, and even of Spain, France, and Northern Germany. The prize remains open to competition for five years, and the decision is referred to a commission of twelve members, including the most eminent men of science in France, Dumas, Chevreul, Pelouze, Regnault, Despretz, &c.—*Scotsman.*

the machine shall work one horse-power on an expenditure of not more than half a kilogramme of zinc, or at forty centimes the hour. This would make the cost of the electro-motive power in Paris five times greater than that of steam, but the many advantages which in other respects it possesses over the latter power would more than counterbalance this disadvantage. According to this rate Mr. Allan's machines in England, where coal is cheaper, would work at a cost ten times greater than the present average price of steam; yet many of our first machinists and manufacturers say that the invention of electro-motive engines at as much as eighteen times the cost for steam-power will pay largely. Mr. Allan professes himself perfectly confident that he can produce a machine not only within the working price we have just mentioned, but even within the French conditions. He maintains that it is an error to consider the cost of electro-motive power as being relatively less "profitable" than steam, and that the error has arisen from the misapplication of the electro-magnetic force, not from the necessary consumption of the electric materials, which consumption is inversely as the dynamical ratios of the force. He considers that the materials, on the other hand, from their chemical admixture in the battery, although of no practical avail for the further production of the electric fluid, become when produced on a large scale of considerable market value, and when sold realize a large per centage of their original cost. But as the cost of the power is thus taken as the standard of success, the expenditure in fairness must be regarded from various points of view. Thus, then, we must not forget that in Madrid and Lisbon the cost of coal for steam power is twice as dear as at Paris; that in most parts of South America, in India, and China, and throughout the East generally, the cost of coal is twice as much as that again, so that in those countries where an easily managed motive power is most wanted, electricity may yet compete with steam on an equal or even advantageous footing with regard to cost. But a great reduction in the cost of the power may be at once effected by not using zinc at all, since iron when used on a large scale as an element in batteries may be regarded as almost equally efficacious with zinc. But the cost of the power must be at the present a subordinate question,—at least other and more important questions must be decided ere the cost can be fairly ascertained. For instance, Mr. Allan finds that there must be a certain relation between the electric current and the diameter and length of the magnet, though what these conditions are it is difficult to say at present. With only a slight modification of the relation of the wire to his magnet, he suddenly found that he lost four-fifths of his power. Now, here is a problem, the solution of which must have a vital influence on the electro-magnetic power, and, therefore, in its cost of production. Yet, these disturbing influences, whatever they are, were not even known to exist until now; and every day the general laws which govern the science of electro-magnetism are becoming more and more fully developed.

Mr. J. P. Joule, who has long experimented in this branch of science, has replied to the above article in the *Times*, in which he shows that,

In order to find the quantity of work which can be got from an absolutely perfect electro-magnetic engine we have only to ascertain the quantity of heat due to the consumption of zinc in the battery, and then to find, by means of the above relation, the work to which that heat is equivalent. The *Philosophical Magazine* for December, 1843, p. 441, contains an account of such experiments, the result being that 1lb. of zinc consumed in a Grove's battery is able, if all the heat be utilized, to raise 1,843,600lb. weight to the height of one foot; but that in a Daniell's battery only 1,106,160lb. can be raised by the same consumption. Subsequent researches have altered these figures a little, diminishing them to about 1,698,000lb. and 1,019,000lb. Hence the utmost work which could be performed by an absolutely perfect engine by each pound of zinc consumed in the best battery is 1,698,000 lb. raised one foot, which in Watts's estimate is equal to one-horse power exerted during 51 minutes. The conditions required by the French are "that the machine shall work one horse power on an expenditure of not more than half a kilogramme of zinc." This, converted into English measure, using Watts's standard of horse-power, demands a work of one-horse-power during 54 minutes for each pound of zinc, or three minutes longer than an absolutely perfect engine could perform. Thus the French prize is offered to him who with the existing voltaic battery shall accomplish an absolute impossibility.

Those who may wish to investigate for themselves the state of knowledge on the above subject, Mr. Joule refers to the papers of Professor Rankine, in the *Transactions* of the Royal Society of Edinburgh; to the articles in *Nichol's Cyclopædia of the Physical Sciences*; and especially to the works of Professor William Thomson published in the *Transactions* of the Royal Societies of London and Edinburgh, and in the *Philosophical Magazine*.

AMERICAN RAILWAYS.

A VERY interesting report has been published on this subject by Captain Galton, who was lately sent by the authorities of the Board of Trade to inspect the construction, management, and progress of American Railways. Of course, the lines of the Far West are as unlike the best railways of England as the rough cartways across a common are unlike the great turnpike-roads, along which mail-coaches used to run at the topmost speed of a picked team. It is not the object of the constructor of an American railway that the train should go fast or comfortably, but that it should go at all. The only problem thought of, is how to make a beginning. If curves are sharp and gradients steep, the train has to go round the sharp curves, and up the steep gradients—the projectors cannot wait until an enormous expenditure of time and money has made everything safe and easy. When the traffic is formed, their improvements are gradually made. The Baltimore and Ohio Railway supplies an excellent instance. There, a line was carried on by a series of zigzags over a hill, by a gradient of 1 in 18 at its steepest part. Each zigzag terminated in a short level space, and the train was then backed up the next zigzag, and so on. There are curves in this railway of 360 feet radius, and it is carried through the streets of Baltimore down to the wharves, and passes round right angles.* As we might suppose, all the appointments of these hastily-formed lines are very rough. The stations are generally unfenced, and passenger stations are considered public thoroughfares. Level crossings are scarcely ever provided with gates or gate-keepers, except in special cases, near towns; but a large board is placed over the crossing, with the words painted on it in large letters—"Railroad crossing. Look out for the cars when the engine-bell rings." In order to prevent cattle from straying on to the line, trenches, about four feet deep, are dug across the railway on either side of level crossings. But the precaution is not always effectual, if we may judge from the spoke in front of the engine-wheels having received the name of a cow-catcher. As also almost all the railways of America have only single lines of rails, there is considerable danger of coming in collision with something worse than a cow. Still, in spite of all the roughness and danger, the trains do, as a matter of fact, run; and by running, they accomplish the great work they are intended to effect.

There are about 26,000 miles of railway in operation at the present time in the United States, of which not much more than one-sixth is double line. Speaking roughly, we may say that one-half of the distance between the two oceans has now been traversed. Over the western half of this distance it is proposed to carry, as soon as the growth of the country will permit, three main lines. The northern will start from Chicago, at the foot of Lake Michigan, and, crossing the head waters of the Missouri, will terminate in the bay fronted by Vancouver's Island. The centre line, also starting from Chicago, will pass by the Great Salt Lake to Benicia, in California; and the southern, starting from a point of the Mississippi opposite to Cairo, will pass through Texas and New Mexico to San Francisco. The rise of Chicago, the city from which two of these lines would start, affords a striking indication of the rapidity with which towns can grow in America when placed exactly in the right spot for railway communication. Chicago has, however, an assemblage of advantages which few other places can possibly possess. It is situated in one of the most fertile regions of the world, at the southern extremity of Lake Michigan, on a perfectly flat plain, at the edge of the prairies. At no great distance from it are rich mines of lead, iron, copper, and coal. It possesses water communication both with the Atlantic and the Gulf of Mexico; and it is now the chief means of railway communication in the West. No wonder, then, that it has grown rapidly. In 1832, the site of the present town was occupied by a small fort and a few log cabins. The first railway was only completed in 1850, and the population, which in 1849 was 23,047, rose in 1855 to 83,509. In 1851, the number of miles of railway centring in Chicago was 40; and the annual receipts from traffic were about 8000*l*. In 1855, the miles of railway centring in Chicago amounted to 2933, and the receipts from traffic to 2,659,640*l*. We may remark that England benefits by all this railway construction and railway prosperity, scarcely less than America. The lines west of Chicago thrive because they pass through rich prairie land which requires no clearing, and which is admirably situated for the growth of wheat. It is calculated that if only one-fourth of the area of the State of Illinois were brought under wheat cultivation, the annual yield in an average year would be greatly above twenty million quarters. American railways will bring a cheap loaf to many a home in England.—*Saturday Review*, No 73.

RAILWAY WORKS IN WESTERN INDIA.

DR. BUIST, of Bombay, has described to the Asiatic Society the principal Railway Works now in progress in Western India, chiefly in reference to their moral and industrial influences upon the people of the country. Betwixt the bottom of the Bhore Ghaut and Sholapore, there were at present above 40,000 natives employed, earning three or four times as much money as they had ever before received. Nothing could be more perfect than the arrangements of the contractors, nor more admirable than the conduct and characters of the Europeans connected with the concern. He illustrated the operations in the Bhore Ghaut by a collection of sketches made by himself about six weeks ago. The incline here is 15 miles in length; the total ascent 2000 feet; the steepest gradient is 1 in 38; the easiest, 1 in 78; the average, 1 in 40. There are twelve tunnels, one of them 437 yards in length, and three large viaducts, the arches of one being 150 feet in height, and 40 in span. The cost of this section was 63,400*l*., and would be completed in six years from the date of its commencement in June, 1856. There were at present 10,000 people engaged on it. One ton of gunpowder was exploded daily, the average charge being 12 lbs., fired from about 200 mines. These were exploded almost simultaneously, when the people were at dinner. Dr. Buist described the extraordinary effect produced, when in the dead stillness of noon, and in one of the most secluded and magnificent scenes in the world, every precipice, dell, and nook sent forth one magnificent burst of sound, and a deep cloud of smoke for a time shaded those below from the fierce rays of an Indian sun.

A MOUNTAIN-TOP RAILWAY.

MR. C. ELLET, jun., Chief Engineer of the American Central Railroad Company, in a pamphlet, describes a Railroad across the Blue Mountain Ridge, at Rock Fish Gap, in the State of Virginia.

M. Latrobe, the able Engineer of the Baltimore and Ohio Railway, was the first to carry railroads *over* great elevations, when he passed his engines and trains over the mountains in anticipation of the completion of the Kingswood and Broad Tree Tunnels.

Mr. Ellet has applied the same system in Virginia; but advocates such roads for temporary use only. He is convinced that there are many points where roads of very high grades—grades of 200 feet, or, in extreme cases, more than 300 feet per mile—may be justifiably introduced for permanent use. The Mountain Top Track crosses the summit of the Blue Ridge at Rock Fish Gap, where the elevation of the mountain is 1885 feet above tide. The crest of the ridge is very narrow, and is passed on a curve of 300 feet radius. There is barely room for an engine with an ordinary train to stand on the summit, before the road slopes off, descending both towards the east and west, to the valleys on either side of the ridge. The length of the descent on the western side, from the summit to what is here assumed to be the foot of the mountain, is 10,650 feet, or $2\frac{1}{100}$ miles. The track descends in this distance, on the west side, 450 feet—or, at the average rate of one foot in 28¾ feet. The *average grade* on the western slope is, therefore, $223\frac{1}{10}$ feet per mile. The *maximum grade* on the western slope is $5\frac{3}{10}$ feet in 100, or $279\frac{84}{100}$ feet per mile. On both sides of the mountain the ruling curves are described with a radius of 300 feet, on which the grade is $237\frac{6}{10}$ feet per mile. But the more difficult portion of the work was on the eastern side of the mountain, where the ascent was greater, and the slope, in order to reach a certain level, which became a necessary condition of the problem of location, was required to be greater. The length of the line of descent from the summit to the foot of the grade, is 12,500 feet, or $2\frac{37}{100}$ miles. The road descends in this distance 610 feet, or at the average rate of one foot in 20½ feet. The *average grade* on the eastern slope is, therefore, $257\frac{4}{10}$ feet per mile. The *maximum grade* on the eastern slope is $5\frac{6}{10}$ feet in 100, or $295\frac{68}{100}$ feet per mile. This maximum grade is found in a continuous line of half a mile in length. The shortest radius of curvature on this side of the mountain was intended to be 300 feet; but in the construction of the work a more abrupt curve was introduced at one difficult point, in order to throw the track further into the hill and keep the embankment off a face of sloping and treacherous rock. At this ravine, which is found about half-way down the mountain, the radius of curvature is only 234 feet, and the grade upon that curve is $237\frac{6}{10}$ feet per mile.

This railway was opened in the spring of 1854. In all that time the admirable engines relied on to perform the extraordinary duties imposed upon them in the passage of this summit, have failed *but once* to make their regular trips, and then the train was caught in a snow-drift near the summit of the mountain. The locomotives mainly relied on for this severe duty are mounted on six wheels, all drivers, and coupled, and 42 inches diameter. The wheels are set very close, to reduce the difficulty of turning the short curves of the road. The diameter of the cylinders is 16½ inches; and the length of the stroke 20 inches. To increase the adhesion, and, at the same time avoid the resistance of a tender, the engine carries its tank upon the boiler, and the footboard is lengthened out and provided with suspended side boxes, where a supply of fuel may be stored. By this means the weight of wood and water, instead of abstracting from the effective power of the engine, contributes to its adhesion and consequent ability to climb the mountain. The total weight of these engines is 55,000 pounds, or 27½ tons, when the boiler and tank are supplied with water, and fuel enough for a trip of eight miles is on board. The capacity of the tank is sufficient to hold 100 cubic feet of water, and it has storage room on top for 100 cubic feet of wood, in addition to what may be carried in the side boxes and on the footboard. In conveying freight, the regular train on the mountain is three of the eight-wheel house cars fully loaded, or four empty or partly loaded. These three cars, when full, weigh with their loads from 40 to 43 tons. Sometimes, though rarely, when the business has been unusually heavy, the loads have exceeded 50 tons. The ordinary speed of the engines, when loaded, is 7½ miles an hour on the ascending grades, and from 5½ to 6 miles an hour on the descent. Greater speed and larger loads might doubtless be permitted with success; but the policy has been to work the track with perfect safety, to risk nothing, and to obtain and hold the public confidence.—*Mechanics' Magazine*, No. 1753.

NOVEL RAILWAY SYSTEM.

MR. J. B. HUMPHREYS, C.E., of Rio de Janeiro, has patented a novel arrangement of the parts of Railway Trains intended for conveying goods and passengers up steep gradients, where the present system of traction by locomotive engine power is difficult and expensive, or entirely inapplicable. Instead of one or more locomotive engines of great power and weight, trucks in a series are each fitted with steam-engine cylinders, by the action of the steam in which motion is communicated to the wheels of such trucks or carriages; and the steam necessary for communicating the power may be conveyed from the boiler of a locomotive traction engine in the front of the train, to the trucks composing the train by means of suitable steam pipes; or a separate boiler is mounted upon each of several suitable trucks, disposed in consecutive positions throughout the length of the train, according to the number of steam trucks composing such train.—*Mechanics' Magazine*, No. 1753.

ASCENT OF STEEP GRADIENTS ON RAILWAYS.

MR. GRASSI, of Milan, has patented an application of the Archimedean Screw to Locomotive Engines, for taking trains up Steep Ascents on Railways. Captain Moorsom, C.E. (who himself invented a system, and introduced it in 1840, at the Lickey incline), has examined Grassi's system by the model, and is of opinion that the screw may be worked as the patentee states. Captain Moorsom further states the method by which he would proceed to apply Grassi's invention.

He proposes to construct a locomotive engine with 18 inch outside cylinders, 4 feet driving wheel and 24 inches stroke, with boiler capacity sufficient to provide steam (with proper expansion gear), for a speed of not less than 12 miles per hour on the incline; with a gross load of not less than 100 tons, including the weight of the engine and tender, which would probably amount to about 28 tons. The engine will carry her tender upon her own frame. On the driving axle of the engine a bevelled wheel will be fixed, so as to connect by means of one intermediate motion with the crown wheel on the end of the shaft of the screw.

The driving wheel and screw revolve in exact ratio to each other, so that the screw will advance exactly as the driving wheels advance; or, in other words, each revolution of the driving wheel sends the screw forward nearly 12 feet 7 inches. Thus 12 turns of the screw are made for every turn of the driver. Captain Moorsom believes about 13,000 such revolutions of the wheel would be made per hour on the level, and that if the same motive power be applied to turn the screw on the incline above stated, of one in twenty, the steam-power will overcome the additional resistance arising from gravity and the friction of the machinery, at a speed not less than from one-third to one-half of that attained on the level with the same load.

With respect to the screw in its relations to the road, Captain Moorsom proposes to make the thread of the screw to be of 13 inches diameter, winding round a cylinder or shaft of 7 inches diameter, and with a pitch of 12½ inches. The cylinder screwed will be about 5 feet 4 inches long, and will always hold two of the rollers in its grasp at one time.

The rollers or pulleys will be placed 3 feet 2 inches apart from centre to centre; they will be about 8¼ inches in diameter, will revolve into a longitudinal balk of timber, and will be lubricated in the same way as the wheels of the carriages.

The bearing timbers for the rollers will be a single line of balks about 10 inches wide by 8 inches deep; thus each mile will require 2933 cubic feet of timber and 1668 rollers.

The rails will be *bridge rails*, weighing 65 lbs. per yard, and screwed to balks equal to a section of 10 inches by 8 at the least. This road will be necessary to be thus laid only on the up side of the incline, and is a not unusual mode of constructing the permanent way. The cost, 3701*l.* per mile. Cost of the engine, with tender and screw and connecting gear complete, 3000*l.*

The rails are not additionally expensive on account of this peculiar construction. Thus we may say that in England the total cost of one mile of railway prepared for this mode of traction will be about 3700*l.* additional as compared with the expense of construction of an ordinary mile of the same railway line; and the additional cost of the engine over and above an ordinary assistant, or bank engine, will be about 500*l.*

The result will be that such ordinary bank engine, if constructed and worked as is usual on the best European railways on steep inclines, would take about 50 tons of load up one in twenty; whereas this engine, constructed as above described, would take about 80 tons of load up the same incline, and no doubt a more powerful engine would take a greater load.

The maintenance of exact action between the wheel and the screw—the friction of the rollers—the economy of the maintenance both of the engine and of the road—are three points of difficulty about which various opinions will prevail, till the system has had the test of practice. Captain Moorsom's opinion is, that these difficulties are only such as the skill and economical care of an engineer, well used to working inclines, may successfully surmount.

The comparison between the estimated cost of a railway over the Alps or the Pyrenees, after the Grassi system, and the estimates of the most moderate projects with tunnels, &c., gives an enormous difference. Thus, the tunnel projected to cross Mont-Cenis, on the line from Lyon to Turin, is estimated to cost more than 100 million francs, even although there occurs a gradient of 2½ per cent.; whilst on this same line, Mont-Cenis may easily be surmounted by the aid of the Grassi system, at a probable expenditure of three or four million francs at most above the cost on ordinary railways, assuming that the increased length of the line is threefold that of the tunnel.

A pamphlet illustrative of the system may be had at the office, 14, Southampton-street, Strand.

SAFETY ON RAILWAYS.

PROFESSOR RANKINE, President of the Institution of Engineers in Scotland, observes that a class of legislation to which an institution of engineers should turn their attention is, laws concerning the public safety—laws to regulate the strength of boilers and the speed of railway trains. There are no laws enacted in reference to either of these matters; but if such laws were provided, they should not be calculated to check enterprise, or restrict or inconvenience inventors or manufacturers more than is necessary; and in order that the Legislature might be accurately informed of the circumstances that should guide them on subjects of the kind, it is of the utmost importance that these subjects should be publicly discussed at meetings by practical and scientific men. He was sorry to perceive a disposition on the part of some very eminent persons to recommend restrictions that he should think very injurious. For instance, Lord Brougham recently suggested* that the speed of trains should be limited to twenty-five or thirty miles an hour! Now, under proper management, and with care, a speed of seventy miles an hour could be made with as much safety as seventeen, for accidents seldom occurred but through mismanagement; and the proper course to adopt would be to enforce proper management and caution. We hope this correction of Lord Brougham's suggestion may be as widely circulated as the error.

SUSPENSION RAILWAY BRIDGES.

MR. C. VIGNOLES has communicated to the British Association a paper "On the Adaptation of Suspension Bridges to sustain the Passage of Railway Trains." The subject was comprised under the following heads:—First, the maximum load to pass the bridge; second, the velocity of the train; third, the strength of the chains; fourth, the rigidity of the platform; fifth, prevention of undulation, vibration, and oscillation. The novelty of the author's inquiry in the matters he adduced was confined to the question of the rigidity of the platform. He instanced the bridge over the river Dnieper, at Keiff, in Prussia, erected according to his designs, and stated that the successful resistance of the well-braced platform of this bridge to the effect of hurricane winds had been long remarkable. This bridge was completed about four years ago, just before the commencement of the Russian war, and at a time when he little thought the result of his exertions would so soon be used in facilitating the military operations of the Russians against the allied forces. He alluded to the severe tests which it had successfully withstood, in the convey-

* At the Meeting of the National Association for the Promotion of Social Science, held at Birmingham, in October, 1857.

ance of armies with heavy ordnance; and he came to the conclusion that the adaptation of suspension bridges to railway purposes is quite practicable; recommending, at the same time, that the speed of the trains, when passing, should be kept moderate, as compared with ordinary speed on railways.

IMPROVEMENT OF PERMANENT WAY ON RAILWAYS.

Mr. J. M. Parsons, C.E., has succeeded in accomplishing a matter much wanted in the Permanent Way of Railways,—that of securing the ends of the rails firmly in their position, and thus preserving an even road at the joints of the rails. This is performed by means of his "wedge fish-joint chair," which is twice the length of the ordinary chair, and so contrived on one side as to catch the lower flange of the rail, and press close under the upper flange. The state of the rails near the joints secured by Mr. Parsons's method forms a striking contrast to those fastened in the ordinary way. It is stated that the expense of removing the ordinary chairs, and replacing them by the "wedge fish-joint chair," will be comparatively small, being less than that of the cost of fishing, and capable of being more readily executed.

WROUGHT IRON RAILWAY CARRIAGES.

In the *Scientific American* is described, in Patterson, N. J., a Railway Carriage constructed almost entirely of Wrought Iron. This material is employed to obtain great strength, with less weight than usual, and to avoid the serious injuries which generally occur to passengers in collisions with carriages of the ordinary construction. The framework of this wrought iron carriage is in effect an extremely strong and stiff, yet elastic, basket, each joint or intersection being strengthened by rivets, and the whole being further protected by making the entire platform at each end one strong spring of steel. Should this carriage come into collision with another in such manner that the springs at the ends cannot absorb the shock, the carriage will itself spring, collapse, twist, or crumple up, but cannot break and crush its contents with the fragments. One of the great dangers from collisions, &c., is the disposition of ordinary carriages to penetrate each other with their timbers, but this and many other minor evils are avoided in the improved carriage.

COAL-BURNING LOCOMOTIVES.

An invention of the greatest importance to railway companies generally has for some time past been successfully employed upon the London and South-Western railway, by which, calculating upon seventy engines being in steam daily, a saving of 25,000*l.* per annum will be effected. The honour of the invention is due to Mr. Joseph Beattie, the locomotive superintendent of the line. Mr. Benjamin Fothergill, of Manchester, has severely tested the contrivance, and the average result obtained showed a difference in fuel of 4·01 lbs. in weight per mile in favour of the coal engine. Mr. Fothergill considers, however, that these results are partly produced by

Mr. Beattie's patented arrangement for heating the feed water before it is pumped into the boiler. Mr. Fothergill further states that the coal engines are fully capable of burning their own smoke; that they rapidly generate an abundance of steam; and that the burning of coal, according to Mr. Beattie's plan, is far more advantageous, as regards the durability of the fire-box and tubes, than coke could possibly be.

FENTON'S PATENT RAILWAY SIGNAL DETECTOR.

MR. FENTON, of the Low Moor Iron-works, has invented and brought into use an apparatus worked in conjunction with Railway Signals, and designed to act as a Detector,—by proving, in the event of an accident occurring, whether the warning signal was or was not set at the time of the passing of the train, and thus fixing the blame with certainty upon the culpable party—the engine-driver or the signal-man, as the case may be. The invention consists in placing a supplementary signal or semaphore between the station signal and the distance signal, or beyond the latter, or beyond both. The supplementary signal is worked in connexion with, and by the same handle as, either the station or the distance signal, and is used for indicating whether the one or other of these signals was set at the time the engine passed it. It stands only as high as 'the buffer beam of the engine, and is placed near the rails, so that when an arm is thrown out therefrom to danger, the engine cannot pass without breaking it down. The arm is secured in a socket, and may be readily replaced when broken, at a small cost; or the arm may be pointed in such manner that, instead of being broken, a portion of it may be turned out of its transverse position, and thus indicate the passage of the engine. The signal post will be inexpensive, as no lamp is required, and a short wire attached to that of the station or distance signal will work the supplementary arm. The additional signal post, when situated between the station and the distance signals, should be placed as far inside the latter as to allow an ordinary train to be protected by the distance signal when the train is pulled up short of the station. A thin glass phial, containing a coloured fluid (or other similar contrivance), may, if found necessary, be introduced into the end of the supplementary semaphore. This would be broken when the engine struck it, and the fluid be spattered over the buffer beam, more certainly insuring the detection of the culpable engine-driver. When the signals are set at caution, it is necessary that the supplementary signal post and arm should be so arranged that the engine and train will pass clear of them.—*Mechanics' Magazine*, No. 1762.

NEW RAILWAY SIGNAL.

DR. GRAY has described to the British Association a new Railway Signal, which has been tested very satisfactorily upon the Midland Great Western Railway. The qualities which it possesses, and which are relied on as establishing its value and efficiency, are—

First, the signal could be made from the guard to the driver and back again with certainty and rapidity. Secondly, that the guard and driver should be able to communicate with each other by means of a code of signals. Thirdly, that in certain cases the signal apparatus should be self-acting automatic—for instance, if any accident caused the severance of the train, which would prevent any communication between the guard and the driver by the voluntary action of either, that notice of the fact would be conveyed to them by the apparatus itself. Fourthly, that there should be no special skill required in order to manage or make the signal; what he meant by that was, that it should not be liable to derangement, and that in case some derangement did occur, the ordinary workmen employed on railway works would be able to set the apparatus right, or make a new one. Fifthly, that there should be always a constant indication before the parties in charge of the train that the signal was in working order, so that the guard would not start from the station without knowing that the signal was all right and in reliable condition, and would not fail him upon the journey. The sixth requisite was, that the communication between the carriages should be of such a nature that there would be no serious delay in making up the train of carriages, because of the use of the signal. Dr. Gray entered at some length into the principles and details of the invention, and exhibited a working model, the size of the actual apparatus, and several experiments were then tried, all of which worked most successfully and elicited loud applause. The signals were made through a tube 168 feet in length with the greatest rapidity, and the air was exhausted at one end by an air-pump, but by a simple turning of the cock the effect of this exhaustion was destroyed, and a red bar or semaphore was thrown across a little box representing the box beside the driver, and a whistle was also made to sound by the same instrumentality.

Lord Otho Fitzgerald said he was present on the occasion on which this apparatus was tested before the Lord Lieutenant. He was in the Lord Lieutenant's carriage, in which there was a means of communication with the guard and driver. They used the signal three or four times, and it answered perfectly in every way. He then went upon the engine, Mr. Dillon being in the guard's van, and they communicated with each other several times with the greatest rapidity and ease. He afterwards went into the guard's van, where he again tested the apparatus, so that he was competent to speak of the perfect success which had attended the experiment.—The President, Mr. Fairbairn, said, Dr. Gray had obtained a desideratum as far as regarded the communication between the guard and driver of a railway train. It was hardly necessary for him to say that any apparatus by which the danger signal could be effectually given, was of the greatest importance as regarded the safety of life and property. He was sorry that time did not permit them to enter into a discussion upon this interesting and important subject; but, indeed, discussion was scarcely necessary, as it was clear from the explanations given by Dr. Gray, and the experiments which they had witnessed, that his very ingenious apparatus would effectually carry out the object for which it was designed.—*Athenæum Report*.

NEW SYSTEM OF TRAIN-SIGNALLING.

Mr. C. V. Walker, the telegraphic engineer of the South-Eastern Railway Company, has devised an expedient by which the power of communicating with the stations on both sides, up and down the line, is placed at the instant command of those in charge of trains. The contrivance is one of extreme simplicity and cheapness. No portable apparatus whatever is employed, and no knowledge of telegraphs or telegraph language is required of the guard. An apparatus is placed at the various stations along the line, every two stations being connected by a wire. It consists of an electro-magnet provided with a keeper, carrying a hammer so fixed as to strike a bell whenever a current of electricity is transmitted. A battery of graphite (from gas retorts) and zinc is placed at every station, the graphite end of each being in connexion with the earth, and the zinc end with the little apparatus we have mentioned. Thus, the galvanic currents of each two batteries are acting in contrary directions in the same circuit, and the power of each being equal, no action ensues. Whenever it is wished to transmit signals in consequence of some break-down occurring between the stations, all that has to be done is to make a connexion between the wire and railway metals, or the earth. The two currents then no longer oppose each other, but flow regularly through the connexion made to the earth, causing the electro-magnets at the two next stations, up and down, to attract their keepers, and thus strike both bells loudly. Very few distinctions of signals are required for train-signalling; one, two, or three blows, in a language which the most obtuse can understand, are adequate for all common purposes. And for engine failures, for accidents, or for damage to permanent way, set signals are provided. This new property has been imparted to the signal bells and their language without extra cost. It is accomplished by merely interchanging the position of two wires inside the instrument. In this way Mr. Walker has modified many groups of bells that have been long doing the old work the old way, and which now do it with the new power at command, in time of need.—*Proc. Royal Society*.

STRENGTH OF METALS.

A volume of Reports of Experiments on the strength and other properties of metal for cannon has been published in Philadelphia, and may be had in London of Trübner and Co.

The bursting of the large gun on board the *Princeton*, American war steamer, thirteen years ago, caused the United States Government to institute a series of investigations on the properties of metals for cannon, a detailed Report of which, so far as prosecuted, is contained in the volume before us.

The portion of the volume allotted to wrought iron is limited to a brief inquiry on the tensile strength of the iron in the unfortunate gun alluded to. This resulted in the discovery, that while the for instruments, that the objects for which he required them would be sufficiently satisfied in a few elementary books of science. A little knowledge would have shown him that what he sought was already made known. The gentleman who introduced me told me that he believed he had already spent 100,000*l*. He stated that a rich lady had speculated in the invention to the extent of 30,000*l*. I am afraid that from this cause public, as well as private, interests have suffered. Three or four years ago I was sailing in the harbour of Portsmouth, and I saw a number of fine ships laid up; I asked a sailor what such and such a one was, and he said to me, "Such a ship is perfectly sound, but she rolled so tremendously that it was impossible to keep her masts in her." He pointed out another that sailed so slowly that she was utterly worthless. It was rather doubtful whether all the information I got from the sailor was correct, when a little book fell into my hands containing papers on the result of the Exhibition in 1851. They were lec- [illegible] n of the day. Amongst them I found one by Capt. Moorsom, one of the most scientific officers of the navy. He was painfully sensible of the fact that, during the last war, the ships of the French and Spaniards, for stability and facility of manœuvring, were superior to those of the English; and although eventually the skill of our seamen, and their courage, had succeeded in estab[illegible] the supremacy of England, yet it was at such a sacrifice of life as might be [illegible] had our ships more nearly approached to those of the enemy. He clearly traces that state of things to the ignorance of scientific principles which prevailed amongst ship-builders. It is a fact, that a person who published a scientific treatise on the subject died a working shipwright, so little was the attention which was paid to it. I have heard on some occasions the complaint made that engineering science had effected very little for us. We should recollect that engineers do not spring up at the spur of the moment, and it always requires a strong inducement to direct inventive powers. Have we never heard of official prejudice in this country? Besides, if any one invents anything, what chance is there that it can be kept secret? What chance is there that the enemy would not get possession of it? It is not by little party inventions that the engineering skill of England has been brought to aid the State in any contest. I believe if some of the most eminent of English civil engineers had been consulted in proper time, in conjunction with the military engineers,—I believe that means would be found by which the gigantic engineering resources of England could be brought to bear effectually on the struggle. It is certainly too much to say that Cronstadt would have been taken by contract. It is certain that wrought iron will resist heavy ordnance; and further, it is a fact, which nobody will deny, that the sea would be able to bear that weight. At that time there were actually French experiments in existence on the resistance of wrought iron to shot—experiments which would be enough to afford correct data for the necessary calculations. There is little doubt that vessels might have been constructed of such solid materials as would enable them to enter a harbour and take the batteries in reverse. This is not the place to enter into the minutiæ of such subjects; but when it is said that engineering science in England has added so little to our strength, I think we should call upon those who say so to show that engineering science was applied for in a proper time and in a proper manner. These observations may be a sufficient answer to the question, Why the Mechanical Section of the British Association is necessary?

RECENT IMPROVEMENTS IN THE MANUFACTURE OF IRON.

A Report has been read to the Fellows of the Chemical Society, by Mr. Abel, director of the chemical establishment of the War Department, on the above inquiry.

The first portion of the Report was devoted to a consideration of proposals relating to the construction of the blast furnace, the application of the blast, the mixture of ores, &c., with the view to ensure uniformity in the working of the furnaces; the preparation and state of division of the ore, and its mixture with fuel and fluxes; the economization of fuel and heat; and the description of fuel employed. The last was considered to be a subject of much interest from the circumstance that the very considerable iron resources of Ireland might be expected to rise to great importance, if the application of peat, in one form or other, as the means of reducing and refining the metal, proved as successful as was anticipated by numerous persons, whose attention has been devoted to the subject.

A review was next taken of the numerous plans proposed for effecting the reduction and purification of the metal in one continuous operation, none of which were considered as likely to compete successfully with the present system of iron smelting. Allusion was also made to the system of producing refined iron or steel direct from the ore in the United States, in the so-called bloomery forges.

The second portion of the Report related to the application of other agents than those in general use in the manufacture of iron.

After an examination into numerous proposals for improving the ordinary refining and puddling processes, patents were noticed in which water was made an agent in the purification or decarbonization of the metal, by coating its surface, when in a divided condition, and prior to its final treatment, with a covering of oxide of iron.

Recent patents relating to the production of steel from refined or wrought iron by fusion and by cementation, with the employment of particular cementing materials and fluxes, and of contrivances for rendering the cementing operation a continuous one, were next noticed; and this led to the discussion of the several patents brought out by Mr. Bessemer for the production of steel and malleable iron. Other patents, such as those of Mr. Martein, Mr. Parry, and Messrs. Lea and Armitage, bearing upon the same principle, were described, and notice was taken of the effects of this particular mode of treatment upon iron. It was held that the results of experiments with Mr. Bessemer's process, and of the chemical examination of his products, had not served to bear out the statements made by him in his paper read before the British Association last year.

The Report concluded by pointing out the great extent to which the puddling process depended upon the skill and industry of the workmen, and by showing that this was sufficient reason to lead all interested in iron manufacture to cherish the hope that the continued exertions of Mr. Bessemer and others, who are now actively engaged on the subject, might lead to the successful application of the principle upon which was based the process which had excited such general attention; so that the prophecy of Mr. Nasmyth, that it would lead to a new era in a most important branch of our manufactures, might ultimately be fulfilled.

NEWLY-INVENTED STEEL.

THE Woolwich Dockyard authorities have reported favourably on the invention of the Abbé Pauvert for producing steel of very superior quality from the most ordinary cast and puddled iron, and pieces of iron in any state, at an extraordinary reduction in price. M. Pauvert has secured his invention by a patent from the British Government. The articles of newly-invented steel tested at the Dockyard were clipped tools, chisels, taps, dies, and other instruments in general use in factories. The conversion of the metal does not require the slightest change in the arrangements of the melting furnace, it being simply effected by chemical ingredients and elastic agency. The advantages of this invention will be rendered sufficiently apparent when it is stated, that steel of superior quality has only been fabricated hitherto from Swedish iron, which, according to current prices, costs between 14*l.* 10*s.* and 16*l.* 10*s.* per ton, whereas by the Abbé Pauvert's process the same is procured from British forged pig iron, varying in price from 4*l.* 10*s.* to 5*l.* per ton; or, as we have intimated, even from old refuse or scrap iron. The cost of the conversion of the metal will not exceed 1*l.* 5*s.* to the ton, nor will there be any loss of material whatever, as one ton of the worst iron yields one ton of raw steel. This most important discovery has already been brought into operation by the Messrs. de Beauchamp, M. Benoit d'Asy, and other large ironmasters in France.—*Holdsworth's Geology, Mines, and Soils of Ireland.*

In a letter on the subject, Mr. J. H. Browne says:—"The Abbé Pauvert, after long and laborious researches into the nature of iron and its varied combinations with carbon, has found that, in order to obtain different qualities of steel from iron, regard must be had not only to the purity of the iron and the quantity of carbon combined with it, but also to the mode in which the carbon existing in the iron enters into combination with it, and to the manner in which crystallization takes place. In order, therefore, to obtain steel of superior quality from all kinds of iron manufactured by means of coke, it was indispensable to ascertain the manner of purifying the iron, of regulating to a certainty its combination with the carbon, and its crystallization. That the Abbé Pauvert has arrived at these results, was fully attested by his experiments at the Royal Dockyard, Woolwich. . . . The manufacture of the steel does not require the slightest change in the actual arrangements of the smelting and cementing furnaces, crucibles, or other apparatus. The conversion of the metal is simply effected by chemical ingredients and electric agency."

NITROGEN IN STEEL.

A PAPER has been read to the Society of Arts "On some Combinations and Phenomena that occur among the Elements engaged in the Manufacture of Iron, and in the conversion of Iron into Steel," by Mr. Christopher Binks. The author began by remarking that the generally received theory of the formation and composition of steel was not satisfactory. The very old practice of using ferrocyanide of potassium as an agent of conversion was worth consideration. This compound contained nitrogen and potassium as well as carbon. He then proceeded to give the details of a series of experiments made by exposing commercial malleable iron to the action of various substances at a high temperature, and remarked that as far as those trials extended, there had always been a co-operation of both carbon and nitrogen whenever steel was produced, though it still remained to be determined whether this was absolutely necessary to its formation. It was also remarkable that various nitrogenous matters, such as horn and leather shavings, animal charcoal, and other substances, were commonly used, either in the manufacture or in the tempering of steel. Analyses made by himself proved that the best kinds of steel contained about one-fifth per cent. of nitrogen. In course of his remarks, allusion was made to the fact that in the formation of the celebrated East Indian steel, called Wootz, highly azotized or nitrogenized vegetable substances were used. At the close, Mr. Binks acknowledged the deep obligations the iron world owed to Mr. Bessemer, were it merely for the practical development of the vivid reaction of atmospheric air and molten iron, at the same time expressing his contempt for the hypercriticisms directed against Mr. Bessemer's exertions.

BESSEMER'S IRON AND STEEL MANUFACTURE.*

MR. BESSEMER seems resolved to make the best possible use of his process for keeping iron melted without fuel. He has filed specifications of other two new patents for further improvements. He states that by the ordinary puddling process of reverberating flame and gaseous matter from mineral coal on to the molten or semi-molten metal, the iron is injured, at great cost; and the object of his first patent is to sustain, without ordinary fuel, the heat requisite during a process producing the effect of puddling, or during puddling itself, by forcing into and amongst the iron particles, through jet pipes of fireclay, or iron, jets of air, or other gaseous or gaseous with pulverulent matter, containing sufficient oxygen to keep up the heat of the metal, so as to admit of the puddling or other processes producing the same effect. The second patent claims the obtainment of crude or gray pig-iron, hard white iron, or steel, and malleable iron, direct from carbonaceous iron ores, or from any mixtures of carbonaceous ores with oxides or other ores of iron, by the application thereto of a blast of hot or cold air, or steam, or of any other gaseous matter containing oxygen or hydrogen, and without requiring any fuel except such as is evolved from the said ores of iron, and from the gaseous matters forced in.

It is rather a curious circumstance in reference to the essential principle of all Mr. Bessemer's processes—namely, the dispensing with ordinary fuel in his melting processes—that an old author, who wrote before Mr. Bessemer could have ever dreamt of his new processes, in a work treating of the Japanese and their inventions, is said to have stated that they had one "for melting iron without using any fire, casting it into a tun, done about on the inside with about a half foot of earth, where they keep it with continual blowing, and take it out by ladles full, to give it what form they please, much better and more artificially than the inhabitants of Liège are able to do. So that it may be said Japan may live without its neighbours, as being well furnished with all things requisite to life."

There is scarcely any *new* invention of mark or moment, of which

* For a full description of Mr. Bessemer's former processes, see *Year-Book of Facts*, 1857, pp. 5-10.

traces have not existed in the East from time immemorial. Such was the case with the screw propeller, with gas, with the compass, and many other inventions and discoveries; and new instances are ever and anon turning up, as was lately the case with the screw augur and the Bramah lock. If the Japanese (a sort of insular Chinese) do really practise this new process of Mr. Bessemer's, depend on it "there is something in it," however much it may as yet be involved in difficulties.—*Builder*, No. 740.

NEW MODE OF APPLYING BESSEMER'S INVENTION.

MESSRS. T. BROWN and G. PARRY, Ebbw Vale, Monmouth, propose a mode of refining, purifying, or decarbonizing melted cast-iron by means of currents of air, in a covered or partially covered furnace, without coal or other fuel. The metal being in a melted state (preferred from the blast furnace as being the most economical), they run it into a chamber or furnace, which is closed so as to prevent the temperature of the contents being too much lowered. They introduce air *tuyères* from a blowing apparatus into the interior of the chamber above the level of the melted iron, and in such a position that air shall be blown down with considerable force upon the top of the melted metal, so as to produce a combustion of the carbon combined or mixed with the iron. The blast may be either hot or cold, and they continue the process until the iron has been brought into a state similar to that called finery metal, or refined iron.

THE MACHINERY OF THE WAR DEPARTMENT.

A VERY interesting paper, on the application of Machinery in the War Department, has been read at the Society of Arts, by Mr. J. Anderson, inspector of machinery, Royal Arsenal, Woolwich. The paper is of necessity of an outline form, the limits assigned to it being too narrow to admit of detailed descriptions.

Up to a recent period, by far the greater proportion of the work, in making the munitions of war, was performed by hand labour. In 1842 there were but two steam-engines, together equal to 32 horse-power, which gave motion to a few machines for sawing and planing the timber of gun-carriages. The simple statement that there are now 68 steam-engines, with a nominal power equal to 1170 horses, giving motion to 16,540 feet of shafting, 18 steam-hammers, 64 hydraulic presses, and 2773 machines of various descriptions, will afford some notion of the extraordinary effort which has been made to render the several establishments efficient and fitted for any emergency.

Without prejudice, the United States of America, the continent of Europe, and our own country, have been searched for the most superior appliances, and hundreds of machines have been designed for purposes peculiar to the War Department, but which may be usefully employed in the general manufactures of the kingdom.

From these important changes and improvements the greater proportion of war stores can now be produced with unskilled labour, the form, dimensions, quality, and quantity of the produce being mostly dependent on self-acting apparatus, a system of operation which has been more fully developed in the wood and metal manufactures of the War Department than in any private establishment with which Mr. Anderson is acquainted.

To ensure perfect success, the details of the small arms machinery are being carried out by an American gentleman, brought over by the Government, who possesses a thorough and practical experience in the working of this system in the United States, and who has the assistance of several of his own countrymen, from the small-arms factories of New England.

The bayonet, from first to last, undergoes seventy-six operations, each of which is definite and simple, and at the conclusion of the last one, the several bayonets are as much alike as the different pieces of money from the Mint, and they present a degree of accuracy which could not be equalled, even at three times the cost, by the tools or apparatus which have hitherto been employed in England.

The American machinery introduced into England by the War Department is so peculiar, that it presents a rich mine of mechanical notions, worthy of being studied by our machine makers. The gun-stock machinery, especially, is a positive addition to the mechanical resources of the nation.

In 1854, an urgent demand was made from the Crimea for wrought iron shells, an article of peculiar shape, not unlike an immense champagne bottle, which it was found impossible to get by contract in sufficient time and quantity to meet the demand. In this emergency, a factory capable of producing 100 of these shells daily was erected; it covers 30,000 square feet, contains 4 steam-engines, 7 steam-hammers, and upwards of 40 machines of various descriptions, many of them original and specially adapted to this manufacture; and this establishment was in operation within two months from the date of order, and that, too, during the severe winter of 1854-5—a fact which is worthy of being recorded.

A peculiar feature in the application of machinery in the War Department is the frequent and successful attempt to congregate a number of instruments together, in such a manner that they may act on an article, or series of articles, simultaneously. To select two examples—one machine is mounted with twenty or more circular saws, on different spindles, horizontal, vertical, and at various angles, so arranged that a passage through the whirling group will produce the required shape or form; a number of pieces of timber are fixed to a moving table, and one after another pass through the saws, and are instantly transformed into shape. Again, there are machines in which some twenty or more drills are arranged in the same manner, and placed so as to drill upwards, in order to get rid of the chips; this principle of operation is extensively used for hard-wood morticing purposes, in various ways, and is very expeditious.

The floating factory which was sent out to the Crimea in ten weeks after it was ordered by Lord Panmure, was visited by the chief officers of the French, Sar-[illegible], and Russian services, all of whom expressed their surprise and admiration, declaring that it, together with the railway, gave them a higher opinion of England, her resources, and her settled determination to conquer ultimately, than almost any other transaction connected with the war.

Besides the floating factory, several other plants of machinery were sent out; among the rest a complete saw mill, with suitable steam-engine, to Sinope, another to Balaklava, with both circular and frame saws, and other machinery.

Of the miscellaneous services carried out during the war, one of the most important was the erection of a pier at the wharf of the Royal Arsenal, extending out into deep water, by means of which four of the largest class of vessels can lie alongside during all conditions of the tide; and in connexion with this pier is the application of hydraulic power to work the cranes. The whole expense, including the steam-engine and hydraulic accumulator apparatus, and the cranes, amounting to nearly 33,500*l*., was cleared off in the saving of the time of vessels alone during the first six weeks that it was in operation—an important consideration, although secondary to the far higher advantage which it affords the War Department, in the rapidity with which it can embark war material and

The Armstrong hydraulic apparatus, for working the cranes, is also being [illegible] ine, with an air-vessel to produce the [illegible] t of water. This air vessel is in the form of a cylindrical steam boiler, with hemispherical ends, and is placed vertically. In connexion therewith, an iron reservoir, 100 feet in diameter, has been placed on a hill in the vicinity, 220 feet above the Arsenal, and is filled through the fire mains by the hydraulic apparatus. In case of fire, the water in the reservoir is always ready; meanwhile the steam engines, equal to 30 horse-power, will go to work on the pumping apparatus as an auxiliary, and the two combined will afford a plentiful supply of water, equal to the requirements of any probable emergency.

There are 69 steam boilers in the War Department, and that everything ducive to safety and economy in fuel should be carefully attended to, a system of reporting has been organized, showing the working history of each boiler, in regard to proof, times of examination, cleaning, and repairs, also the consumption of fuel, the quantity of water evaporated by a pound of coal, and other particulars.—*Journal of the Society of Arts.*

NEW RIFLE EXPERIMENTS AT HYTHE.

THE weapon recently supplied to our troops is the new Rifle, called after the place of its manufacture—a Government establishment at Enfield—and the efficacy of this arm was to that of the old musket pretty nearly as twenty to one. But during the last week or two the Enfield rifle has been challenged and encountered by a competitor in the shape of a rifle devised by Mr. Whitworth, and in some of the principal points of excellence it has been completely surpassed. As regards range, the Whitworth rifle actually sent its bullet into a target at a distance considerably exceeding a mile (1880 yards) with measurable results, when the Enfield rifle made no hits at even 1400 yards. As regards accuracy, the Whitworth was nearly as good at 1100 yards as the Enfield at 500, and when both were fired at 500 yards the shooting of the former was three times as good as that of the latter. As regards force, the ball from the Enfield weapon, charged with only the regulation quantity of powder, did certainly penetrate twelve planks of elm, each half an inch thick in succession—a performance which, but for comparisons, might be thought both respectable and sufficient. When, however, the Whitworth rifle was tried, under precisely the same conditions, it positively drove its bullet through *three-and-thirty* of these planks, and the missile was only then stopped by a solid block of oak behind. There can be no doubt, therefore, that on these points—points evidently of the greatest importance in the estimation of a firearm—the new regulation weapon, excellent as it is, has been beaten by one still better; but it does not follow that the best rifle for shooting quietly at a mark will be the best for the service of an army.

A NEW CANNON.

THE *Journal de Geneve* describes an experiment made of a mechanical Cannon, which loads itself and fires twenty shots a minute. The balls crossed the Rhone, without the gun, which was mounted on a plateau, making any recoil worth speaking of. This cannon is the invention of M. Ravel, a manufacturer of musical instruments.

NEW MILITARY BRIDGE.

IN May last, experiments were made at Chatham, for the purpose of testing a new description of Suspension Bridge for the passage of artillery, cavalry, and infantry over rivers and streams, the invention of Sergeant Major J. Jones, R.E. A field bridge of this description can be constructed and thrown across a river of from 50 to 100 feet span in less than three hours, and when completed will be capable of sustaining the passage of heavy field-pieces and any number of troops required to proceed over it; after which it can be taken to pieces in an exceedingly short time, and transported with the troops. Sergeant-Major Jones's suspension-bridge is formed by using the sheet iron bands of the new gabions introduced into the service, which are also his invention. The bridge, which has been tested at Chatham, was constructed with a span of about 50 feet, and was formed simply with the bands of 24 gabions, the weight of which was 480 lbs., the whole being completed and fixed by the troops in little more than two hours. With the view of ascertaining its strength, a 6-pounder gun and limber, weighing a ton and a-half, was wheeled backward and forward over it, with a number of men; after which several bodies of troops were marched across it, during the whole of which time the deflection was scarcely perceptible. The materials for an ordinary bridge can be stowed in a box of about 6 feet square.

IMPROVED MOVING BATTERIES.

Mr. Jones proposes, in the *Mining Journal*, to accomplish this object by employing a machine attached to an ordinary locomotive on rails or otherwise, and carrying a number of rifles or cannons, arranged to be projected at pleasure. To each of the cannons is a branch wire, communicating with a galvanic battery. The ball is placed in the cannon, and hermetically sealed with partially damp cotton; when a stroke or shock of electricity is applied, the ball is projected. In case of the engine being electro-locomotive, the same electric fluid will be convenient. In case of rifles, each man may have a pocket battery—now in use. The electric fluid causes the air to expand (our atmosphère has more electricity in proportion to height): each cannon is lined with a non-conductor, of gutta percha. Another cannon is oxyhydrogen, the explosive gas in mines: the cannon is, as before, lined in or outside with gutta percha (a non-conductor); a sponge suspending water is first put into the cannon, then the ball, and hermetically sealed with cotton, when a little vitriol (a few drops) is introduced through the touch-hole, and the ball is ejected. By a particular device, the touch-hole is sealed until the ball is ejected. The engine and batteries are defended by alternate layers of gutta percha, iron, and cotton, covering the whole, and also the fronts of the wheels.

MARTIN'S SHELLS.

Experiments have been made with Martin's Shells in Woolwich Marsh over the usual range of 400 and 600 yards. The shells, filled with the ordinary amount of molten iron, 28 lbs. each, were levelled at the bulk-head, as on a former occasion, and the first shell which struck the object produced the desired effect of speedily igniting. Fourteen similar shells were thrown in succession, some of which passed completely through the bulk-head; four others fell wide of the mark, and the remainder proved to be as successful as the first. Some additional experiments were likewise made, the object being to prove the solidity of sundry plates of steel and iron, the former 3 inches in thickness, and the latter 4½ inches. The shot employed for the test were of cast and wrought iron, and were fired over the usual range, 400 and 600 yards, from a 68-pounder gun erected on a newly-invented dwarf platform. The effect was clearly visible from the first shot, which passed through the entire structure. Between 20 and 30 shots were fired with a similar result.—*Times.*

CHAIN CABLE AND TIMBER TESTING MACHINES.

MR. T. DUNN, in a paper read by him to the Institution of Civil Engineers, states that the Hydraulic Press Machines, for Testing Chain Cables, have been generally so costly in construction, and require such expensive foundations, that few of the chain manufacturers have on their premises any means of testing their chains. Messrs. Dunn, Hattersley, and Co., of the Windsor Bridge Iron Works, Manchester, having had their attention directed to this want, designed the simplified Testing Machine, the description of which formed the subject of the paper, and which could be produced for 200*l.* to 300*l.*, instead of 1100*l.* to 1600*l.*, the cost of the Government and Corporation testing machines. The bed of the new machine consists of a trough of cast iron, with a slot throughout its length (30 yards), to contain the portion of cable under proof; this trough is laid on guntrees of wood as a foundation, and a few cross bars are placed over the slot, to prevent the end of the chain from rising in case of fracture. This arrangement precludes the possibility of accident to the workmen when testing chains, as the ends are retained within the trough instead of sweeping across laterally, as frequently occurs when the chains were laid upon a bench for testing. The arrangements for the main hydraulic cylinder, the valves, and the levers, are very simple and effective; and the results of very numerous series of experiments, which were given, demonstrated the power and uniform action of these machines—one of which was used at the Paris Universal Exhibition in 1855, for making a long series of experiments on the strengths of colonial and other timber, under the direction of Captain Fowke, R.E., part of whose Report was quoted.

The paper was illustrated by numerous drawings, and some of the links broken in testing were exhibited.

In the course of the discussion it was remarked, that the broken links showed, in almost every instance, that the fractures had arisen from an imperfect union of the iron of the links in welding. It is considered that sufficient force and rapidity of blows cannot be obtained by hand labour, and that tilt hammers with the requisite speed have not yet been employed; neither have steam hammers, which are merely lifted by steam and fall by their own gravity, sufficient speed for heavy chain making. A description was given of Naylor's single, or double-acting steam hammer, which can be changed at pleasure, by merely moving a lever; and by which any amount of steam, from a mere breathing upon the piston to that of the full pressure of the boiler, can be applied, and be varied whilst the hammer is in full work. Two of these hammers are employed in the workshops of the Eastern Counties Railway at Stratford, and one at Norwich. They are somewhat like the "Nasmyth" hammer, but comprise several modifications having reference particularly to the valves and valve gearing. The hammers weigh 10 cwt. each, and when worked with a length of stroke of 12 inches, and double acting, 250 blows per minute can be obtained, or more than twice the number that can be given by an ordinary hammer lifted by steam, and falling by its own unaided gravity. The same principle is said to be applicable for rivetting iron plates for ship building—also for boilers, tanks, wrought iron bridges, rivet making, &c.

Some calculations which have been made to discover the law which regulates the size of the chain cable and the weight of anchor for a given ship, show that

$$\tfrac{1}{8}\sqrt[3]{\text{Load displacement}}$$

gives the diameter of the chain cable usually employed by screw steamers of the present form.

COMBINED GIRDERS AND SUSPENSION CHAINS.

A PAPER has been read to the British Association "On the Mechanical Effect of Combining Girders and Suspension Chains," by Mr. P. W. Barlow. The author states that his attention had been directed to the subject from having, as engineer to the Londonderry and Enniskillen and Londonderry and Coleraine Railways been required to consider how a junction of the lines, combined with an improved road communication, could best be carried out. The design had been approved by Sir William Corbett, the consulting engineer of the Road Commissioners; but some doubt having been expressed as to the accuracy of the calculation of the weight of metal required in a suspension girder, he caused a series of experiments to be made, the results of which completely confirmed his calculation; and, being of great practical importance, he laid them before the British Association, in order that the simple mechanical question of the effect of combining a girder and chain, on which no difference of opinion ought to exist, should be determined. The author, in general remarks on the construction of bridges, pointed out that a girder to have equal strength requires double the metal, and to have equal rigidity, four times the metal, of a suspension chain of the same span, if loaded equally all over. Mr. Barlow then called attention to the theory hitherto adopted on this subject of the weight of girder required to stiffen a suspension chain, viz., that of Mr. C. Clarke, who, in his work on the Britannia Tube, in speaking of the difficulty of rendering the Menai Suspension Bridge sufficiently rigid for railway traffic, asserts that the construction of a platform 451 feet long, sufficiently rigid for a railway, almost amounts to the construction of the tube itself. The author next described his various experiments on a model bridge, 13 feet 6 inches in length, the results of which are entirely at variance with Mr. Clarke's theory; inasmuch as they prove that a girder, when attached to a chain, will not deflect more than one twenty-fifth of a girder unattached under ordinary circumstances. Having, by repeated experiments, established this result, which, he explains, is quite consistent with the law of the deflection being as the cube of the length, he proceeded to compare the weight of metal and deflection of the proposed Londonderry-bridge with a girder of equal span, and selected the Britannia Tube, from being nearly the same span. The weight of metal in one span of the Britannia Tube is 3100 tons. The weight of metal in the proposed Londonderry-bridge, with equal deflections, is 432 tons. This result, the author remarked, is unexpected, but quite consistent with the fact that the Derry-bridge has three times the depth, and has 2600 tons less of its own weight to support. The author, in summing up the result of his investigation, gives the following results:—That the deflection of the wave of a girder attached to a chain similar to the Londonderry-bridge will not exceed one twenty-fifth of the deflection of the same girder not attached to the chain. That theoretically the saving of metal to give equal strength in a suspension bridge is only one-half of a girder; but as it can be made of great depth without practical difficulty, and as the deflection varies as the cube of the depth, a bridge on the principle of such spans as the Londonderry-bridge may be made, under average circumstances, with at least one-fourth of the metal of an ordinary girder bridge having equal rigidity.

CONVERSION OF WOOD BY MACHINERY.

MR. G. L. MOLESWORTH has read to the Institution of Civil Engineers a paper on this subject. In briefly glancing at the history of Wood Conversion, the author noticed the early application of machinery for the purpose, and also the introduction of the circular-saw, the planing-machine, and the band-saw. The inventions of Bentham and Brunel were mentioned as having contributed largely to the advance of this branch of engineering. A comparison was then drawn showing the more rapid progress of wood conversion in America than in England. This was ascribed to the greater cheapness of material and the scarcity of skilled labour in the former country, which gave a stimulus to invention; whilst in England the case was different, the material was comparatively expensive, and skilled artizans were abundant. Nor was the system of the subdivision of labour as yet fully carried out, the conversion of wood being hitherto in the hands of a class who could not employ much capital in machinery, or keep it constantly at work to the greatest advantage, even when they had it; and, at the same time, the prejudices of foremen and the combinations of workmen had operated powerfully against the introduction of new machines. Many of the machines of English construction had been of too costly a character, and in designing them sufficient attention had not been given to economy of the converted material. The cheap and simple character of the American machines was mentioned, and some of their characteristic details were described.

NEW MACHINERY FOR MAKING ENVELOPES.

MR. J. KEITH, of Eltham, Kent, has patented an improved set of machinery (the invention of a foreigner) for Manufacturing Envelopes. The paper blank is fed into this machinery by hand, and creased by the descent of a plunger into the creasing box as usual. A partial exhaustion is then effected under the paper, to hold it in the box while the plunger rises. The box is then traversed forward along guides under a second plunger of peculiar construction, for folding over the flaps or lappets of the blanks, and pressing them down previous to discharging the finished envelope from the machine. As the crease blank is carried forward with its flaps standing vertically, or nearly so, out of the box, the end flaps meet yielding projections which turn the flaps inwards, and thus bring them under the second plunger. This plunger consists of a hollow rectangular frame, fitted with sliding pieces, which act in consecutive order, first turning inwards the forward side flap while the creased blank is moving into position, and then laying the end flaps over it. A pendent curved spring, which is caused to advance slightly by the pressure of the descending plunger, turns over the fourth flap, and the plunger, pushing aside the projections which turned in the end flaps, then comes down on the envelope, to give it the final pressure. Before this takes place, the exhaustion below the envelope is removed. The plunger is also provided with an exhaust arrangement, by means of which the plunger, when rising, is enabled to draw up the envelope out of the box. The box then returns to be fed by a fresh blank, and the exhaust being cut off immediately the box has passed away, the envelope is then free to fall by its own gravity out of the machine.—*Mechanics' Magazine*, No. 1758.

AUTOMATON.

M. SALLES, *arquebusier* to the Emperor Napoleon, has invented a Post-office Automaton, which takes up every letter as it is thrown into the box, places it under the stamp, where it receives the post-mark and date, and throws it out again for delivery to its destination. The process also indicates the number of letters thus stamped. It is said that no less than two hundred letters may be stamped by this machine in one minute.

LARGE TUBULAR CRANES.

MR. W. P. MARSHALL has described to the Institution of Mechanical Engineers at Manchester, the Large Tubular Wrought-iron Crane, recently erected at Keyham Dockyard, Devonport, by Mr. William Fairbairn. Six cranes of this kind have been ordered by Government. The cranes are constructed to raise 12 tons each; would sweep a circle of 53 feet radius; lift the load a perpendicular height of 37 feet from the quay wall, to a height of 85 feet above the level of low-water mark; and place it 68 feet from the edge of the quay. The under-side of the crane is of cellular construction, to resist pressure, and there are long plates, and T iron, on the upper side, to resist tension. The paper gave the details of various experimental tests by gradual weighting. It has been tried up to 20 tons, and the deflection was about 3½ inches; the permanent set was under an inch. It is believed that a 12-ton crane was capable of bearing 60 tons. In the ordinary crane, a large object could not be raised to the top of the peak, on account of the jib, usually placed at an angle of 45 degrees, being in the way, but the curved form of this crane would allow a large boiler or other article to be raised to the top. It is also adapted for stepping the masts of ships, the purpose for which large sheers were used.

ORGAN BLOWN BY WATER POWER.

An apparatus of practical value has been affixed to the organ in East Parade Chapel, Leeds. The invention (which has been patented by Mr. D. Joy, engineer, and Mr. W. Holt, organ builder, Leeds) is called the "Hydro-pneumatic Engine," and can be affixed to any organ. Its object is to supersede manual labour and the more expensive steam power, in blowing large organs in churches, chapels, and public edifices. The apparatus in East Parade Chapel is affixed to an ordinary one-inch pipe, conveying the town's water, brought into the vestry beneath the chapel. The whole apparatus does not occupy a space exceeding four feet, and it is found fully equal to blowing the bellows of the organ above, which is an instrument of 44 stops, including pedal pipes of 24 feet, to G G G. Upon turning the tap of the water-pipe, the apparatus is at once set in motion, and air forced into the bellows with the utmost regularity, until they are properly filled. The engine then stops until the air is so far exhausted by the performer that the bellows have fallen an inch, when it recommences pumping air into them, until they are filled; and this goes on, with more or less rapidity—without any interference whatever—according to the exhaustion of air by the player. The pressure is very much more steady and continuous than can be attained by manual labour. Near to the hand of the organist is placed a stop, by applying or removing which, by a touch of the finger, the apparatus is set in motion or stopped at once. The advantage of the invention is equally great in a pecuniary point of view. For example, at East Parade, 8*l.* per annum has been paid to the organ blower; but the apparatus has been fixed for less than 40*l.*, and the consumption of water is not more than 2½d. per day, or less than 11s. per annum for the Sunday services. Probably, taking all the services in the year, the cost of water will not exceed 25s.—*Abridged from the Leeds Mercury.*

POLISHING MACHINE.

Two surfaces rubbed together for the purpose of polishing have a property, either by excluding the air or otherwise, of adhering together with such force as to make the friction in some cases very excessive. To remedy this objection, Mr. Burgess, of New York, has patented an improvement on the Polishing Machinery now extensively employed in finishing marble and plate-glass, by introducing grooves in the rubbing surface, so as to admit the air alternately to every part. Mr. Burgess is, we believe, the inventor of the Grinding and Polishing Machine, on which this is simply an improvement. A horizontal disk of cast-iron, some ten feet or more in diameter, is rotated by steam-power, while the glass or other material to be dressed is fixed loosely to a point not coincident with the centre thereof, and being free to rotate at pleasure, presents itself in an infinite variety of positions to the action of the disk. The polishing disk is similar, but covered with moist woollen cloth. With this machinery, as now improved, it requires but five hours to grind and an additional time to polish perfectly a large pane of plate glass, which by the old process is represented to require a week or more.

LIFTING A HOUSE.

In the *Builder*, No. 777, is described the operation of Lifting a House, at the corner of Petty Cury, Cambridge. The timber supports built into the foundations having decayed, the house had settled very much, and was six inches out of the perpendicular. Mr. Reynolds Rowe, the town surveyor, was consulted upon the subject, and under his able direction substantial shores were first placed against the walls; then, by a judicious application of screw jacks and the hydraulic press, the house was lifted up to its original height, and the whole of the circular corner underpinned, and massive cast-iron story posts inserted. These were firmly held down by long iron bolts, penetrating to the underside of the foundation. The shoring was then cleared away, and the work successfully finished.

NEW SELF-ACTING KILN.

Mr. W. F. Journeaux, of Warcourt Mills, Dublin, has patented a Kiln which is Self-acting. The grain is in perpetual motion during the process of drying, so that the grain cannot possibly be scorched; the steam from the grain, instead of being forced through and through the grain, as in the old kiln, each time a cast is turned, is at once carried off, so that the grain is thoroughly and evenly dried, and much stronger and brighter than when dried by the old plan; the flour by this method is also equally improved. The saving of labour and fuel is great. The grain itself is also much improved by the friction caused by its passing through wire cases when drying, as a vast quantity of dust, &c., is rubbed off, and no loss of small corn occurs, as is unavoidably the case in the old kiln, from its dropping through the tiles, or wires, into the lantern, where it becomes burnt and unfit for use. Several of these kilns have been recently erected in different parts of Ireland.—*Illustrated Inventor*, No. 2.

IMPROVED HOUSE BUILDING.

A paper of practical value has been read to the Society of Arts—"On Houses as they were, are, and ought to be," by Mr. J. W. Papworth. It is much to be regretted that those who invest money in building are generally lamentably ignorant on the subject, and the result is in many cases a serious misapplication of capital. Indeed, the building owner and the builder meet on very unfair terms without the intervention of an architect. This is the more important, since the present system of excessive competition has gradually reduced the stability of buildings to an alarming extent. Towards the latter part of the eighteenth and the beginning of the present century, the solidity of the buildings seems to have declined, till it arrived at the present flimsy style. Mr. Papworth then dwelt at length upon the present competitive system. When tenders are sent in, a most embarrassing discrepancy exists in the amounts named, and generally if the lowest tender is accepted, it is found to be in the end false economy, and eventually more money is spent than was originally contemplated. The subject of house-building as at present carried on by speculative builders was then discussed; and the badness of the bricks employed, the careless preparation of the mortar, the mixing of old brick-work with new, the bad method of laying foundations—these and numerous other evils were pointed out. The rapidity with which the work is carried on naturally produces serious imperfections, amongst which smoky chimneys are not the least. With reference to the bad policy of such a system, every year of a badly built house may be said to cost at least one-third of the rent in repairs: if they are not done, the house goes to ruin at once. Indeed, our modern houses are so badly built that even speculative builders now find it difficult to sell a lease. Mr. Papworth concluded by expressing a hope that if the system he had condemned were continued, the blame would not be unfairly laid upon the profession to which he considered it an honour to belong.

VISCOUNT CARLINGFORD'S AËRIAL MACHINE.

VISCOUNT CARLINGFORD, of Swift's Heath, Kilkenny, has patented an Aërial Machine, with which he anticipates obtaining great results. The following is an extract from the specification which was written by the patentee himself:—"The aërial chariot in form is something of the shape of a boat, extremely light, with one wheel in front and two behind, having two wings slightly concave fixed to its sides, and sustained by laths of a half hollow form pressing against them, and communicating their pressure through the body of the chariot from one wing to the other, and supported by cords, whose force, acting on two hoops nearly of an oval shape, holds the wings firmly in their position, using a force that cannot be less than ten tons, on the principle of corded musical instruments. The aërial chariot is provided with a tail that can be raised or lowered at pleasure, and which serves for giving an elevating or declining position, and worked by a cord that communicates into the interior of the chariot, which is drawn forward by an aërial screw of the perfect form of the screw propeller discovered by the same inventor, and presented by him to Government the 16th of June, 1854, and which screws into the air at an elevation of 45°, similar to the bird's wing, and is turned by means of a winch acting on three multiplying wheels. The wings of the chariot are covered with a net-work, of a lengthened square shape, which produces the effect of birds' feathers when the chariot floats on the air, covered with silk, at which time may be seen its impression with the points forwards, and the same backwards, by which no pocket, as it were, can be formed by the pressure of the silk on the air. The upper part is finished in the same manner, and both sides of the wings are covered with varnish. The body of the chariot, the wings, and all of it in general, are made of very light wood, with few exceptions, weighing in all from four to six stones, and covering a space from 25 to 30 feet square, or according to the weight it is intended to carry. It can also be constructed, and considerably increased in size, to carry very superior weights, yet the wings will not require to be increased in the same proportion." Lord Carlingford adds, in a foot note—"An aërial screw, of only five inches long, can give a pull greater than a ten-pound weight suspended to a cord, and drawing through a pulley, and as it will only take such a small force to maintain the flight of the aërial chariot, that what we look upon as fabulous may hereafter come to pass, and that, like the chariot of Jupiter, we may yet behold two eagles trained to draw the Aërial Chariot!"

COMPOSING AND DISTRIBUTING TYPE BY MACHINERY.

MR. T. ALDEN, of New York, has patented certain improvements in Setting and Distributing Type. The invention consists of a machine, partly automatical in its operation, and partly worked by an attendant. The purely automatical part lies in the type-distributing operation, while the setting of the type is governed by the attendant. By means of it both setting and distributing may be going on at the same time, or separately. A machine of which the functions are so varied must of necessity be composed of many parts, having more or less complexity both in construction and operation. The specification in question is nearly three hundred and fifty folios of seventy words each in length, one of the longest ever filed. It has annexed to it a series of very elaborate drawings.—*Mechanics' Magazine.*

TABLES CALCULATED, STEREOMOULDED, AND PRINTED BY MACHINERY.

A SMALL volume has lately been presented to the Institution of Civil Engineers by Messrs. Scheutz, of Stockholm, through Mr. Gravatt, entitled, *Specimens of Tables, Calculated, Stereomoulded, and Printed by Machinery.* The book is, with excellent feeling, dedicated to Mr. Babbage, in recognition of the generous assistance he has afforded to the ingenious labourers in a similar field to that in which he has so long toiled.* A short memoir describes the progress of the construction of the machine under the most discouraging circumstances,—the ultimate success attained,—the introduction of the machine in this country, through Count Sparre, to Messrs. Bryan, Donkin, and Co., where Mr. Gravatt became interested in it, and placed it before the Royal Society and the Institution of Civil Engineers,—its success at the Great Exhibition of Paris in 1855, where it obtained a gold medal, and finally its acquisition, through Professor B. A. Gould, for the Dudley Observatory at Albany, U. S. America, as a gift to that establishment from Mr. John F. Rathbone, an enlightened and public-spirited merchant of that city.

The construction has been briefly described to the Institution, and it has been shown, that at the average rate of working, 120 lines

* Mr. Babbage's address to the Royal Society on the claims of Mr. Scheutz's Engine, will be found in the *Year-Book of Facts*, 1857, pp. 57-59; and a full description of the Machine in the *Year-Book*, 1856, pp. 59-60.

per hour of arguments and results were calculated and stereotyped, ready for the press. On trial it was found, that the machine would calculate and stereotype, without chance of error, two pages and a half of figures, in the same time that a skilful compositor would take

. . . .

There was also given an abstract of Mr. Gravatt's description of his manner of considering and working the machine; then followed tables of logarithms of numbers from 1 to 10,000; and various examples of calculations performed with unerring accuracy. The remarkable and unique feature of the book itself is, that the tables and calculations are all printed from stereotyped plates produced directly from the machine, and without the use of any moveable type.

IMPROVED SURFACE PRINTING.

MESSRS. CHEVALIER and O'SULLIVAN have patented a new or improved method of obtaining or preparing Printing Surfaces, and in printing therefrom. By this invention the different colours of a design can be printed at the same time. The patentees take any suitable permeable substance or fabric, such as linen, &c., or it may be a reticulated metal surface or perforated metallic plate, and on it draw the desired figures in an ink composed of lampblack, Indian ink, gum, sugar, and salt. They next coat the substance with a thin coating of gutta percha (or gelatinous material), then dry the coating and wash it. The gutta percha, where it comes in contact with the permeable material, adheres thereto; but the ink, being soluble in water, is removed in the washing, and carries away the gutta percha covering it. The back of the fabric is now coated with the ink or colours to be printed, and the impression is taken from the face of the fabric by pressure in a press; the ink or colour passing through the pervious part on to the paper or other surface.

HEAT OF COKE AND COAL.

MR. APSLEY PELLATT has read to the Society of Arts a paper "On the Comparative Heating Properties of Coke and Coal in regard to Economy and the Prevention of Smoke." By the stringent operation of Lord Palmerston's Smoke Act, metropolitan manufacturers are now forced to use coke and other smokeless fuel, or to adopt some smoke preventing apparatus. It has been ascertained that one chaldron of coke, weighing thirteen or fourteen cwt., performs the same heating duty as one ton of Newcastle small coals. Mr. Frederick Pellatt, at the Falcon Glass-works, has recently used gas coke fuel, in the proportion of twenty chaldrons of coke to one ton of coals, for above twelve months, with economy and success. He has also experienced collateral advantages—viz., that coke fines the metal many hours earlier than coal; is more certain in its effects; that the crucibles are of longer duration, with a relative saving of about two and a half per cent., and an almost entire prevention of smoke. The author is therefore of opinion, it may be assumed, that in localities where gas coke can be purchased as cheap by the chaldron as small coals can be by the ton, that coke will be superior to coals in heating powers for raising steam or melting metals.

CONSTRUCTION OF FLUES AND VENTILATION.

Mr. George Jennings has patented certain improvements relating to Construction and Ventilation. He proposes to employ a light iron trimmer in front of chimney openings, instead of the wood trimmer now used; also, hearth blocks, perforated, instead of the half-brick trimmer arch—the perforations in the "blocks" to correspond with air spaces in the iron trimmer joist. He then, in combination with these matters, proposes to use earthenware flue-pipes, having air spaces or chambers round them, so shaped as to make the circle into a square. These air chambers are to serve as extractors of vitiated air, and are so made that they bond in with the brickwork, and take the inclinations peculiar to flues in buildings.

"Suppose a two-roomed house," says the patentee, "the lower room only having a fire-place, but the chimney formed with my flue pipes, if the upper room, wanting the fire-place, be connected by a junction block, with my extraction chambers, the sleeping-room would be continually changing the air. Of course, I have also a simple plan for supplying air for respiration, and to support combustion." In a larger house, the kitchen chimney only being built with the flue pipes, and the extraction chambers communicating with every room, at or near the ceiling line, vitiated air, from the heat imparted from the smoke flue, would be drawn off without any communication with the interior of the smoke flue, as is the case with the Arnott ventilator.—*Builder*, No. 776.

HOT-WATER APPARATUS.

The Birmingham Patent Tube Company have introduced an improved description of Stove and Hot-water Apparatus, by which one ordinary fire is made to heat several chambers. The heat is generated in a coil of tubing placed behind the grate; the water in the coil becoming warm, begins to ascend and follow the travel of the piping, transmitting the heat obtained in the coil through to any length of piping. The peculiarity in the grate consists in its having a double back, so that if it be required to increase the heat, the register is shut, and the heated air passes through the coil and up between the backs; while to decrease the heat, it is simply necessary to throw back the register, when the chamber between the backs is closed, and the heat ascends the chimney in the regular way. The improvement in the arrangement of the piping consists in having the ends open, whereby accidents become impossible, and the inconveniences generally attending the use of hot water for heating are removed. The apparatus may be usefully applied.

PREVENTION OF EXPLOSION IN COAL MINES.

Mr. Jones proposes, in the *Mining Journal*, the following method:—Introduce into a coal mine a basin containing muriatic acid, which, when the lid is raised, readily gasifies, as gas is the peculiar natural condition of muriatic acid; on escaping from the basin it quickly combines with the hydrogen and nitrogen of the mine, for which muriatic acid has the greatest affinity, and beautiful needle-like crystals of muriate of ammonia are deposited on the sides and surface of the mine: the effect is striking, invisible gases readily producing a solid substance. For agreeableness, the lid may be partially raised during the day. For greater security, a wire is introduced through the mine, communicating with an electro-galvanic battery on the bank of the mine, and every evening when the miners have left, a current of electricity is passed through the mine, which causes the gases more easily and quickly to combine, and by probing the mine ensures no aggregation of fire-damp beyond that accumulated in one day. Muriatic acid costs about 1d. per lb. in carboys, and is offered at 2*l.* 10s. per ton. The muriate of ammonia, or sal ammonia precipitated, sells for about three times that amount. A little lime will absorb the choke damp. There are in mines, properly speaking, three kinds of damp—fire damp, which is hydrogen; choke damp, carbonic acid; and nitrogen, a sleepy, stupifying gas, which renders the miners careless and neglectful of rules, working, it might almost be said, by instinct.

NEW INVENTION FOR PREVENTING COMBUSTION.

MESSRS. SCHUESSEL and THOURET, by this invention, profess to be able to render incombustible every substance hitherto liable to be consumed by fire: they state that by its application conflagrations in theatres and private houses, on railways, and on board ship, will be impossible, while persons dressed in any material whatever which has been prepared with the preventive will no longer be exposed to danger from fire. The inventors (in some experiments lately made at 34, Alfred-place, Bedford-square) first exposed to the flame of an ordinary candle unprepared pieces of muslin, plain and flowered, which of course were rapidly ignited and consumed. The same kinds of muslins, prepared, were next held to the flame for a considerable time, the only effect being to char the fabric. Not the slightest flame was visible, and the effect of the application of the candle was confined to those parts with which the flame came into immediate contact. Shavings, twisted in the way in which cigar and pipe lights are often made, were next tried in the flame of the candle, with the same effect. A small box of ordinary deal, which had been prepared, but was incased in inflammable canvas, was then placed on a clear, strong fire, and its force aided by a liberal supply of firewood all round, for a quarter of an hour. At the end of that time the box was removed, broken up, and handed round for inspection, showing that the outside only was blackened and charred; during the whole process not the slightest flame was produced from the box. Lastly, upon a tall screen with two cross-bars four long pieces of flowered muslin were hung, two unprepared pieces below, and two prepared pieces above. The under strips were speedily lighted, the flame rising with great force to the upper pieces, but with a similar effect as before; the parts with which the flames came into contact were charred, not ignited; and the attempts of several of the gentlemen present to set other portions on fire by means of lighted torches ended in the same result. The inventors state that the material will be as cheap as common starch, or that a bale of linen, or cotton, or muslin, one cubic foot square, may be prepared by it at a cost of a penny; that the cloth so prepared will preserve its anti-inflammable qualities until it is again washed, and that mere wear has no effect upon it; and lastly, that the preparation is of such an innocuous nature that it not only leaves the fibre unaltered in strength and character, but may be applied to the most delicate colours in all textures with the exception of light rose and blue silks, with which extra pains must be taken. The experiments, so far as they went, fully sustained these statements.

A NEW SMOKE-CONSUMING APPARATUS.

At the Great Paris Exhibition of 1855 was shown this invention for Consuming, or rather Preventing, the Generation of Smoke, invented by Dr. Beaufumé. The apparatus, which at that time was little more than a mere experiment, has now, in a greatly improved state, been carefully tested in M. Cail's great boiler-manufactories at Denain and Grenelle, in Paris. Smoke being a volume of inflammable gases charged with minute particles of unconsumed coal, all forced through the chimney by the draught of air with which the combustion is maintained in the fire-place, it follows that the very air causes the loss of an immense quantity of combustible matter which has not had time to produce any useful effect, while at the same time creating that nuisance which legislation has hitherto been powerless to put down. The problem, therefore, of destroying smoke is reduced to two chief points:—1. Regulating the draught of a furnace so as to allow all the combustible elements of the fuel to be consumed. 2. Obtaining those elements in a pure state. M. Beaufumé attains both these results by simply decomposing the fuel employed (whether it be coal, anthracite, lignite, or peat, is of little moment) in an apparatus by itself, and conducting the oxide of carbon thus generated to the furnace, where it is definitively consumed by a gentle and well-regulated draught of air. The apparatus consists of a copper vessel provided with an aperture below for the admission of air, and fitted into another vessel of the same material, the interval between the two being filled with water; so that the fuel undergoing decomposition receives no higher degree of caloric than that of the boiling point of water. The steam generated by the water is carried off through a tube into the boiler of the steam-engine which it is required to supply with heat; and the gas distilled is conducted through another tube to the fire-place, situated under the boiler, where it feeds the flame. By this process upwards of forty per cent. of fuel is saved; the tall chimneys hitherto requisite to carry off the smoke, and produce a powerful draught, may be replaced by others scarcely two feet high, which will emit nothing but warm air without any noxious vapour whatever; and lastly, the vast fields of anthracite, lignite, and peat, with which France abounds, and which cannot be profitably used in the common furnace, may become a source of national wealth.

NEW FURNACE.

A PAPER has been read to the Institution of Mechanical Engineers, at Manchester—"On a new construction of Furnace, particularly applicable where intense heat is required," by Mr. C. W. Siemens, London. The Furnace, as at present constructed, is applied to the melting of metals. A number of zigzag passages are formed of fire-brick. There are two fires, and the draught from each passes alternately along these heated passages, the air entering the furnace at an immense heat. So nearly is this absorbed, however, that what ultimately escapes up the chimney is only at about 200 to 300 degrees Fah. It had been used for about three months in a furnace for iron and steel, and the result showed a saving of 79 per cent. as compared with the old furnace, turning out the same quantity of metal. Mr. Atkinson, Sheffield, has one of those furnaces, and he states that he found the consumption to be so small that he had the particulars noted during six days, of twenty-four hours per day; the consumption was 1 ton 10 cwt., while the consumption for the same period by the old furnace was 7 tons; each furnace doing the same description of work. The furnace has been applied to the melting of cast steel with favourable results. The average for melting steel is generally 5 tons of coal to 1 ton of steel, but with this furnace can be melted a ton of steel with a ton of coal. Besides this, there is no smoke whatever; and if this furnace become general in Sheffield, of which there is little doubt, the town will be in a position to vie with any atmosphere in the world. In answer to a question as to whether the changing of the currents in the regenerator—thus letting in cold air upon them after they had become highly heated—did not damage the brickwork, Mr. Siemens explained that in each case the cold air came first against the part least heated, then against the next, taking up 100 or 200 degrees at each stage, and on this account no cracking, from contraction, took place. Mr. Fenton wished to know how the iron could be improved by this plan? Mr. Siemens replied that the puddling had not been long tried, but he thought it might arise in this way. In the ordinary furnace there was a violent draught, but in this the draught was small, and the flame did not cut the iron; it gave an intense heat, with a comparative quiet atmosphere—thus less oxide of iron was produced. The iron must also be more pure, because fewer particles were carried over to it from the fire.

A SMOKELESS STOVE.

A STOVE of very novel construction has been invented by M. Touet-Chambor, of Paris. The object of the inventor was to construct a Stove which should diffuse a uniform heat, and at the same time consume its own smoke. By M. Chambor's system the front of the fire-place is covered with a metal plate, and there is no cavity for fuel as in the ordinary stove. In place of this receptacle, a sort of iron basket is fixed about eight inches above the hearth-stone. Beneath this is a grating by which air is admitted to a chamber behind the plate, and above the latter is another chamber communicating with that underneath, and which can be opened or shut at will by the aid of two registers. The grating under the basket can also be opened or shut by means of a lever worked by a handle fixed in the upper part of the plate: and the combustion of the fuel is quickened or slackened in proportion as the grating below and the registers above are made to act. When the registers (which are nothing more than small iron doors about six inches square) are closed and the grating is open, the flame and smoke of the fire are reversed; and when the registers are open and the grating closed, the smoke and flame pass into the upper chamber as in an ordinary stove, with this exception, that the combustion is more active. If the registers and grating be partially open, the smoke is burnt in the upper chamber. Heat and ventilation are provided by means of a zigzag traversing pipe which passes behind the plate, and emits a stream of hot air through apertures provided in the chimney for that purpose. Metal pipes may be fixed to those apertures, and thus a continuous stream of warm air can be circulated through the room. A cinder tray is placed beneath the basket, and as these portions of the stove can be more or less ornamented, the cheerful glow of an open fire-place is secured, while the nuisance of a smoky chimney is rendered impossible. Another and not unimportant improvement embraced by the invention is, that when used for cooking purposes no smell of any kind is perceptible, all impurities being destroyed in their passage through the flame. The only drawback to the usefulness of the invention appears to be the too rapid combustion of fuel; but M. Chambor states that when the stove is managed by a competent person the consumption of fuel is not greater than in an ordinary fire-place. M. Chambor has received the large gold medal of the "Société d'Encouragement pour l'Industrie Nationale" for his invention, which has been introduced in Paris with great success.

"THE CALORIC MOTOR."

One of the scientific marvels of 1852 was the Caloric Ship *Ericsson*,* which failing in practice, the caloric machinery was replaced by the ordinary steam-engine. Mr. Ericsson has, however, since laboured indefatigably for the perfection of his original design, and the development of a Motor, as we learn in the following report from the *New York Journal of Commerce*:—

At 37, William-street, one of Mr. Ericsson's engines has just been completed on a small scale, but is sufficiently large to illustrate the principle. Though occupying less than a cubic foot of space, and heated only by gas, the power developed defies the strength of a single man. It is employed in pumping, and raises three hogsheads per hour to an elevation of five feet. This pattern is called a "domestic engine," being adapted to perform a great variety of work

* See *Year-Book of Facts*, 1853, pp. 5 and 15.

ordinarily done by hand, and with a surprising degree of economy. Still another caloric engine is located on one of the piers on the North River, and is designed for ships' use. In this capacity it promises to accomplish important results; for our fine large packets and sailing-ships, being unable to carry steam-engines, are unsupplied with the Worthington pump, and, therefore, have wholly to rely on manual labour in ridding the ship of water in case of leak or other exigency. The caloric engine may be placed in the corner of the cook's galley, almost unobserved, and may be put in operation in fifteen or twenty minutes, saving the labour of an entire crew. There being no possibility of explosion or other disaster, the cook is amply qualified to officiate as engineer, if desired. The position of the engine is a matter of the least consequence, as it requires little beside air, and can run in the fore-top, or upper deck, equally well. In addition to the above, a beautiful steam-yacht has been plying about the harbour for the last ten weeks, and is often seen running across from Staten Island to Long Island, &c., propelled solely by caloric. This boat is 50 feet in length, with an 8-feet paddle-wheel, which works about thirty turns per minute, giving a speed equal to eight or nine knots an hour. The engine is controlled by any one who happens to belong to the party on board. The fuel is either coal or wood. Small oakwood has generally been used, sawed into 8-inch lengths, and, incredible as it may seem, only one cord has been used during the last six weeks, though the [illegible] tinguished, sufficient heat is retained in the metal of the engine (if it has been thoroughly warmed, and is in good working order) to propel the boat at least two miles. The space occupied by the engine of this boat is not larger than the boiler which the same boat would require if propelled by steam. It is said that the caloric engine can be built on any desired scale of magnitude. Though the principle on which Ericsson's caloric engine was originally built is wholly preserved, the arrangement and mechanism are entirely different—the whole being reduced to a degree of simplicity never before attained in any engine.

FIREPROOF GARMENTS FOR FIREMEN.

Some experiments have lately taken place at Paris, to test a new contrivance for Protecting Firemen from the action of the Flames, and enabling them to resist a strong heat. It consists of gloves made of amianthus, a kind of filamentous mineral; a helmet of the same material, fitting into another of wire-gauze; and a shield one metre in length and eighty centimetres broad, besides other garments of the above-mentioned materials. Three firemen, having put on the gloves, were enabled to carry iron bars at a white heat for three minutes without being obliged to let go their hold. Straw was afterwards set fire to in a large cast-iron cauldron, and continually kept up while a fireman, wearing the double helmet above-mentioned, stood above the flames, which he warded off with the shield. Although they rose at times above his head, he was enabled to keep his post for a minute and a half, at the end of which time his pulse, which was at 72 before the experiments, had risen to 152. Another fireman followed, who having covered his forehead with a piece of amianthus, was enabled to resist the flames for 3 minutes and 40 seconds. Two longitudinal heaps of chips, splinters, and straw had been prepared about 5 feet asunder, and 30 feet in length, two lateral openings being left to enable the firemen to get out in case of necessity. Four men were now equipped in complete suits of wire-gauze, with boots of amianthus; two of them wore, besides, a dress of amianthus, over another suit of clothes rendered incombustible by means of borax, alum, and phosphate of ammonia; the two others wore a double dress of prepared cloth; one man, moreover, was entrusted with a basket of wire-gauze on his back, containing a boy ten years old, protected by a helmet of amianthus. The heaps being set fire to, these men went into the flames together, and, walking at a very moderate pace, performed the distance several times. At the end of 60 seconds the boy shrieked out, and the fireman who carried him immediately stepped out of the flames. The boy was examined, but was found perfectly uninjured; his skin was cool, and his pulse, which was at 84 before the experiment, had only risen to 96; he might therefore have resisted longer had he not been frightened at seeing the flames meet over his head, while at the same time one of the ropes which held the basket had slid down the fireman's shoulder a little, with a slight shock. A few minutes after he was as lively as ever, and betrayed no signs of indisposition. The fireman's pulse, which was 92 before, was 116 after, the experiment. The other three men remained 2 minutes and 44 seconds in the flames, and stated on coming out that they had experienced no particularly painful sensation except that of excessive heat. Their pulses, which were 88, 84, and 72 before, were respectively 152, 138, and 124 after. A circle of fire, about 10 metres in diameter, was now formed around them, and they withstood the effect extremely well with their fireproof coverings, although at a distance of 5 metres the bystanders could not resist the heat.*

LIGHTING MINES BY GAS.

At the Institution of Civil Engineers, the first meeting of the session 1857-8 was occupied by the reading of a paper "On Lighting Mines by Gas," by Mr. A. Wright, who stated that, for lighting mines, the present mode of employing tallow candles, or oil lamps, was found to be prejudicial to the health of the miners, whilst the light afforded was so inadequate, that the men could not perform their duty properly. It was added, that the expenditure of oil and tallow in the mines of England, might be roughly estimated at 500,000*l.* per annum. In Cornwall and Devon alone there were about 30,000 men employed underground, who were lighted at an annual expense of 90,000*l.*; and in one of the large mines the annual expenditure for candles had reached as high as 7000*l.* A general review of the state of lighting and ventilation of the Cornish mines, induced the attention of the author to the introduction of gas for superseding candles and oil lamps. An attempt had been previously made at the Treseveau mine in Gwennap, but it was abandoned. He concurred that it was preferable to make the trial upon a mine where explosive gases were not given off, as in coal-mines; and where the work was closer, and did not extend so rapidly. The Cornish mines varied in depth from 1000 to 2000 feet, with extensive lateral galleries, the approach to which was by a shaft with ladders, sometimes twisted in all directions. Each miner, in descend-

* This "invention" closely resembles "Aldini's Incombustible Dress for Firemen," described in the *Arcana of Science*, 1830, p. 25; and *Arcana*, 1831, p. 121.

ing, or in ascending, stuck his candle in a lump of clay, by which it adhered to his hat; the wind caused it to flare, and not only to waste much tallow, but to give off carbonaceous substances, which were swallowed by the men, and produced very prejudicial effects on their lungs.

The first object, then, was to light the ladders, and afterwards to extend the system to the working chambers following the lode. The mine selected for the experiment was the Balleswidden Mine; the depth of the shaft was described as being about 780 feet, whence there branched out several levels and tramways, at various depths, and in numerous directions. About 340 miners were employed underground, in two changes, or shifts, each of about eight hours' duration. Each man worked about five days during the week underground, and one day aboveground. In the ordinary mode of lighting, each miner burned four candles in eight hours, obtaining only an inadequate light for the expense incurred. The gas which was introduced to this mine was manufactured at the surface, and was forced by a pump into a heavy gas-holder, composed of cast-iron plates, whence it issued by a descending pipe into the mine, under a pressure equal to 18·7 inches of water. The shaft and levels were fitted with wrought-iron tubes, proved by high-pressure steam, and from the branches flexible tubes and burners were carried into the pitches and chambers for the miners, and to the floors for picking the ore. The tramways, also, had a sufficient number of burners to preclude the necessity for using any candles or lamps in the mine. The quantity of gas consumed was about 4000 cubic feet per day, of two shifts of miners. The comparative expense of the two systems of lighting was stated to be much in favour of gas, as the annual cost of candles was 834*l*. 3s. 4d., whereas that of gas was 487*l*. 2s., including interest on plant, wear and tear, and all expenses. If several mines combined, the economy would be still greater; and when the system became more general, modifications would, doubtless, be advantageously introduced. It was stated that the sanitary condition of the mine was visibly improved; the ventilation was better, and there was an entire absence of the sickening smoke and bad odour previously pervading the mine, which the author believed to arise from some particular compounds of hydrogen and carbon, given off during the imperfect combustion of the candles. The advantages to be derived from the introduction of gas in copper, tin, lead, and other mines, and probably ultimately to coal mines, were stated to be :—1. A saving of nearly 50 per cent. of the annual cost. 2. The better work, on account of the increased light. 3. A saving in time to the workman, in not having the candle or lamp to attend to. 4. The improvement in the ventilation, and in the quality of the air breathed by the miners. The experiment was stated to have been completely successful, and there did not appear to be any reason why the system should not be extended to mines generally, and, under certain precautionary measures, to coal-mines.

A Company is now carrying out the clever contrivance of Mr. A.

Longbottom, late of Leeds, for Lighting Mines. The apparatus can be manufactured of all sizes, from that to light a drawing-room to the illumination of a city. The gas is produced by the conversion of a resinous oil into that vapour, which is purified in the simplest possible manner to such a degree as not to soil a porcelain plate, or a sheet of paper, if placed over the flame. The apparatus itself is so simple and compact, that it may be placed in a shed or out-house, or even on the engine-boilers, where it could be easily attended by an engine-man of ordinary capacity. The cost of the article is trifling indeed, for its illuminating power is equal to twenty best Price's mould candles; the cost of the oil is but ninepence per gallon, for which, after the distillation has been effected, the company will give sixpence a gallon, they having a market for this residuum. The quantity of coal required for its manufacture is trifling.

CLAY RETORTS FOR GAS-MAKING.

A PAPER has been read to the Institution of Civil Engineers, "On the Results of the Use of Clay Retorts for Gas-making," by Mr. Jabez Church. The substitution of fire-clay for metal, in the construction of retorts, was attributed to Mr. Graftôn, and dated back as far as the year 1820. Originally they were square in transverse section, but that form was soon changed for the ⌓, or oven-shape, which had been since adhered to, both in this country and abroad; this latter form of retort admitting of a stratum of coal being distributed of an equal thickness throughout.

The comparative quantities of gas made by iron and clay retorts, of the ⌓ form, of 15 inches by 13 inches in section, and 7 feet 6 inches in length, had been found by the author to be as follows:—

The iron retorts lasting 365 days, and working off 1½ cwt. of coal for each charge, effected the carbonization of 2190 cwt. of coal, which, at 9000 cubic feet of gas per ton, gave a total quantity of 985,500 cubic feet of gas per retort; whilst the clay retorts lasted 912 days, carbonized 5472 cwt. of coal, which, at 9000 cubic feet of gas per ton, gave 2,462,000 cubic feet of gas per retort. It would thus be seen, that the clay retorts yielded a greater quantity of gas, from the same weight of coal, than the iron retorts; but the specific gravity of the gas so made was less, and its illuminating power was diminished, in consequence of the increased temperature of the clay retorts, which caused the last portion of the gas to be decomposed.

The most practical method of working clay retorts in large works was with the addition of an exhauster. This reduced the pressure on the retort, and prevented the escape of gas through the pores and fissures; and by that system the quantity made was increased about 200 cubic feet per ton of coal. In small works, the expense of an exhausting apparatus, and steam machinery to work it, would not be compensated by the gas saved.

GAS WARMING AND VENTILATING APPARATUS.

THIS double purpose is proposed to be effected in a mode which has been patented by Mr. Adolph, of St. Mary-axe, who has exhibited his apparatus in operation at Bucklersbury. The invention, as described in the *Morning Herald*, consists of a small box, on the hearth, containing the gas jets, the top covered with talc. At one end of this box there is an aperture to admit the air for supporting the combustion of the gas. Another aperture at the opposite end communicates with a tube passing in a spiral through the hot-air box, and finally out at the chimney. Through this tube the whole products of combustion pass, raising the temperature of the air surrounding it, without in the least contaminating it. The dry air as it is heated passes out into the room through two perforated plates at the top of the box, its place being supplied by cold air admitted at the lower part. There is also an aperture at the top of the apparatus which can be closed, by which the room is effectually ventilated. The whole is fitted in such a manner as to occupy the position of an ordinary stove. It is also contemplated to distribute the light from the gas-jets about the room by means of compound reflectors. An equal temperature of 60 deg. Fahrenheit may thus, it is said, be maintained in a large room at the cost of about ½d. per hour.

LIVERPOOL TOWN-HALL CLOCK.

A GREAT improvement has been effected in this Clock, by connecting it electrically with the Observatory and with the office of the Magnetic Telegraph Company. Branch wires from those previously laid between these stations have been passed up to the turret of the Town-hall, and a current of electricity is, through them, applied to control the movement of the pendulum, which is so effectually done as to preserve the indications of the clock in constantly exact accordance with Greenwich mean time. The dial which ornaments the window of the Magnetic Telegraph Company's office, in Exchange-buildings, is also in electrical connexion with the timekeeper of the Observatory, and now forms the most convenient standard by which, at any hour of the day, the chronometers of the port may be regulated with exactitude. It is really marvellous, when standing before this dial, to observe the undeviating accuracy with which, in the latter half of the sixtieth second, as indicated by it, the sound of the large bell of the Town-hall Clock breaks upon the ear. The public are much indebted to the Magnetic Telegraph Company, whose wires are the medium by which the electrical current is conveyed, for the assistance which, by their permission, the officers of the Company, Messrs. Bright and Moseley, have so zealously afforded. Mr. Hartnup, the director of the Observatory, has also been indefatigable in his exertions to give practical effect to this new application of electricity. Mr. Jones, of the Chester Railway Station, is the inventor of the method which has been adopted for the above object. The method is peculiar in this, that the electricity is applied, not as the moving power, nor in substitution of any portion of the works of the clock, but merely as a corrector of the errors to which its performance is ordinarily liable. One great advantage incidental to Mr. Jones's invention is the fact that, in case any accident should happen to the battery or the wires which produce and convey the current, the clock will continue to perform its ordinary duty just as if the current had not been applied.

LOCKS AND KEYS.

Mr. Chubb has addressed to the Editor of the *Builder* the following sensible letter :—

I shall not enter into the question as to whether a certain lock or locks may or may not be scientifically picked. I have no intention of attacking the inventions of other manufacturers, my sole object being to uphold the reputation of my own. The question, so far as my locks are concerned, is this: are they not proved by practical use to answer the purpose for which they are intended—viz., to keep property safe from thieves and housebreakers? I am content to let their reputation rest upon this test. Notwithstanding the controversies, lectures, and illustrated hand-books on the subject of lock-picking, equally accessible to thieves and honest men, the result has been that public confidence in the security of Chubb's locks has increased instead of diminished. Some people, it is true, expect perfect impossibilities, and imagine that having obtained a secure lock they have done all that is necessary. This is a great mistake. No lock whatever will guard against culpable negligence with regard to its key; or, as in the late South-Eastern bullion robbery, the treachery of supposed trustworthy servants.*

Since 1851, I have made and adopted many improvements in my locks, and more still have been tried and rejected, as interfering with their proper working. Complexity of action in any lock will, sooner or later, invariably prove fatal to its success. A lock is not like a watch, or other delicate machine, that is treated with a considerable amount of carefulness. It is subject to every-day hard wear and rough usage; and it has been, as it always will be, my endeavour not to overlook these facts in making whatever may from time to time appear to be desirable alterations or additions. Absolute perfection is perhaps as unattainable in locks as in other matters; nevertheless, the present is an age of progress. Lock patents by scores have appeared within the last seven years; some good, others indifferent or bad in principle, and many of them embracing as new ideas certain principles of construction long since exploded or laid aside. Of those practically defunct (and they are many), my opinion is, that the ingenuity of their inventors has generally been allowed to overrun their perception of the before-mentioned fact—viz., that a lock is a very hard-worked machine, and that in its construction *simplicity* is as necessary an element as *sec*

DENISON'S NEW LOCK.

Mr. E. B. Denison, in a lecture on Locks, lately delivered by him at Doncaster, described a New Lock invented by himself, and of which he exhibited a specimen, manufactured by Mr. Chubb. In this lock, said the lecturer, the tumblers act without springs, being pushed one way by the handle which shoots the bolt, and the other way by the key. The key is not used for locking, so that the owner of a door with this lock may leave any person to lock it for him without entrusting him with the key. The tumblers have thin plates lying between them, and the friction, which is an impediment to the action of most locks, and sometimes makes them stick fast alto-

* It will be remembered that the notorious lock-picker Agar said the robbery would be impossible unless copies of the keys could be taken. By the connivance of Tester this was accomplished, and yet the duplicate keys thus made were useless until Agar had travelled seven or eight times to Folkestone with the chests, altering the keys until they fitted.

gether when the lock gets dirty, is an assistance to this, and no high finish of the working parts is required. The key not having to move, the bolt may be very thin; the key of the large lock exhibited weighs just a quarter of an ounce. It pushes in a spring curtain, which closes the keyhole completely when the key is out; and when it is pushed in ever so little, it prevents the bolts from being pressed against the tumblers, there being a square plug behind the curtain, which goes through a notch in the edge of the bolt, except when the curtain is up against the keyhole. You must, therefore, not only turn the key about half round, but take it out again, before you can turn the handle and open the lock, and it cannot be opened while any instrument whatever remains in the key-hole. Mr. Denison added, that he did not know that the lock described was manufactured by anybody; he believed not, although it was not patented, and although it was stated on the authority of Mr. Hobbs, in his Treatise on Locks, to be secure against any known mode of picking.

PARNELL'S PATENT UNIVERSAL LOCK.

THE year 1851 was a grand turning point in lock construction; so much so, indeed, was this the case, that all locks invented previous to that year have been regarded as old locks, and only those since invented as the new order of locks. Of these latter, however, there are not many.

One of these very locks (patented February, 1856,) has been selected by the authorities acting on behalf of the Board of Trade Department of Science and Art, as the most suitable for the new Museum at Brompton. The patentee is Mr. Parnell. The lock selected is named the "Universal Lock," the patentee having aimed at such simplicity in construction and lowness of price, combined with new and effective modes of security, as would entitle it to be regarded as a lock for general and not for mere special uses. Mr. Parnell is known to have been in the van of those inventors who endeavoured to give that security which the controversy of 1851 so clearly proved to be desirable and necessary. The new lock just selected by the Board of Trade does seem to be capable of fulfilling its purposes so as to obviate all idea of insecurity.—*Builder*, No. 765.

INSTRUMENT FOR CUTTING HOLES IN IRON SAFES.—CHUBB'S PATENT PREVENTIVE.

DURING some months in the past year, several ordinary iron safes were opened by thieves in London and Manchester, by means of a perfect instrument which cuts a large hole through the iron door, and this enables the "cracksman" to destroy the works of the lock, and so open the door. The construction of this instrument, and even its *modus operandi*, was unknown till one of the instruments, with all its tools and apparatus, was captured by the metropolitan police; and a more powerful, well-made, and compact instrument has seldom been seen. Mr. Chubb, the inventor of fire-proof safes, &c., was allowed to experiment with the instrument, and he has provided means to baffle and destroy its operation. This he has done most effectually, and has secured his improvement by patent. We have had an opportunity of examining the burglar's instrument, which, of course, we shall not describe. Suffice it, that it readily and noiselessly, though with great power, cuts a hole two inches in diameter through the thickest door of any iron safe. We have also seen the result of an attempt with the same cutter to bore through a door protected by Mr. Chubb's improvement. It only took a mere skin off the surface of the door, in doing which the cutter itself was utterly destroyed.

CONTRIVANCE FOR THE DETECTION OF BURGLARY.

THIS invention, patented by Mr. Turner, of Wolverhampton, and of City-road, London, is so constructed that it can be readily affixed to any house or set of offices. It is also adapted to gardens and pleasure-grounds, iron safes to contain valuable property, wine-cellars, plate-closets, jewellery-rooms, &c. Its appearance is similar to a clock face, or the dial of an electric telegraph; and it is so contrived that no door, window, or gate to which it is applied, can possibly be opened without an immediate alarm being given by the ringing of a bell; at the same time a match is struck which lights a candle, thus enabling the inmates, by the face of the indicator, to know what particular apartment has been entered, and also indicate the progress of the unlawful visitor through the premises. A general alarm may be given by it to the inmates by the watchman, or person in whose room the dial is placed (unknown to the depredator), thus enabling them to prepare for his capture. The apparatus forms an ornament to the room, requires but little space, and after fitting is very inexpensive.

MAPPIN'S IMPROVED PANEL.

MR. W. S. MAPPIN, of Birmingham, has recently patented an improved panel, designed to resist the action of burglars' tools, or to give strength wherever it may be desirable. The panel is made of pulp or other suitable material, and has embedded in it a layer of thin hard steel, capable of resisting the action of ordinary cutting tools. In making a full size panel, the steel is not in one piece the size of the panel, but a series of strips, 1½ inch broad, is inserted at intervals, leaving a space of three quarters of an inch between the adjacent strips. The following are a few advantages the improved panel has over the ordinary wood panels—viz., a perfect resistance to sharp instruments used by burglars for cutting holes through doors, &c.; it will never shrink or twist, and is well adapted for round or other curved panels, as they will never split. The price at which they can be manufactured is much less than that of ordinary wood panels with iron plates screwed on. The material of the panel can be worked in every respect as pine or other wood.—*Mechanics' Magazine*, No. 1755.

NEW AMERICAN HORSE-SHOE.

A PATENT has been granted to a mechanic of Philadelphia for an improvement in the method of fastening Horse-shoes. The invention consists in the construction of flanges or lips rising from the front and sides of the hoof, against which they are made to bear separately; they are fastened by sliding into a recess in the side of the shoe, and secured by means of a screw, thus entirely dispensing with the use of nails, and avoiding any liability to injury by pricking.

PRIEST AND WOOLNOUGH'S PATENT HORSE HOES.

MESSRS. PRIEST and WOOLNOUGH, of the Iron Works, Kingston-on-Thames, have improved the construction of Horse Hoes made with hoes or cutting parts affixed to stalks and levers rising and falling independently of each other, by arranging the bar which carries the hoe lever, so that its distance from the land can be adjusted while the hoe is travelling; first, to set the hoes in a more or less oblique position, as the hardness of the ground or nature of the work may render necessary; and, secondly, to admit of either one or both ends of the bar being raised or depressed at pleasure, so that sloping ground or side hills may be hoed with equal precision in depth as flat. For this purpose the axes or standards, to which the ends of the bar are attached, are made capable of being moved up or down in the frame at either end, by suitable lifting apparatus. For details, see *Mechanics' Magazine*, No. 1757.

PATENT WELDED-COLLAR IRON HURDLES.

AT the St. Pancras Works, Old St. Pancras, some novel machinery has been designed for the more rapid manufacture of Iron Hurdles. The increased and increasing demand for iron hurdles, principally induced by the introduction of open-farming of late years, and the economy of such barriers both as permanent and moveable fences, appears to have induced the managers of these works to obviate all the existing objections to their use, and to produce them improved, at a price that should at once permit of their taking the place of the ordinary hurdles. The improvements consist in a simple but effectual mode of giving the greatest possible strength and rigidity to the whole of the horizontal bars and perpendicular supports. This is effected by welding on to the bars a circular nut or collar, which, fitting with exactness on the one side or the other of the three upright supports, compensates for any strain which may be applied to any portion of the hurdle. In other words, the rods having these collars welded thereon at exact distances, are threaded alternately, and thus not only confine the two outside uprights in fixed immovable positions, but also render the centre upright—hitherto only a mere rest for the horizontal bars—not only a firm and rigid support, but an effective stay against the bending of the bars themselves under the weight of persons who may use them as stiles. These are obvious and valuable advantages, inasmuch as it is well known that even the ordinary iron hurdle will last a very long time, although it rapidly loses all its shape and fair proportions, while the

Patent Welded-collar Hurdles will keep symmetrical for very many years, and in excellent condition, if, once in three years or so, a coat of tar be applied to them. There is another advantage which this perfect rigidity affords; the junction of each hurdle with its fellow is most complete, and those gaps in the shape of acute angles, so often seen, despite the application of cords or wire ties, cannot be present to the eye of the landowner, to whom order and fitness are objects of desire.

The machinery used to turn out these patent hurdles is worthy of especial remark. It may be stated in brief, that the principles involved are the division of labour and an unerring exactness in all the several parts. It has been found, likewise, that the employment of the very best iron is an element of gain in the manufacture of these hurdles, as, by its means, a saving of labour more than equal to any pecuniary advantage that would accrue from the use of an inferior metal results. We were informed that the increased demand for these hurdles had necessitated the erection of other premises, and that a plot of ground in Maiden-lane, Battle-bridge, would shortly be thus employed.—*Mechanics' Magazine*, No. 1766.

TIMBER-BORING MACHINERY.

At the Royal Scottish Society of Arts, Mr. Donald Rose, of Helmsdale, has exhibited a Machine for Boring Timber. He proposes to fix the auger to the end of a guide screw bar, working in a female screw, so as to force the auger into the wood to be bored. The screw bar forms the axle, on which there is a flywheel of 5 feet diameter, worked by two men; and the carpenter sets the machine to the proper place so as to bore in the proper direction. For smaller work he proposes a smaller wheel, to be driven by the flywheel, the auger or bit being fixed to the end of the screw bar, which is on the axle of the smaller wheel. He estimates that two labourers and one carpenter will thereby be able to do the work of fifty carpenters. After the description had been read, Mr. Sang made some remarks tending to show that more time would be lost in the application and adjustment of such a machine to the boring of tree-nail holes in ships than in boring by the usual method, and that such a machine would require to be stationary, and the work brought to it, in place of it being moved to the work. He gave, as an instance, Mr. Fairbairn's riveting machine, a most useful one; but then the boiler to be riveted was swung in such a manner as that any part to be riveted could be brought exactly opposite to the riveting machine. This could not be done with a ship on the stocks.

NEW SEWING MACHINE.

W. C. Watson, of New York, has patented a new Sewing Machine, which is a reversion of the ordinary one. In this, the needle is perfectly stationary, while the table or platform has an up and down motion; thus the work is performed, and the feed motion, shuttle or loop-maker, and other parts, instead of being operated by cams, are moved by striking against fixed parts. The machine is rendered simple in its construction, and there being less mechanism than in the ordinary sewing-machine, this improved one is less likely to get out of repair.—*Scientific American*.

AN IMPROVED SLIDE RULE.

MR. CHARLES HOARE has arranged an Improved Slide Rule, and published a small book of instructions for using the same. We learn from the latter that the author's object in attempting a total revision of the sliding rule has been "to render its operations so connected and apparent, and the estimation of the results obtained so easy and certain, that the difficulties hitherto experienced in the use of this invaluable instrument, and the objections reasonably urged against its practical utility without a thorough re-arrangement, may be for ever removed. Stimulated by the conviction that great benefit would accrue from its general introduction as a frequent substitute for (and a sure guide and check upon) the laborious processes of arithmetical calculation, his undivided attention has for many months been devoted to its improvement." This could only be effected, he states, by entirely re-modelling the instrument.

The advantages of the new Rule appear, from a statement published by the Institution of Civil Engineers, to consist in a thorough revision of the Constants or Gauge Points, which were very clearly and neatly tabulated; in the systematical arrangement of a large amount of useful data for reference; a cleverly adapted Decimal Reducing Scale with a Vernier Reader, by which the equivalent to any given fraction, or the value of any decimal in money, weight, or measure, could be found on inspection; concise formulæ were also engraved below the several tables, giving examples of their application, thus preventing the necessity for trusting to or taxing the memory. The whole design bore evidence of care and excellence, fairly supporting its pretensions to novelty and utility as a Pocket Calculator, adapted to the use of the civil and mechanical engineer, the architect, the builder, the naval and military officer, the schoolmaster, and the artisan.—*Mechanics' Magazine*, No. 1768.

HANCOCK'S PATENT INKSTAND.

A GOOD inkstand is an important consideration in an age of ready writers like the present; and Hancock's Pneumatic Safety Inkstand is really an excellent combination of simplicity with convenience. The ink rises in the cup at the touch of the pen, and retires again immediately, and being thus exposed only momentarily to the air, it keeps its colour, and does not evaporate; dust does not readily reach it, and it comes always pure and without sediment into the pen. The inkstand requires no stopper, or rather it is its own stopper; even if overturned it is equally so, for none of the ink escapes. This is, of course, not its least recommendation.

INDIA-RUBBER INKSTAND.

MESSRS. COOK and MERRITT, of New York, have invented an

India-rubber Inkstand, of a simple and useful form. The receptacle for the ink is made entirely of rubber, having a glass funnel inserted in the top, into which the pen is dipped. By giving a gentle pressure to the ink receptacle, and removing it *quickly*, a fresh supply is brought into the funnel; and by the same pressure, and that removed *gradually*, the ink flows back into the inkstand. It is a most ingenious contrivance.—*Scientific American.*

A WRITING MACHINE.

AN ingenious piece of mechanism, designed to enable a person to write while travelling by rail, in a crowd, or in a place where ordinary apparatus cannot be used, has been invented by Mr. Benjamin Livermore, of Hartland, Vt. The paper on which the writing, or rather printing—for it resembles the telegraphic system of printing—is impressed, is coiled round two cylinders, which revolve as the lines are completed, and the letters are worked by a set of keys. No ink is required, the letters being coloured by a prepared blue paper, against which the writing paper is pressed by each movement of the keys. The machine works with great accuracy and much facility, and is very compact, not exceeding four inches in length, by about two and a half in width. It can be easily carried in a side pocket, and can be used without taking it from the pocket. By it a blind person might be taught to write.—*Boston Journal.*

PARCHMENT PAPER.

THE Rev. J. Barlow has read to the Royal Institution a paper "On some Modifications of Woody Fibre and their Applications."

The principal subject of Mr. Barlow's discourse being the *Parchment Paper* invented and patented by Mr. W. E. Gaine, C.E., and about to be introduced into commerce by Messrs. Thomas De la Rue and Co., he confined his remarks principally to the physical and chemical properties of vegetable fibre when converted into paper. Having reminded the audience that, in all cases, a change in chemical constitution accompanied the change in physical properties, Mr. Barlow contrasted with the pyroxylized textures of Kuhlmann and the gun paper of Pelouse, the woven fabrics subjected to Mercer's process, and the *parchment paper*, the invention of Mr. Gaine. By acting on cloth with chloride of zinc, tin, or calcium, with sulphuric and arsenic acid, and especially by the caustic alkalis in the cold (the temperature sometimes being lowered to 10° Fahr.), Mr. Mercer has obtained many important effects on the fineness and general appearance of cloth, and its susceptibility of dye. This subject was brought before the Royal Institution by Dr. Lyon Playfair, C.B.,* and it has since been closely investigated by Dr. Gladstone.† Mr. Mercer also experimented on the effect of acids on paper. It being known that sulphuric acid, under certain conditions,

* *Proceedings of the Royal Institution*, vol. i., p. 134. (1852.)
† *Journal of the Chemical Society*, vol v., p. 17. (1853.)

modified vegetable fibre, Mr. Gaine instituted a course of experiments to ascertain the exact strength of acid which would produce that effect on paper which he sought, as well as the time during which the paper should be subjected to its action. He succeeded in discovering, that when paper is exposed to a mixture of two parts of concentrated sulphuric acid (*s. g.* 1·854, or thereabout) with one part of water, for no longer time than is taken up in drawing it through the acid, it is immediately converted into a strong, tough, skin-like material. All traces of the sulphuric acid must be instantly removed by careful washing in water. If the strength of the acid much exceeds, or falls short of these limits, the paper is either charred, or else converted into dextrine. The same conversion into dextrine also ensues, if the paper be allowed to remain for many minutes in the sulphuric acid after the change in its texture has been effected. In a little more than a second of time, a piece of porous and feeble unsized paper is thus converted into *parchment paper*, a substance so strong, that a ring seven-eighths of an inch in width, and weighing no more than 23 grains, sustained 92 lbs.; a strip of parchment of the same dimensions supporting about 56 lbs. Though, like animal parchment, it absorbs water, water does not percolate through it.

The strength of this new substance, before alluded to, and its indestructibility by water, indicate many uses to which it may be applied. It will, probably, replace, to some extent, vellum in bookbinding; it will furnish material for legal documents, such as policies of insurance, scrip certificates, &c; it will take the place of ordinary paper in school-books, and other books exposed to constant wear. Paper, after having been printed either from the surface or in intaglio, is still capable of conversion, by Mr. Gaine's method; no part of the printed matter being obliterated by the process. *Parchment paper* also promises to be of value for photographic purposes, and also for artistic uses, in consequence of the manner in which it bears both oil and water-colour.

CHADWICK AND FROST'S NEW PISTON WATER METER.

A PAPER has been read to the Manchester Institution of Mechanical Engineers, by Mr. Fothergill, "On recent Improvements in Water Meters." The nearest approach to practical efficiency amongst the meters formed with flexible material, was Chadwick's Rotary Meter; but although it registered correctly, it had not been found satisfactory in regard to durability. Several by other makers were liable to objection of unequal extension of the flexible material. Amongst the piston meters were Kennedy's, Worthington's, Jopling's, and Chadwick and Frost's. In Kennedy's meter, the racked piston rod, and the use of Woodcock's patent rolling packing, were the distinguishing features. This meter was the best which had hitherto been brought into use; but there was some liability to stoppage, by the sticking of the tumbling-lever, when the valve was only partially closed, the water being then allowed to pass unregistered. There was also necessity for lubrication and packing, involving inspection. In Chadwick and Frost's piston meter, the latest and most important improvements had been effected, and the difficulties connected with previous attempts appeared to have been satisfactorily solved by the invention or application of a compound fluid motive valve, actuated by the pressure of water, but not concerned in the measurement. The meter, consisting of a cylinder and piston, with Woodcock's rolling packing and other arrangements, was explained by the aid of diagrams. It was comparatively small in size, required no lubrication, had no tumbling weights, worked smoothly, allowed no leakage, and from an examination which he had made, he found it to register with a nearer approach to absolute correctness than any other. There was one at work in the adjoining room, and a larger one constructed to measure eight thousand gallons per hour was placed in the Water Works' Yard, Town Hall, Salford. Mr. Fothergill then remarked that he believed this to be the best meter at present produced.

Mr. Chadwick remarked that it had only been patented a few months, and was brought forward earlier than was intended. After giving seven years' attention to the subject of water meters, he was acquainted with the difficulties, and knew that a large amount of durability was requisite in every part. There was a great want of a perfect meter, and he thought this one would prove to be free from some of the defects which had been referred to, and to be economical in construction.—*Mechanics' Magazine*, No. 1760.

NEW PROCESS OF COPYING.

A PAPER has been read to the Society of Arts, "On the History and Chemistry of Writing, Printing, and Copying Letters, and a New Plan of taking Copies of Written and Printed Documents, Maps, and Charts," by Mr. John Underwood. After referring to the various inks used in ancient times, and their particular effects, and expressing his belief that carbonaceous inks were not so much used as had been generally supposed, Mr. Underwood said that the desired permanence could best be secured in the description of paper used in the present day by preparing it chemically previously. He then proceeded to describe a process which he had invented for that purpose. The process consists in soaking each sheet in a solution of the neutral chromate of potash, and then slightly glazing it by rolling. The ink is made with galls, iron, and logwood. The multiplication of copies, he said, might be effected by using paper prepared in a similar manner, and writing with ink consisting of a solution of logwood, varying its strength according to the number of copies required. An Indian ink had been prepared, by means of which copies of maps could be taken. The author concluded by some remarks upon the composition of various kinds of printing ink, stating that he had succeeded in producing one capable of being copied in the same manner as that employed for writing, so that a document, partly written and partly printed, could be copied at one operation.

NATURE-PRINTING.

MR. C. DRESSER has read to the Society of Arts a paper "On the New System of Nature-Printing." He considers the great objection to the old processes to be the necessity for first drying the plant, and he proposes another, of which the following is an outline:—The botanical specimen is dabbed with lithographic ink, and an impression of it taken upon stone, which may afterwards be printed from by the usual process. Similarly an impression may be obtained upon metal by employing a peculiar composition instead of lithographic ink, and afterwards etching the plate, which may be printed from like a wood engraving. By a modification of the process, a copper-plate with engraving concave may be obtained. The author is of opinion that these processes offer considerable advantages, rendering it possible to use living specimens rather than dried ones, so as to secure the true texture of the leaf. It is also possible to produce impressions even of such delicate things as the cells of plants.

ON DISINFECTANTS.

A PAPER has been read at the Society of Arts, *On Disinfectants*, by Dr. R. Angus Smith, of Manchester. The author began by giving some account of the precautions taken in reference to this subject in ancient times. Having expressed it as his opinion that much of the knowledge possessed by the ancients on these subjects has been lost, Dr. Smith proceeded to discuss some of the various changes which take place in bodies, particularly fermentation and putrefaction, and, after touching upon many substances which had been used as disinfectants, he gave the results of some experiments made by Mr. M'Dougal and himself in reference to this subject. They found that of all bases magnesia was the best to use for the disinfection of manures, as the only one which gave an insoluble ammoniacal salt, and preserved the ammonia at the same time, whilst it was an agent also employed regularly by nature in the economy of vegetation;—that of all acids sulphurous acid was the best, and its power was at least equal to chlorine, but it had not the quality which chlorine possesses, of decomposing ammonia; whilst, when it had done its work, it was either converted into a harmless solid, as sulphur, or, by combining with an alkali in the soil, became a sulphite, another agent used by nature. They combined the base and the acid, and found that by this means disinfection was nearly completed by the use of only a small portion of material. They had tried the carbolic acid from coal tar, a homologue of creosote, but had not been able to produce good results by it alone. When the sulphite acted there was still a small remaining smell, which the carbolic acid removed: they, therefore, added to the sulphite about 5 per cent. of carbolic acid, and so produced their disinfecting powder. Dr. Smith then gave some account of the successful use of this powder, particularly in the town of Leek, which had recently been attacked by an epidemic, and when the disinfectant was applied to the principal sewers and cesspools, the disease was found gradually to abate. A discussion ensued, in which Mr. P. H. Holland, Dr. Milroy, Messrs. Dugald Campbell, Robert Rawlinson, and the chairman took part.

A NEW CEMENT.

PROFESSOR EDMUND DAVY has read a paper to the Royal Dublin Society, on a Cement which he obtains by melting together in an iron vessel two parts by weight of common pitch with one part of gutta percha. It forms a homogeneous fluid, which is more manageable for many useful purposes than gutta percha alone, and which, after being poured into cold water, may be easily wiped dry and kept for use. "My first trials with this cement," says the Professor, "put it to a very severe test. I used it as a substitute for plumbers' solder in repairing the lead gutters on the roof of my house, which were cracking in several places, and admitted water freely; and also to staunch the leaks of an old common and forcing-pump, attached for yielding a supply of water for the use of two houses, and raising it about thirty feet. For these purposes I found it quite effectual. And all that was necessary in the case of the gutters was to remove with a brush all loose earthy matters from the cracked lead, slightly warm it with a hot iron, then pour the cement in a fluid state on the cracks, so as to cover them on both sides." The pump was repaired with equal success, the leaks being wiped dry; and the Professor continues: "I entertain no apprehension that the warmth of our climate at any time will impair the efficacy of this cement, when applied to repair lead, zinc, or iron gutters; for though it softens at a comparatively low temperature, it still adheres most tenaciously to metals and other substances, and does not allow water to pass through it." Vessels of any kind may be similarly patched or repaired, and be ready for use in a few hours afterwards; and wet metallic surfaces may be joined as well as dry ones, if they are warm. And further, to quote again from the paper, the cement "adheres with the greatest tenacity to wood, stones, glass, porcelain, ivory, leather, parchment, paper, hair, feathers, silk, woollen, cotton, linen fabrics, &c. It is well adapted for glazing windows, and as a cement for aquariums. As far as my experience has yet extended," adds Professor Davy, "the cement does not appear to affect water, and will apparently be found applicable for coating metal tanks; to secure the joints of stone-tanks; to make a glue for joining wood, which will not be affected by damp; to prevent the depredation of insects on wood. The heavy oak beams and rafters in the roof of the house of the Royal Dublin Society are attacked to a considerable extent by insects—as the weevil, &c. As this cement is soluble in volatile oils, an application of the cement in turpentine or naphtha might be beneficial, and arrest the ravages of the insects. It may be highly deserving of inquiry whether the cement may not be applied to preserve surfaces of metal and wood exposed to the atmosphere, and to fresh water; also to protect anchors, chain-cables, &c., from the corroding agencies of sea-water." We doubt not that due advantage will be taken of Professor Davy's experiments and suggestions.

ARTIFICIAL GRANITE.

MR. JOHN BAKER, of Thirsk, has patented, on behalf of a Canadian relative of his (Mr. J. H. Headley, of Walpole), a plan for plating or veneering a mass of coarse stone so as to present an exterior coat of marble. For the substratum, sand, gravel, or almost any kind of pulverable, mainly siliceous, rock may be employed. After the particles of this have been reduced to the requisite degree of tenacity, the mass is mixed with a quantity of protoxide of calcium, varying in proportion according to the mineralogical and chemical nature of the basis. When the ingredients of the composition have become amalgamated, the mass is moistened, then placed in a mould to be coated with carbonate of lime, and afterwards subjected to powerful hydraulic pressure. After a variety of ingenious experiments, Mr. Headley has attained great success in imitating the qualities and varieties of different kinds of marble. He employs oxide of iron largely as a colouring material, and finds that by silicate of potash extra hardness is given to the block, which renders it susceptible of a high degree of polish. The material has been extensively used in Canada for the last two years, and has realized everything anticipated. The patent right has been sold in eight counties for 12,000*l*. Messrs. Peto and Brassey have paid 4000*l*. for a licence to use it in the construction of the bridges of the Grand Trunk Railway. Hydraulic pressure is used to the extent of 1000 lbs. to the square inch, and 30,000 blocks are turned out of a machine on the rotatory principle daily, and are ready for building, thus saving the squaring of stone or the burning of brick, and making a much more handsome structure, and at a lower cost.—*Correspondent of the Leeds Mercury.*

ARTIFICIAL MARBLE.

MR. FELIX ABATE, of Naples, communicated to the French Academy of Sciences, at its last meeting, a New System of Moulding, which gives to plaster the hardness and durability of marble. He places the plaster in a drum turning horizontally on its axis, and admits steam from a steam-boiler; by this means the plaster is made to absorb, in a short space of time, the desired quantity of moisture, which can be regulated with the greatest precision. With plaster thus prepared, and which always preserves its pulverulent state, he fills suitable moulds, and submits the whole for a short time to the action of an hydraulic press. When taken out of the moulds, the articles are ready for use. This process is simple and economical, the cost of the manufacture very little exceeding that of the material. The plaster thus prepared is perfectly hard and compact, taking the polish of marble. The most delicate bas-reliefs and highly-finished medals may be produced from it, with the same perfection as they have in the original. An experience of three years has shown that productions obtained by this process resist the most unfavourable atmospheric influences; it can therefore be employed as well for works in the open air as for the interior of buildings. Mr. Abate proposes to substitute this substance for all ornamental purposes where marble or stone has been hitherto employed; and from calculations which he has made, he is of opinion that it will cost but a fifth or sixth of the price of cut stone of the first quality.

EMERY PAPER.

THE *Moniteur Industriel* mentions an ingenious method of obtaining fine Emery Paper for polishing metals. Slips of paper, coated with fresh starch size, are hung on ropes at different altitudes in a small room, which is afterwards carefully closed. A quantity of fine emery is then blown in by means of a ventilator through an aperture left for the purpose, by which means a dense cloud of emery dust fills the room, but only the finest particles rise in the air to a sufficient height for them to be deposited on the upper slips; those of the second row receive a somewhat coarser sort, and so on; while such particles as are too heavy, and therefore too coarse for delicate polish, fall to the ground at once. Thus, emery paper of different degrees of fineness may be obtained by a single operation, and sorted with mathematical certainty.

NEW ZEALAND FLAX.

FROM experiments which have been made recently, it has been clearly established that the New Zealand Flax, when properly prepared, is equal in strength to the best qualities of Russian or Italian hemp, and would successfully compete in the manufacture of cordage with that material. At some trials made in one of her Majesty's dockyards, by order of the Board of Admiralty, it was found that cordage made from the New Zealand flax bore a much greater strain than some of a similar size made from the hemp usually employed. In this case, as in the finer descriptions of manufacture, the great difficulty to be overcome is the removal, at a moderate cost, of the large quantity of resinous matter, which, in spite of the ineffectual mechanical or chemical means hitherto employed, serves to increase the bulk while it adds nothing to the strength of the rope. There are no grounds for supposing that the mechanical genius or mechanical science of this country will be unable to do upon a commercial scale for the *phormium tenax*, what the nail and the shell and a few hours' steeping in cold water once accomplished for the few domestic wants of the native tribes of New Zealand.—*Australian and New Zealand Gazette.*

LOZENGE-MAKING MACHINERY.

MR. D. LESSER has patented certain improvements in Machinery or Apparatus for making Lozenges or other similar articles. An upper and lower set of rollers compress the lozenge paste to a proper thickness for the die, and a box or sieve scatters finely-powdered sugar upon the upper surface of the sheet of paste as it goes through the rollers. That the under surface may also be powdered, the lower rollers revolve in boxes of pulverized sugar. When the paste has become thinned, it is propelled over a bed containing dies;

punches now descend, cut out the lozenge, and press it into the lower die, impressing a design upon both surfaces of the lozenge. These punches then rise from the dies, leaving the lozenges in them; the bed then moves, and plungers force out the lozenges on to a traversing cloth for drying.

NEW PROCESS OF MAKING BREAD.

A NEW process of Bread-making has been patented by Dr. Dauglish, and tested at the large establishment of Messrs. Carr and Co., in Carlisle. The process of fermenting bread has ever been one of the greatest difficulties which the baker has had to contend with: the change of material, or the slightest change of temperature, has often spoiled a good baking; and fermentation has always been attended with uncertainty. To remedy this, chemicals injurious to health have been frequently used, to make the bread rise, or impart to it a good colour. But this is by no means the least evil attending the process. Fermentation is almost synonymous with decay: it is produced by the action of the barm, or yeast, upon the particles of starch in the flour, thus liberating minute bubbles of carbonic acid gas which permeate the entire mass of the dough, and make it "rise." The chemical change, however, which here takes place is such that it has been estimated by M. Dumas that in France 17½ per cent., and in England 8½ to 12 per cent., is wasted by the decomposition which takes place in the process of fermentation. The fermentation of bread is similar to the fermentation of beer and wine, the difference being, that whereas, in the latter process, the deleterious material of the yeast sinks to the bottom of the cask when the liquor clears, the noxious matters cannot sink in the dough, but must remain incorporated with the bread. In the new process patented by Dr. Dauglish no yeast or baking-powder is used, the rising of the dough being effected by water impregnated with carbonic acid gas. The idea of making bread with aërated water is not a new one: a patent was taken out for such a process some years ago, but it was then found that when the flour was mixed with the impregnated water the gas escaped before the bread had time to rise.

The novelty of Dr. Dauglish's patent consists in preventing the escape of the gas from the water, by subjecting the materials to an outward pressure of carbonic acid gas while the flour is being mixed with carbonated water. The carbonic acid gas is generated in such apparatus as is usually employed by soda-water manufacturers; the gas is pumped into a large reservoir, from which it is forced, as it is required, into a vessel containing water—the absorbing power of water for carbonic acid being very great. The kneading machine is a strong iron retort, fitted with air-tight lids, and provided with revolving prongs in the inside for mixing the dough. In the machine now in operation this retort is capable of containing 40 stones of flour. Into this are put 20 stones of flour with the requisite amount of salt. A stream of carbonic acid gas is forced into the retort, and a sufficient quantity of carbonated water is admitted and well mixed with the flour and salt; the gas with which the water is impregnated being prevented from escaping by the pressure of the ambient carbonic acid gas. As soon as the flour and water are mixed, a pipe is opened, and the loose gas is let out. The consequence of the pressure being taken away from the service of the paste is, that the gas which was held in solution by the water, operates in precisely the same manner as the gas in a bottle of soda-water when the cork is removed, the dough rises and fills the retort, occupying twice as much space as before. The bread is then ready for being worked into loaves—the only operation that will necessitate handling. The rising can be regulated by the pressure of gas; so that, did the strength of the machinery permit, the bread might be made of almost any lightness. The pressure of the gas, and the quantity of water admitted, are of course regulated by gauges.

We may summarize the advantages which the new process is calculated to possess over the present system of bread-making. 1. The bread will be free from every impurity, for the only materials used in its manufacture will be flour, water, and salt. After the revelations of the *Lancet*, all will rejoice if by any means bread can be had absolutely pure. 2. The same weight of material that is put into the kneading-machine will come out, for there will be no loss by fermentation, and thus there will be considerably more bread made out of a sack of flour than at present. 3. There will be a great saving of time. Bread-setting now occupies 8 to 10 hours; by the new process it will occupy as many minutes. 4. The cost of the gas will, it is expected, be considerably less than the average price of yeast in different parts of the kingdom. Finally, it is stated that should the whole of the bread in the kingdom be thus made, a saving would be effected of an amount equal to our entire importations of foreign wheat.

AMERICAN BREAD-KNEADING MACHINE.

Mr. Berdan, of New York, has built a machine, and placed it on trial at an ordinary French bakery in that city, and the quality of the bread it produces is not excelled by the most careful hand work. The defects of machinery applied to this operation have been chopping up the dough, or working it short and heating it so as to kill the flour, instead of preserving a certain continuity of the mass in combination with a thorough mixing process, incorporating the air perfectly—effects which are produced by the violent action of the hands and arms of the workmen in punching, squeezing, drawing out and doubling up the dough. Mr. Berdan imitates the manual operation of kneading dough, and has succeeded in producing the same effects. The machine will knead a batch of ten barrels of flour every half hour, and is worked by a light application of steam-power in connexion with the machinery of the automatic oven. This is a stationary cylinder of wood, open on the top, ten feet long by six feet in diameter, in which is a horizontal shaft, so secured that the inside heads of the cylinder revolve with it; and on these heads, extending across near the periphery, are iron bars, varying in form, which mix and thoroughly incorporate the flour and water as they revolve. This kneading is the first in order after the sponge is raised, and is performed by the rotation of the cylinder in a few minutes. Another operation is executed by an additional cross-bar, which is moveable, and is inserted at the right time; it swings on hinges in an eccentric manner, and plunges into the dough at the bottom of the cylinder, cuts off and raises up a portion of the dough till it passes over a certain point, spreading and drawing it out in the act, and then throwing or flapping it down with force so as to inclose the air and imitate the same motion and result accomplished by the workman with his hands and arms. This movement is continued until the dough is perfectly kneaded, when it is taken out by a trap-door, and the machine is ready to receive another batch.

GERMAN YEAST.

MR. HENNEL has patented the manufacture of German Yeast from Flour. To obtain 10 lbs. of this German Yeast, the inventor takes 2½ lbs. of flour of malted wheat, the same of flour of malted barley, and the same of rye flour. To this mixture water is added (at 30° Reaumur), and the mass stirred to a thin paste. This paste is then raised to 45° Reaumur by hot water, and afterwards cooled down to 30° Reaumur; next are added 2½ lbs. of wheat starch dissolved in cold water; and 5 oz. of double carbonate of soda, and 2½ oz. of tartaric acid, severally dissolved in lukewarm water, together with 1½ lbs. of common yeast. The mass will now require hot or cold water to bring it to 27° Reaumur, when it is left 12 hours to ferment. After this it is pressed through a hair sieve, and in eight or ten hours the yeast forms on the bottom of the cask. This yeast is taken and put into double bags, which are submitted to pressure to free it from moisture.

BROWN BREAD.

THE *Comptes Rendus* of the French Academy of Sciences of Paris, contains a very long paper, which is of some scientific and of more practical interest, on the art of making Bread. It appears that the bran of ground wheat contains an active principle or ferment, which has hitherto not been rightly understood by chemists, and to which the name of *céréaline* has now been given. This ferment can, we are told in the paper before us, be neutralized by the application of glucose, employed in a particular way; and being neutralized, the greater part of the bran becomes transformed into good flour. In other words, what in France is called bread of the second quality, which the common people are obliged to eat on account of its cheapness (though they do so with a certain degree of repugnance), can be done away with, and bread equal to that of the first quality, which is consumed by the better classes, can, without increase of expense, be substituted for it. Thus the new system seems to be of great utility; and it is desirable that our bakers should inquire into it. The bread produced is represented to be very palatable and wholesome. In the course of the experiments which the new plan necessitated, a curious chemical fact was discovered,—namely, that the dark colour of bread of the second quality is not caused, as has always been supposed, by the presence of bran in the flour, but by a peculiar fermentation of the flour. The discoverer of the improved system is M. Mège-Mouriès.—*Literary Gazette.*

MILITARY COOKERY.

CAPTAIN GRANT has described, at the Royal Institution, his plans for the application of heat to Military Cookery. He first exhibited a model of an open stove, extensively used in Brussels, which projects from the fire-place, and radiates heat from the sides and top, at the same time that it possesses the English requisite of presenting a cheerful-looking fire. This stove has also the important advantage of preventing the chimney from smoking. An economical stove for the poorer classes was exhibited, in which there is an arrangement for baking, boiling, and roasting, by means of a small fire inclosed in iron plates, the heat from which is carried by a flue round the top of the oven, instead of the bottom, as usual; and by the introduction of a thick tile the heat is communicated to the bottom. The economical application of heat to military cookery was illustrated by several models of cooking apparatus, contrived by Captain Grant, which have been practically employed with great advantage at Aldershott. The plan, in its rude form, as adapted for campaigning, is to dig a long trench about a foot wide, at one end of which a chimney may be constructed of pieces of turf, piled one upon another, with a hole in the centre. On the top of the trench, iron plates are placed with holes, into which camp-kettles will fit, and the fire is lighted in the trench, the top of which being covered by the camp-kettles, there is a good draught established through the chimney. By this contrivance a number of camp-kettles may be effectually heated with a small consumption of fuel. At Aldershott the same principle is carried out in a more finished manner. There are a brick-work trench and moveable fire-bars, and an ash-pit; and a well-constructed chimney in the centre serves to make a draught in two directions. The iron-plates and the camp-kettles are larger, and the heat thus generated is so great that when the ash-pit is not cleared, the thick iron fire-bars have been occasionally melted like lead. Captain Grant said, that with this cooking apparatus dinners for 23,000 men have been cooked with an expenditure of fuel of only half a pound to a man. By a recent contrivance, baking has also been effected by placing the oven in an enlargement of the chimney. Another contrivance suitable for campaigning is a portable cooking canteen, by means of which, with the aid of a small quantity of patent fuel, a soldier's ration of meat and vegetables may be cooked in half an hour.

PATENT LIFE-PRESERVING AND VENTILATING WINDOW-SASHES.

AN ingenious contrivance has been invented by Messrs. Dick and

Oliver, of Cranbourn-street, Leicester-square, for the purpose of obviating the serious accidents which too often occur from cleaning the upper windows of a house from the outside, and also for rendering windows more adapted to purposes of ventilation. The sashes consist of two frameworks, one of which is fixed to the ropes of the window, and the other, containing the glass, is made to fit tightly inside the permanent portion, and is secured there by two locks. Thus, by simply undoing the two fastenings, the whole window, which is usually secured by a pivot to the lower end of the permanent sash, can be turned completely inside out, and cleaned at leisure. A small chain is also attached to the top of the lower sash, to allow of its being inclined slightly into the room, leaving an aperture sufficient for ventilation, and at the same time passing the draught over the heads of the inmates. The whole window may be removed from the sashes with the greatest facility, without the removal of the ropes, or of the beading, in order to introduce large pieces of furniture, pianofortes, &c., into the upper rooms of a house, which cannot be conveniently carried up-stairs. One of the greatest advantages of the invention is, that its extreme simplicity allows of its being easily adapted to old sashes at a comparatively trifling cost. Contrary to the idea which would be naturally conveyed from a description, there is in reality little chance of the glass getting broken, even when not very carefully handled.

PATENT FAMILY FIRE-ESCAPE.

THIS invention, by Mr. Thomas Rose, of Manchester, consists of a cage or cradle of light but strong iron wire, and with an iron bottom; to the cage there is attached by chains a hood; and the whole is covered with flannel, chemically prepared, so as to be uninflammable. A large opening is left in the covering, so that any person can step into the cage, be protected, and without the possibility of falling out. The escape is said to weigh only 21 lbs. When not in use, the hood falls within the cage; and the whole occupies a small box, which the inventor proposes to make plain or ornamental, so that it may appear like an ordinary piece of furniture in the bedroom of the upper or middle classes. For the effective use of the escape, an iron bar would be required across the window near to which it was kept; and to this bar a hook at the top of the hood could be instantly affixed. The cage being then pushed out of the window, with its ropes, all is in readiness for use; and in cases of fire, the occupants of the house could be lowered by themselves personally, or by some one who might remain to the last in the room, or by firemen or neighbours in the street. We are told that from the friction of the ropes in the pulleys, a person lowering himself would have to bear or support only one-third of his weight, which can be done without inconvenience. Ropes are attached to the bottom of the cage, so that, during its descent, it can be kept clear of window dressings, or brought over cellar :

SEA-SICKNESS CURABLE.

DR. W. P. HARRIS, surgeon to the *Khersonese* steamship, writes to the *Lancet*:—"As surgeon to one of the first-class American steamships, which each voyage carries over to Portland at least 400 emigrants, I may state that, in the greater number of instances, I allow the stomach to discharge its contents once or twice, and then, if there is no organic disease, I give five drops of chloroform in a little water, and, if necessary, repeat the dose in four or six hours. The almost constant effect of this treatment, if conjoined with a few simple precautions is to cause an immediate sensation, as it were, of warmth in the stomach, accompanied by almost a total relief of the nausea and sickness, likewise curing the distressing headache, and usually causing a quiet sleep, from which the passenger awakes quite well."

WATER.

THAT indefatigable analyst of the comestibles which we consume for our daily nutriment, Dr. Hassall, F.L.S., has handed an interesting Report to the General Board of Health on the microscopical examination of the Metropolitan Water Supply under the provisions of the Metropolis Water Act. The conclusions deduced from the learned doctor's analysis are by no means satisfactory. They show that the waters supplied by the nine metropolitan water-companies still contain considerable numbers of living animal and vegetable productions belonging to different orders, genera, and species, but especially to the orders or tribes annelidæ, entomostraceæ, infusoriæ, conferveæ, desmideæ, diatomaceæ, and fungi. These living organic productions were found particularly abundant in the waters supplied by the Southwark and Vauxhall, the Lambeth, the New River, and the Hampstead Companies; they were rather numerous in the waters of the Grand Junction Company, but much less abundant in the waters of the Chelsea, West Middlesex, Kent, and East London Companies. The waters most tainted with organic matter were cloudy and opalescent, whereas those which contained a smaller quantity of such productions were clear and bright. It follows that the metropolis is still supplied with comparatively impure water—that is to say, with water tainted with numbers of living vegetable and animal productions, which are not present in the purer waters of the Plumstead, Woolwich, and Charlton Company. Great improvement, however, is manifest in the condition of the present supplies as contrasted with those of 1854 (before the recent Act was passed). It should be stated, on the other hand, that the examinations were made in the depth of winter—that is, at the period most unfavourable to the development of animal and vegetable life; a very excellent test is the colour test, for if the water, viewed in bulk, present any decided tinge or colouration, it is generally impure. Now, the waters of all the companies examined presented a very marked yellowish green colouration, which became more obvious as the water was concentrated by evaporation. A detailed account of the various forms of animal life which still contaminate our water is supplied by Dr. Hassall.

ROOFS AND STONE OF THE NEW PALACE OF WESTMINSTER.

SIR CHARLES BARRY, R.A., has addressed to the public journals the following letter:—

SIR,—Public attention having, by a recent discussion in Parliament, been directed to the condition of the iron roofs and the stone of the New Palace at Westminster, the following information respecting them may not be unacceptable to your readers, and may serve to remove any misapprehension that may exist on the subject.

Metal roofs were not contemplated in the original design. They were resorted to upon the adoption, by the Government, of Dr. Reid's plans for warming, ventilating, &c., by which they were required to contain, as they now do, the main smoke flues of the building; and therefore it became necessary that they should be constructed entirely of fire-proof materials. A coating of zinc in preference to paint for the external plates was adopted, upon the strongest testimonials from the French Government, and other sources, as to its long and successful use in France, where it still continues to be employed extensively, particularly in the dockyards of that country. Since its adoption at the New Palace at Westminster, it has also been extensively used, both in public and private works, in this country, and is still being used by the Government in our own dockyards. Experience, however, has proved that it is not capable of offering a long resistance to the deleterious effects of a smoky and impure atmosphere, and the roofs of the New Palace at Westminster have consequently become partially covered with an oxide of iron, or rust. As regards their stability and weatherproof qualities, however, they are none the worse on that account. No difficulty, moreover, exists in resisting all further oxidation, by covering them with one of the anti-oxide compositions now in use, which may be done at a very moderate cost. Several of these compositions have been in course of trial, in various parts of the roofs, for some time past; and I have reason to believe that I have discovered one that may be said to be almost imperishable.

The choice of the stone adopted was the result of the labours of a Commission consisting of two of the most eminent geologists of the day, an intelligent mason, and the architect, who in the year 1838 visited every quarry and locality in the kingdom likely to furnish building-stone. The stone at Anston, in Yorkshire, was selected and adopted by the Government, and every precaution has been taken to obtain a supply from the best beds of it. Upon the whole, it has turned out to be at least as good as any stone hitherto employed in London. Portions of it, in particular situations, and under peculiar conditions, have doubtless yielded to the deleterious effects of a London atmosphere; but the proportion of the parts affected, to those which are perfectly sound, is infinitesimally small; and it is remarkable that the decomposition is almost exclusively confined to the plain faces, the moulded and carved portions of the work being generally as sharp and perfect as when first executed. To say, therefore, as has been recklessly asserted, that the stone is perishing in all directions, conveys a most unfair and exaggerated impression relative to its actual condition. Various economical means, however, are available for arresting all further decomposition of the parts affected, and experiments have been in the course of trial for years, with a view to determine upon the most effectual and unobjectionable process to be employed; and it is hoped, therefore, that ere long all further decomposition will be successfully arrested.

I am, &c.,

CHARLES BARRY.

Old Palace-yard, 30th June, 1857.

A NEW SCIENTIFIC COLLEGE FOR YOUNG MEN.

A COLLEGE for the Education of Young Men has been established at Gnoll—a large mansion, situated in a park between the Vale of Neath and the Bristol Channel, being, of course, in South Wales. The plan of this college is a most admirable one, and appears to us to afford all the advantages which can possibly be comprised at the present day in an institution of the kind. The founders have laid down a scheme which, if faithfully and skilfully carried out, will offer to the rising young men of this country opportunities for obtaining a higher and sounder culture in science than they have ever yet had placed within their reach. Of course, any educational scheme, however excellent, may be rendered futile by defective management; and we have no further knowledge of the proposed college than is given in a little treatise* recently issued with the view of making its character known. But the publication of a very admirable plan, and a very sensible treatise upon it, affords good ground for high expectations of what is to follow.—*Mechanics' Magazine*, No. 1768.

THE NEW READING-ROOM AT THE BRITISH MUSEUM.

THIS magnificent addition to our national Museum, which was in part described in the *Year-Book of Facts*, 1856, pp. 92-93, is now completed. It originated with Mr. Panizzi, the chief librarian, and was designed by Mr. Sydney Smirke, and is placed in the quadrangle of the Museum, of which it does not occupy the whole, there being a clear interval of from 20 to 30 feet all round, to give light and air to the surrounding buildings, and as a guard against possible destruction by fire from the outer parts of the Museum.

"The Reading-room is circular, and is roofed with a dome 150 feet in diameter, its height being 106 feet. In this dimension of diameter it is only inferior to the Pantheon of Rome by 2 feet; St. Peter's being only 139 feet; St Maria, in Florence, 139 feet; the Tomb of Mahomet, Bejapore, 135 feet; St. Paul's, 112 feet; St. Sophia's, Constantinople, 107 feet; and the church at Darmstadt, 105 feet. In other particulars our new dome is far superior. The new Reading-room contains 1,250,000 cubic feet of space; its 'suburbs,' or surrounding libraries, 750,000 cubic feet. The building is constructed principally of iron, with brick arches between the main ribs, supported by twenty iron piers, having a sectional area of 10 superficial feet to each, including the brick casing, or 200 feet in all. This saving of space by the use of iron is remarkable, the piers of support on which our dome rests only thus occupying 200 feet, whereas the piers of the Pantheon of Rome fill 7477 feet of area, and those of the Tomb of Mahomet 5593 feet. Upwards of 2000 tons of iron have been used in the construction. The weight of materials used in the dome is about 4200 tons—viz., upwards of 200 tons on each pier. The first standard was only fixed in January, 1855. The framework and scaffolding upon which the dome rested were removed on the 2nd of the following June. No subsidence or 'set' of material was observable on the wedges being removed. The entire dome was roofed in, and copper covering laid in September, 1855. The roof is formed into two separate spherical and concentric air chambers, extending over the whole surface; one between the external covering and brick vaulting, the object being the equalization of temperature during extremes of heat and cold out of doors: the other chamber, between the brick vaulting and the internal visible surface, being intended to carry off the vitiated air from the Reading-room. This ventilation is effected through apertures in the soffits of the windows, and partly by others at the top of the dome; the bad air passing through outlets provided around the lantern. In order to obviate the effects of condensation, all the skylights, lanterns, and windows throughout the building are double. The quantity of glass used amounts to about 60,000 superficial feet."

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* *The Principles of Collegiate Education Discussed and Elucidated, in a Description of Gnoll College, Vale of Neath, South Wales.* E. Stanford, Charing-cross. 1857.

WITH SILKWORMS.

A PAPER has been read to the Society of Arts, "On Experiments with Silkworms, with a view to Improve the present Silk-yielding of Bengal," by Mr. T. Bashford, of Surda, East Indies. After having devoted his attention to silk-reeling in Bengal for nearly twenty years, with a view of producing a thread as fine and as well suited for manufacturing purposes in Europe as French and Italian silk, Mr. Bashford has succeeded so far as to merit the medal of the Society of Arts, for his superior quality over other Bengals, having surpassed China, and come up very close in the finer sizes to middling Italian. He gave some account of the various species of silkworms known in Bengal. It requires ten thousand of the best cocoons to produce one pound of good silk; in France, 2500 cocoons produce the same quantity. With a view to improve this produce, Mr. Bashford imported a large quantity of the best French, Italian, and China eggs, to engraft upon the different species of the Bengal race. Various details of the experiments were then given; but Mr. Bashford sums up by saying, that as he had spent three years in trying ineffectually to engraft a superior nature and invigorate the common stock, he felt discouraged, and would gladly have the opinion of naturalists as to the probability of his object ever being attainable, and the proper steps to be taken for realizing it. The paper concluded with some remarks upon the mode of rearing silkworms practised by the natives in Bengal.

CAUSES OF FIRES.

A PAPER has been read to the Institute of Architects, by Mr. G. G. Fothergill, "On the Causes of Fires in London from 1833 to 1856 inclusively." It appears that the total number of fires attended by the Fire Brigade during these 24 years have been 17,816, giving an average of 742 in a year, or very nearly 2 in every twenty-four hours. The average number of fires in each year from 1833 to 1848 was,—totally destroyed, 26·4; considerably damaged, 194·2; slightly damaged, 433·5; total, 654·1; and during the 8 years 1849 to 1856—totally destroyed, 26·7; considerably damaged, 273·9; slightly damaged, 618; total, 918·6. Hence it appears that while the total yearly average has advanced in the last 8 years by about 40 per cent. as compared with the preceding 16 years, the number involving entire destruction has remained almost stationary. Of fires caused by candles, curtains, and gas, those in drapers' shops were 61·8 per cent.; at lodgings, 52·7; at private houses, 47·9; while in 22 trades out of 96 no fires have been traced to such a cause. A very considerable per centage of total destruction was observed in churches—viz. 8·8, a higher proportion than that among carpenters, japanners, lampblack makers, musical instrument makers, and varnish makers. One reason for this may be, that places of worship are left unwatched and unoccupied when not in use. A large proportion of the cases of total destruction of this class of buildings arose from the heating apparatus. No instances of total destruction occurred among colour-makers, illicit distillers, or lucifer match-makers. Six fires among printers' ink makers had all been either total or considerable, and 34 fires in theatres showed no medium between absolute destruction and slight damage.

PRESENT ANNUAL PRODUCTION OF IRON.

MR. HEWITT, of New York, in a paper presented to the Geographical and Statistical Society, furnishes the following memoranda respecting the Production and Manufacture of Iron :—Cast iron can only be traced back to the thirteenth century. Previously, the ore and charcoal were placed in alternate layers in a rude oven, and there smelted by a blast injected by a bellows worked by hand. Even so late as 1740, the total annual product of England was but 17,350 tons, made by 59 furnaces, at the rate of 294 tons per annum to each furnace—say one ton per furnace for each working day. Mr. Hewitt estimates the entire annual product of Europe at that time at 100,000 tons, 60,000 of which were made in Sweden and Russia, and one-half of this quantity exported to England. The total consumption of iron in England at that day (only 116 years ago, or since the birth of some persons yet living) was not 15 pounds per head per annum, and that of all Europe but *two* pounds per head. The whole human race did not then annually require or produce so much as *one* pound of iron per head. Now Mr. Hewitt produces data showing an annual production of *seventeen* pounds per head for the whole human family, or seven millions of tons in the aggregate, of which Great Britain produces rather more than one-half, and consumes at least one-fourth. The total product of 1856 is estimated by Mr. Hewitt, from imperfect data, as follows :—

	Tons.		Tons.
Great Britain	3,585,000	United States	1,000,000
France	650,000	Prussia	600,000
Belgium	255,000	Germany (bal. of)	200,000
Russia	300,000	Austria	200,000
Sweden and Norway	179,500	Spain	27,000
Italy and Elba	72,000	Denmark, &c.	20,000
Total		7,088,500 tons.	

Asia, Africa, and America outside of the United States, may possibly raise this aggregate to 7,250,000 tons.

The annual production and consumption of the several countries is estimated as follows :—

	Produce per head, lbs.	Consume per head, lbs.
Great Britain	287	144
United States	84	117
Belgium	136	70
France	40	60
Sweden and Norway	92	30
Germany, including Prussia	50	50
Austria	12½	15
Russia	10	10
Switzerland	—	22
Spain	4½	5

The rest of the world too little to be computed.

The intimate relations of iron to industrial progress and efficiency, as exhibited by this table, need here only be suggested.

THE GREAT BELL OF WESTMINSTER.

MR. E. BECKETT DENISON, M.A., has read to the Royal Institution a paper on this Great Bell, of which the following is an abstract.* After disclaiming the propounding of a scientific theory of bell-founding, and stating his object to have been the making of the best bell of 14 tons weight, Mr. Denison proceeded :—

All that I have to do is to describe the observations and experiments which led me to adopt the particular form and composition which have been used for this the largest bell that has ever been cast in England. The result is, undoubtedly, a bell which gives a sound of a different quality and strength from any of the other great bells in England. Of course it is very easy to say, as some persons have said, that we have got a clapper so much larger than usual, in proportion to the bell, that the sound must needs be different. But the reply to that is equally easy: the bellfounders always make the clapper at their own discretion; and in order to make the most they can of their bells, you may be sure they will make the clapper either as large as they dare, with regard to the strength of the bell, or as large as they find it of any use to make it; because there is always a limit, beyond which you can get no more sound from a bell by increasing the clapper. In the Westminster bell we found that we could go on increasing the sound by increasing the clapper up to 13 cwt., or say 12 cwt., excluding the shank or handle of the clapper, or about $\frac{1}{22}$th of the weight of the bell; which is somewhat higher than the proportion found to hold in some of the great continental bells; but two or three times as high as the usual English proportion. And if the makers of the other large bells in England have found it either useless or unsafe to put clappers into them of more than $\frac{1}{50}$th, $\frac{1}{60}$th, or $\frac{1}{100}$th of their weight, it certainly is not surprising that the sound of this bell should be so different from theirs, as it is observed to be. The truth is, that the difference in the size of the clapper is the consequence of the bell having a much greater power both of bearing blows and of giving out sound than usual; and if we knew nothing more about the matter than that there is one large bell in England which will advantageously bear a clapper twice as heavy in proportion as any other, it would be enough to show that there must be some essential difference between the constitution of that and other bells, which is worth investigating.

The art of bell-founding having sunk so low, as is indicated by what has taken place at the Royal Exchange, and by the great bell of York being not used at all, after having cost 2000*l*., except having the hour struck upon it by hand once a day, it was obviously necessary to begin at the beginning, as we may say, and take nothing for granted as proper to be adopted, merely because we find it in common use now. Accordingly, when I undertook the responsibility of determining the size, and shape, and composition of these five bells, the bell-founders having refused to take any responsibility beyond that of sound casting according to orders, the Chief Commissioner of Works authorized the making of such experiments as might be required before finally determining the design and composition of the bells. Those experiments have only cost about 100*l*., a small sum compared with the value of this one bell, and quite insignificant compared with the importance of success or failure in a national work of this kind.

According to my observation, no bell is likely to be a good one unless you could put a stick as thick as $\frac{1}{13}$th of the diameter between the side or waist of the bell, and a straight edge laid against the top and the bottom. There was a very marked difference between two of our experimental bells, which were alike in all other respects, except that one was straighter in the waist than the other, and that was decidedly the worst. This condition is generally satisfied by the English bells; indeed, I think the fault of their shape is rather the contrary, and that they open out the mouth too much, as if the bell had been jumped down on a great anvil while it was soft, and so the mouth spread suddenly outwards. The shape which we adopted, after various experiments in both directions, is something between the shape of the great bell of Notre Dame, at Paris, and that of the great bell of Bow, which is probably much the same as that of St. Paul's, York, and Lincoln, as they all came from the same foundry in Whitechapel.

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* See *Year-Book of Facts*, 1857, p. 63. The Great Clock is described at pp. 59-63.

Indeed, the sound-bow of this bell is fuller outside than the Paris bell, because it is thicker; so much so, that a straight edge laid externally against the top of the bell and the sound-bow would be thrown out beyond the lip; whereas generally such a straight line would touch the lip, and just clear the sound-bow. I have found one other remarkable exception to this general rule of construction, and a remarkable coincidence with the external shape, and the proportions of height, breadth, and thickness of our bell, and that is no other than the great bell of Moscow, of which an exact section is given in Lyall's *Russia*, with various different versions of its weight. The inside shape, however, is not the same, and I am satisfied not so good, the curve being discontinuous, and presenting an angle just below where the clapper strikes, as in the Paris bell. That bell seems to have had a very short life, a large piece having been broken out in a fire the year after it was cast. Sir Roderick Murchison tells me that the sound of the Russian bells is remarkably sweet.

I cannot find that the exact height of a bell makes much difference. The foreign bells, except the Russian ones, it seems, are generally higher than ours, being nearly $\frac{4}{5}$ths of their diameter high, whether you measure it vertically inside, or obliquely outside from the lip to the top corner, as the two measures are generally much alike on account of the curvature of the top or *crown*. Ours run from $\frac{2}{3}$rds to $\frac{3}{4}$ths of the diameter, though there are some higher; and on the whole my impression is against the high ones. The vertical height inside of all these bells at Westminster is $\frac{11}{15}$ths of the diameter. Lower than that, the bell does not look well; I never saw an ugly bell that was a good one; and it is clear, from all our experiments, that the upper or nearly cylindrical part is of considerable importance, and though its vibrations are hardly sensible, it cannot even be reduced in thickness without injury to the sound, of which we had a curious proof. A bell of the usual proportions, in which the thickness of the upper or thin part is one-third of the *sound-bow* or thickest part, sounds a third or a fourth above the proper note when it is struck in the waist, and the sound there is generally harsh and unmusical besides. It occurred to both my colleague, the Rev. W. Taylor, and myself, that it would be better to make the waist thinner, so as to give the same note as the sound-bow. After two or three trials we succeeded in doing this very nearly, and without reducing the weight below $\frac{1}{4}$th instead of $\frac{1}{3}$rd of the sound-bow. The bell sounded very freely with a light blow, and kept the sound a long time, and a blow on the waist gave a much better sound than usual. But for all that, when we tried it at a distance with another bell of the same size and same thickness of sound-bow, but a thicker waist, the thin one was manifestly the worst, and had a peculiar unsteadiness of tone, and sounded more of what they call the harmonics along with the fundamental note, instead of less, as we expected.

But still we have to ascertain what should be the thickness of the sound-bow itself (which is often called for shortness the thickness of the bell). The large bells of a peal are sometimes made as thin as $\frac{1}{15}$th of the diameter, and by one of the modern bellfounders even thinner, and the small ones as thick as $\frac{1}{10}$th of the diameter. It is clear that the most effective proportion is from $\frac{D}{13}$ to $\frac{D}{12}$. In casting peals of bells it is necessary to take rather a wider range, in order to prevent the treble being so small and weak as to be overpowered by the tenor; though here I am convinced that the modern bellfounders run into the opposite error, and always make their large bells too thin. I know several peals in London in which the large bells are hardly heard when they are all rung, and are besides very inferior in quality to the others. Again, if you make the small bells too thick, for the purpose of getting a larger bell to sound the proper note, you approach the state in which the bell is a lump of metal too thick to have any musical vibration. This is a much less common fault than the other, because the nearly universal demand for as deep notes as can be got for the money is a strong temptation to make the thickest bells, *i.e.* the small ones, only just thick enough, and the large ones much too thin.

The thickness of the Westminster bell was designed to be $\frac{2}{25}$ths of the diameter, or 9 inches, which would have made it 14 tons, the weight which was prescribed for it twelve or thirteen years ago, long before I had anything to do with the bells or the clock. By some mistake in setting out the pattern, or making the mould, which the founders have never been able to account for, the bell was made 9¼ in. thick, which is very nearly $\frac{1}{12}$th of the diameter, 9 ft. 5½ in., and which increased the weight to 16 tons, within 174 lbs., and raised the note from E flat to E. Fortunately the same ratio of increase was made throughout, and the waist is $3\frac{1}{2}$ in., or one-third of the sound-bow, as it ought to be; and therefore the only effect of the mistake is, that the bell is heavier and more powerful; for it being cast the first, the alteration of the note did not signify, as the four quarter-bells can as easily be made to accord with E natural as with E flat. And as they will be rather smaller in consequence, the aggregate weight of the whole five will be about 24 tons, as I originally estimated. I have only to add, with reference to this part of the subject, that the width of the bell at the top inside is half the width at the mouth, as it generally is; though in some bells—for instance, the great clock bell at Exeter—it is the outside diameter that is made half the diameter at the mouth. It is of no use to state here the precise geometrical rules by which the pattern of a bell, of what we now call the Westminster pattern, is drawn, as they are purely empirical. I mean, that having got a bell, by trial, which we all agreed was better than any other, I made out some sufficiently simple rules for drawing the figure of its section by means of a few circles, whose radii are all some definite numbers of 24th parts of the diameter of the bell: but there is no kind of *à priori* reason, that I know of, why a bell whose section or *sweep* is made of those particular curves, should be better than any other; and therefore I call the rules for tracing the curve merely empirical; and as they would be of no use to any one but bellfounders, who know them already, or easily may, if they like, I shall say no more on this part of the subject.

As I have been asked many questions about the mode of calculating the size of a bell, so as to produce a particular note, and the answer is very simple, I may as well give it, though it may be found already, with other information on this subject, in the only English book I know of which contains such information—I mean the second edition of my *Lectures on Church Building*, to which a chapter on bells is added. If you make eight bells, of any shape and material, provided they are all of the same, and their sections exactly similar figures (in the mathematical sense of the word), they will sound the eight notes of the diatonic scale, if all their dimensions are in these proportions—60, $53\frac{1}{3}$, 48, 45, 40, 36, 32, 30; which are merely convenient figures for representing, with only one fraction, the inverse proportions of the times of vibration belonging to the eight notes of the scale. And so, if you want to make a bell, a fifth above a given one—for instance, the B bell to our E—it must be $\frac{2}{3}$rds of the size in every dimension, unless you mean to vary the proportion of thickness to diameter; for the same rule then no longer holds, as a thinner bell will give the same note with a less diameter. The reason is, that, according to the general law of vibrating plates or springs, the time of vibration of similar bells varies as $\frac{\text{thickness}}{(\text{diameter})^2}$. When the bells are also completely similar solids, the thickness itself varies as the diameter, and then the time of vibration may be said simply to vary inversely as the diameter. But for a recent letter in the *Times* from a Doctor of Music, who seems to have taken this bell under his special protection, it would have seemed superfluous to add that the size of the "column of air contained within a bell" has no more to do with its note, than the quantity of air in an American clock has to do with the note of the wire on which it strikes. You may have half-a-dozen bells of different notes, because of different thicknesses, all enclosing exactly the same body of air. I certainly agree with the opinion published by some of the bellfounders on a former occasion, that musicians are by no means necessarily the best judges of bells, except as to the single point of their being in tune with each other.

The weights of bells of similar figures of course vary as the cubes of their diameters, and may be nearly enough represented by these numbers—216, 152, 110, 91, 64, 46, 33, 27. But as we are now only concerned with the making of a single bell, I shall say no more on this point, beyond desiring you to remember, that the exact tune of a set of bells, as they come out of the moulds, is quite a secondary consideration to their tone or quality of sound, because the notes can be altered, a little either way by cutting, but the quality of the tone will remain the same for ever; except that it gets louder for the first two or three years that the bell is used, probably from the particles arranging themselves more completely in a crystalline order under the hammering, as is well known to take place even in wrought iron.

The remainder of Mr. Denison's paper relates to the composition of bell-metal, and by a table of analyses, shows that the Westminster

Bell contains less tin and antimony together, and more copper, than the old bells of York Minster; and a great deal less tin in proportion to the copper than the famous bell of Rouen, which was broken up and melted into a cannon in the first French Revolution. The mode of casting the bell, and hanging it, follow. For the entire paper see the Reports of the Royal Institution Weekly Meetings—March 6, 1857.

We have only here to add, that the Great Bell having been conveyed from the foundry to Westminster, was cracked in the sounding before it was attempted to be raised, and has now to be re-cast.

CLIFFORD'S NEW METHOD OF LOWERING SHIPS' BOATS.

By this mechanically novel but simple invention,*—remedying the evils of the old system, productive of such melancholy loss of life at sea—a boat, when laden with a full crew, is, by the single act of one of the crew in the boat paying off a handline, at one and the same time unlashed, lowered evenly without the possibility of canting in descent, and entirely disengaged from the ship, whether at anchor or going at full speed. After having been subjected to most severe trials during the last two years by the Admiralty, the Emigration Commissioners, and the East India Company, this Boat has been adopted throughout their different services; and has been the means of saving the lives of men who have fallen overboard (in nearly every case when the ship was in full sail) from H.M.S. *Shannon* (Captain Peel, commander); from the emigrant ships *Commodore Perry, Blundell, Black Eagle, Washington Irving*, and *Ebba Brahe*; and from the *Transatlantic*, belonging to Messrs. Thompson, of Aberdeen. In several of these instances, the officers have officially reported that but for the boats being so fitted they would not have risked the lives of the crews in attempting to lower them, from the heavy sea running at the time. The example thus set by the Admiralty and the other public bodies above named, in providing for the crews and passengers of their ships so necessary a means of security in case of accident, will do incalculable good, and must lead not only to the laws now existing (though unhappily entirely disregarded) being enforced, but more stringent ones being passed for the better protection in future of life at sea.

PRINTING BY WATER POWER.

The *Montrose Standard* is now printed by water power. The engine consists of two oscillating cylinders with pistons acting on the shaft of a driving pulley, the pistons being moved by water, as those of a locomotive or other steam-engine are by steam. It differs from the steam-engine chiefly in the absence of sliding valves, which are inappropriate to the employment of water in place of steam. The means through which these are dispensed with are in the highest degree simple and ingenious.

* Described in the *Year-Book of Facts*, 1856, p. 47.

Natural Philosophy.

THE ROYAL SOCIETY.

THE first anniversary meeting of the Royal Society, in their new rooms at Burlington House, Piccadilly, was held on Nov. 30, the Lord Wrottesley, President, in the chair. After the Report from the auditors of the income and expenditure for the past year, his lordship delivered his annual address, in which he advocated the claims of science to the recognition of all who are interested in the moral and physical progress of the nation. In reviewing the advance made in the department of terrestrial magnetism, he instanced the patient observations of Schwabe, of Berne, as an illustration of the valuable aid which one branch of science may undesignedly lend to another. For thirty years the obscure Swiss astronomer had daily noted down the appearance of spots on the solar disc, little thinking that his demonstration of a decennial period for the complete revolution of those remarkable phenomena would be made just in time to enable General Sabine to demonstrate in his turn the coincidence of that decennial period with that in which the phenomena of terrestrial magnetism—their maxima and minima—pass through a complete series. Modern science has no parallel to Schwabe's persevering labours.

The Government having promised to dispatch a vessel to explore the Zambesi, Lord Wrottesley expressed a hope that the request made to the First Lord of the Treasury, by a deputation of members of the British Association and Fellows of the Royal Society, for a small party to be sent out to take a three years' series of magnetic observations near the mouth of Mackenzie River, in Arctic America, would also be granted. These observations are of especial interest to physical science, as in the latitude of the abovenamed river will, it is thought, be found the neutral point between the magnetic disturbances, or "storms," which manifest themselves at Point Barrow and Toronto simultaneously, but in opposite directions.

The Foreign Secretary, Professor W. H. Miller, received the Copley Medal for Professor Michel-Eugène Chevreul, to whom it had been awarded by the Council of the Society, as a testimony on their part of his long-continued chemical investigations. The true nature of saponification was not understood until he, many years ago, elucidated it in a memoir which remains among the master works of chemistry. It opened the way for those important branches of industry which now send light all over the kingdom, in the form of stearine and composite candles. To Chevreul we owe the discovery that coarse and low-priced oils could be made to yield hard fats, eminently useful in commerce and domestic life. He has also greatly improved the art of dyeing, and his late work *On the Law of the Contrast of Colours*, has, in the original and by translations, made his name known wherever the fine arts are cultivated.

Dr. Edward Frankland, the recently appointed lecturer on chemistry to St. Bartholomew's Hospital, was selected as the recipient of one of the two Royal Medals placed every year by the Crown at the disposal of the Society, for—to quote the words of the award —"The Isolation of the Organic Radicals of the Alcohols, and for his Researches on the Metallic Derivatives of Alcohol." The other Royal Medal was given to Dr. John Lindley, for his numerous researches and works on all branches of Scientific Botany, and especially for his *Vegetable Kingdom* and his *Genera and Species of Orchideæ*.

SCIENCE AND THE GOVERNMENT.

At the late Meeting of the British Association, in Dublin, the President, in his inaugural address, stated: An important question has been, for some years, under the consideration of the British Association, and that of the Royal Society—the question, namely, whether any measures could be adopted by the Government or Parliament that would improve the position of Science or its cultivators in this country. The Parliamentary Committee of the Association have taken much trouble in the attempt to arrive at a solution of this large and complex question. They consulted, in the first instance, several of the most eminent scientific men of this country; and in their first Report, presented to the meeting of the Association at Glasgow, they have analysed the replies obtained, and have recommended certain general measures founded thereon. The most important of these are the provision, at the cost of the nation, of a central building in London, in which the principal scientific societies of the metropolis may be located together, and the formation of a Scientific Board, to have the control and expenditure of the public funds allotted to the advancement of science. This Report was under the consideration of the Committee of Recommendations at the last two meetings of the Association, and the opinions of the members of the General Committee have been since invited in reference to its suggestions. The Council of the Royal Society have likewise deliberated on the same question, and have passed certain resolutions on the subject, which accord in substance with the conclusions of the Parliamentary Committee. A copy of these resolutions was forwarded by Lord Wrottesley, as President of the Society, to Lord Palmerston, and motions have been made in both Houses of Parliament for the production of the correspondence. The first of the objects above referred to, namely, the juxtaposition of the scientific societies of London in one locality, has been since accomplished by the grant of Burlington House for the use of the Royal, Linnean, and Chemical Societies.

THE BAKERIAN LECTURE.

The Bakerian Lecture for 1857, at the Royal Society, delivered by Professor Faraday, is "On the Relations of Gold and Silver and other Metals to Light."

The lecturer commenced by expressing a hope that the undulatory theory of light, when more fully and perfectly developed, may aid in comparing local actions with those which take place at a distance, and even help towards the comprehension of the physical means by which the latter are carried on; and with that view he endeavoured, experimentally, to subject a ray of light to the action of particles so small in size as to have an immediate and near relation, not only to the undulations of light, but even to the far smaller motions of the parts of ether, which are supposed to produce, by their joint and successive action, the light-wave. He hoped that by choosing particles of a fitting substance, experimental results might be obtained, which, in the hands of the mathematical philosopher, might aid in perfecting the theory; and for this purpose gold was selected, because of its high optical qualities, shown in its comparative opacity, whilst possessing a real transparency; its high yellow reflexion and its true green transmission; its known action on light in very minute quantity; its capability of extreme division; its great gravitating force, which could be called upon for aid when the metal was in a state of extreme division; its elementary character; the integrity of its metallic state; the facilities of testing its presence and condition; and finally, because known phenomena seemed already to indicate differences of action on light, consequent upon its division.

The properties of gold-leaf were first considered. If this be taken up on glass damped by breathing or moistening, and then water introduced between the glass and the gold as a cushion, the gold can be perfectly stretched, so that when dry it is fit for optical examination: or if a diluted solution of cyanide of potassium be in like manner introduced beneath the gold, it can be more or less attenuated by solution, and then washed and dried. If gold-leaf thus extended and attached, either to glass, or plates of rock-crystal, or mica, be heated, it gradually loses its reflective power and its green colour, and becomes transparent. This change takes place far below the fusing point of gold, and at a temperature as low as the boiling point of oil, if continued for several hours. When the heat is considerable, the gold-leaf suffers retraction of its parts, and becomes perforated by many fine holes, often symmetric in their form and dimensions; but when the heat applied is the lowest competent to produce the change, it does not seem certain that the effect is due to such retraction: a good microscopic examination of this point is required. When pressure is applied to such discoloured gold by a convex piece of rock-crystal of short radius (as half an inch or less), the green colour of the transmitted ray reappears. This production of the green colour by pressure can often be referred to in different states of gold, as a proof, amongst others, that the metal is in the metallic condition. Silver-leaf undergoes a like change by heat, at even a lower temperature. When a gold wire is deflagrated near the surface of glass plates by a strong electric discharge, it is dissipated in minute particles, which are deposited on the glass. All these particles act with acid and chemical re-agents as gold acts, and there is no reason to believe they are anything but metallic gold. They appear with precisely the same colours and characters, whether the deflagrations are made in common air, in oxygen, or in hydrogen, and whether the deposits are formed on glass, rock-crystal, topaz, or mica. When heated by any ordinary means, the green and grey parts change to a ruby or ruby-amethystine colour, and that whether surrounded by air or vapour of alcohol or ether. Agate pressure confers the green character on the heated deposits, and also, in frequent cases, upon that which has not been heated.

Thin films of gold may be produced by placing a very weak solution of chloride of gold, free from excess of acid, containing about one and a half grain of metal to two or three pints of water in a very clean glass vessel, and allowing two or three small particles of phosphorus to float on the surface.

In about twelve hours a film of gold will extend over the surface of the liquid, which may be raised from the fluid by plates of glass. The thinner parts of such film are scarcely visible, either by reflected or transmitted light; the transition to thicker parts is gradual, the thickest being opaque, and their reflexion that of clean gold. The colour by transmitted light varies, being grey, green, or dull violet. The films are porous, and act as pure gold, resisting all the agents which metallic gold resists. When heated, the transmitted colour changes toward amethyst and ruby; and then the effect of pressure in producing a green colour is in many cases very remarkable—even a touch with a card or the finger is able to cause the change. Whilst the particles of phosphorus are producing a film on the surface, it frequently happens that streams of a red colour descend from them through the fluid; and if the phosphorus be submerged and left for twenty-four or forty-eight hours, this red product is easily and abundantly obtained. If the gold-solution be placed in a very clean bottle, and then a few drops of a solution of phosphorus in ether be added, and the whole agitated from time to time, the ruby-fluid is obtained in a shorter period. This fluid is apt to change in colour, becoming amethystine, violet-purple, and finally blue. When a light is looked at through the fluid, it appears transparent; but when the eye is on the illuminated side, then the fluid is seen opalescent. If a cone of sun-rays be thrown by a lens into the fluid, the illumination of the particles within the cone shows their pressure as undissolved bodies. All the particles are metallic gold, the ruby being in the finest state of division, the blue in a more aggregate condition. Professor Faraday considers a ruby glass coloured by gold to be analogous to this ruby-fluid, being a diffusion of gold particles through vitreous matter.

The relations of gold (and other metals) to polarized light are of the following nature: a leaf of gold inclined at a certain angle across a ray of polarized light (the inclination not being in the plane of polarization or at right angles to it) affects it as a thin plate of any uncrystallized transparent substance would do, *i. e.*, the light appears in the analyser, and the plane of polarization is rotated; or if a leaf of gold be held in an inclined position across a ray of unpolarized light, the beam is polarized as it would have been in passing through a like inclined plate of uncrystallised transparent matter.

The gold, rendered green by heat or pressure, when examined, does not appear to have acquired any particular tension or structure. Sulphide of carbon and crown-glass are optically so near each other that a plate of the latter immersed in the former is neutralized; and though placed in an inclined position to a ray of light, either polarized or not, does not then affect it; but gold (and all metals) is still far above either of these. Hence the gold-films obtained by phosphorus when attached to glass could be examined, and were found to have the optical properties of leaf-gold, the effect having no reference to the *thickness* of the film, but being most perfect in the thinner films, because they were in a more regular and perfect condition.

In like manner, the deposits of gold (and other metals) obtained by electric deflagrations were examined and found to have the same marked qualities in a high degree; places where the film was scarcely visible on the glass, instantly showing the presence of the gold by their action on the polarized ray. In the same manner the very thin and almost invisible films, deposited occasionally on the sides of the vessels containing the gold fluids, showed themselves as gold. The thinnest layer of the fluid itself, however rich in particles, held between two plates of glass, acted no otherwise than a layer of water. It appears by the deflagrations that the particles of gold must be deposited in a plane, and then, though discontinuous, they act in the manner of continuous films of ordinary uncrystallized transparent bodies.

As to the quantity of gold in the different films or solutions, it can at present only be said that it is very small. Suppose that a leaf of gold, which weighs about 0·2 of a grain, and covers a superficies of nearly ten square inches, were diffused through a column having that base, and 2·7 inches in height, it would give a ruby-fluid equal in depth of tint to a good red rose, the volume of gold present being about the $\frac{1}{500000}$th part of the volume of the fluid; another result gave 0·01 of a grain of gold in a cubic inch of fluid. These fine diffused particles have not as yet been distinguished by any microscopic power applied to them.

The lecture was illustrated by a great variety of extremely interesting experiments. In the course of these, Professor Faraday observed that he had succeeded in obtaining pure and unalloyed gold-leaf from the parties employed in gilding the dome of the new reading-room at the British Museum.

WHAT THE BRITISH ASSOCIATION HAS DONE FOR MATHEMATICAL SCIENCE.

THE President of the British Association, at the late meeting in Dublin, said, Twenty-two years ago we met in this city for the first time; when important were the researches which were originated at that meeting, and the success with which they were carried out. Some of them I shall name as evidence of what the British Association has done for science. To begin with my own special pursuits. —1. There had been made at Greenwich during the preceding century a vast series of solar, lunar, and planetary observations, matchless in the world, of the highest importance to perfect the planetary theory, but quite useless, because unreduced. How troublesome that process is none know but they who have used it, and it would, perhaps, never have been performed but that we obtained it from Government. It has been perfectly accomplished under the direction of Mr. Airy.—2. There existed a collection of star observations, the *Histoire Céleste*, the proudest distinction of the two Lalandes, comprising 50,000 stars, all, however, unreduced and nearly useless. These we have reduced; and at a large pecuniary outlay, we have given to astronomers a catalogue not of less value than those of Bradley or Piazzi.—3. We originated those researches on the strength of iron, by which Hodgkinson and Fairbairn have added so much to the resources of constructive engineers.—4. We called for the investigations, and supplied funds for those discussions of tidal phenomena by which Dr. Whewell has not only thrown light on a most difficult portion of hydrodynamics, but given precious aid to the practical navigator.—5. Two years before that meeting, a great physicist had declared that to improve by theory the former was as hopeless as to get the equation of a breaker; at that meeting a young man, then unknown, produced the germ of those researches which, extended under our auspices, and largely aided by our pecuniary grants, have given J. Scott Russell a world-wide fame, and made possible the construction of those noble ships which, during the last month, have borne from your bay, at a speed twice what was once thought attainable, their freight of heroes, to uphold our nation's power—to avenge our slaughtered countrymen.—6. Lastly, we set on foot that system of magnetic observation of which you heard last night, which has added so much to our knowledge of terrestrial magnetism; nay, which has gone beyond our globe and opened a new range for inquiry, by showing us that this wondrous agent has power in other parts of the solar system. Is not this a list of achievements on which those of us who were then present may look with just pride? May we not venture to hope that when, in the next of its cycles, the Association shall return to this city, those who shall survive to witness that event shall have it in their power to record one yet more brilliant?

REPORT OF THE KEW COMMITTEE OF THE BRITISH ASSOCIATION.

SINCE the meeting of the British Association in 1856, the works necessary for lighting the Observatory with gas have been executed at a cost of 250*l.*, which has been defrayed by a grant from the Wollaston Fund by the President and Council of the Royal Society.

Soon after the meeting of the Association, in 1856, the Board of Works commenced the external repairs of the Observatory. These were completed in the following November. The Chairman having represented to the Chief Commissioner of Works the necessity for considerable repairs to the interior of the building, the Board of Works agreed to execute such repairs as soon as the necessary funds should be voted by Parliament; the requisite vote has been passed, and the works have been proceeded with.

The following memorandum relative to the re-establishment of self-recording magnetic instruments at the Kew Observatory was submitted to the committee by General Sabine, on July 22, 1856:—

"1. The decennial period in the solar magnetic variations, and its coincidence with a similar period in the frequency and amount of the solar spots, appear to be highly deserving of attention in an observatory established, as Kew is, for physical researches.

"2. There is reason to suppose that the permanency and regularity in the occurrence of the decennial period in the magnetic variations, and its coincidence with the periodic variation of the solar spots, might be effectually and satisfactorily tested by observations of both classes of phenomena at the alternate periods of maximum and minimum—say, for example, in 1857 and 1858 as the anticipated period of maximum, and in 1863 and 1864 as the anticipated period of minimum, and so forth.

"3. The apparatus constructing under the superintendence of Mr. De la Rue will, it is hoped, fully meet the requirements of the research in respect to the solar spots.

"4. Since the time when the magnetic self-recording instruments belonging to the Kew Observatory were constructed under the direction of Mr. Ronalds, very considerable improvements have been made in the art of photography, and the six months' trial, which was made by Mr. Welsh of Mr. Ronalds' instruments, has led in several other respects to suggestions for improvements which could not but be expected to be required in instruments of so novel a kind, while at the same time the six months' trial referred to has placed beyond doubt the sufficiency of a properly conducted research by means of self-recording instruments for the examination of the solar magnetic variations."

The committee authorized Mr. Welsh to proceed with the construction of the instruments, which have now been completed at an expense not exceeding 250*l.*, this sum being defrayed from the funds supplied by the Government grant through the Council of the Royal Society, the instruments remaining at Kew at the disposition of the Council of the Royal Society.

With the assistance of apparatus lent from General Sabine's department, the Observatory is now possessed of the means of determining with great accuracy the various constants required in magnetic observation. Some alterations in the method of manipulation have, it is believed, added considerably to the accuracy of observation of the absolute value of the magnetic force.

SCIENTIFIC MISSION TO INDIA.

A PAPER has been read to the Paris Academy of Sciences on a Mission sent to India and Upper Asia in 1854, by the King of Prussia and the East India Company. The members of the mission consisted of three brothers, MM. Herrmann, Adolphus, and Robert Schlagintweit. During the winter of 1854-55, these enterprising travellers visited the region lying between Bombay and Madras. In the following summer, M. Herrmann explored the eastern parts of the Himalaya, the Sikkim, Bhootan, and Kossia mountains, where he measured the altitudes of several peaks. The chief results obtained from this exploration of Asia are the following:—The Himalaya mountains everywhere exercise a decided influence over all the elements of the magnetic force; the declination everywhere presents a slight deviation, causing the needle to converge towards the central parts of that enormous mass, and the magnetic intensity is greater than it would be anywhere else under an equal latitude. In the south of India the increase of the magnetic intensity from south to north is extremely rapid. In the Deccan and Behar the rocks are magnetic. On the Himalaya, at altitudes of 17,000, and even 20,000 feet, the daily maximum and minimum variations of the barometer occurred nearly about the same hours as in the plains below. Again, at the above altitudes, the inversion of the curves of daily variation, which is met with on the Alps, does not take place. At the altitude of 17,000 feet, the diminution of transparency produced by a stratum of air of the thickness of 3000 feet is no longer distinguishable by the eye. During the dust-storms, which frequently occur in India, the disc of the sun is seen of a blue colour; if small bodies are made to project their shadows on a white surface under such circumstances, the shadow is of an orange colour—that is, complementary to blue. The transparency of the waters of the Ganges, the Brahmapootra, and the Indus, was tested by letting down a stone into them, which generally became invisible at a depth of from twelve to fifteen centimetres (five to six inches), showing that they are overcharged with earthy particles, for in the sea near Corfu a stone is visible to the depth of 50 feet, and in the seas under the tropics it remains visible at a depth of 80 feet.—*Galignani's Messenger.*

THE STANDARD OF LENGTH.

MR. AIRY, the Astronomer Royal, has read to the Royal Society an "Account of the Construction of the New National Standard of Length, and of its Principal Copies," executed almost entirely by Mr. Baily and Mr. Sheepshanks. The paper commences with a history of the British and Foreign Standards, and of the methods of using them in Base and Pendulum Measures anterior to the legalization of the Imperial Standards by the Act of Parliament of 1824. The question of the propriety of adopting line-measure, or end-measure, for the national standard, which in this country had been practically decided in favour of line-measure, had again been raised by Bessel's adoption of end-measure, when in 1834 the fire at the Houses of Parliament destroyed the standard.

A Commission was now appointed by Government for the purpose of restoring the lost standard. The first Report recommended the adoption of a material standard, without any reference to physical experiments, and that four copies should be made, of which one should be immured in the wall of a public building; also, that these copies should, by means of bars which had been compared with the old standard, be made, as nearly as possible, equal in length to the old standard, and that the superintendence of construction should be entrusted to a committee. These recommendations were adopted by the Lords Commissioners of the Treasury, and led to the appointment of the superintending committee, and of the late Mr. Baily, F.R.S., as immediate manager of the work. Mr. Baily made many experiments on the fitness of different alloys, and finally fixed upon a hard bronze, or gun-metal, as best for the standards.

He then made numerous experiments on the thermometrical expansion of different metals, compared the various bars on which the restoration of the standard must depend, and proved that the Astronomical Society's tubular scale was not worthy of entire credit as a means of restoring the length of the old standard. Mr. Baily's death interrupted these inquiries. Generally, however, it appeared that it would be very undesirable to refer in any degree to Shuckburgh's scale (adopted by Kater as the scientific standard), inasmuch as there was no security whatever that, in retaining documentary or numerical expressions of measure founded on this scale, we were referring to a consistent system.

Mr. Sheepshanks was now appointed to succeed Mr. Baily in the work of constructing a new standard of length. He made new thermometers, and a massive and highly ingenious comparing apparatus, which he set up in a cellar in Somerset House, where he laboured gratuitously for many years on the delicate task assigned to him. Mr. Airy gives a full account of all Mr. Sheepshanks's experiments on the expansion of various metals, which were of the most elaborate nature, and extended from 1847 to 1855, when they ceased by his death.

The Astronomer-Royal now undertook the completion of the important national work, and superintended the completion of end-measure bars, which had been begun by Mr. Sheepshanks. The general principle of these bars is this:—If two end-bars have each a defining mark almost equally distant in the two bars from the middle of its length, and if the two bars are placed end to end, the longer segment of the one touching the shorter segment of the other, the distance between the two lines can be compared by microscopes with a line-standard. If the contacts be now made by the other ends, a similar comparison can be made. If the two results be added together, we have a comparison of the sum of the entire lengths of the two end-standards with double the length of the line-standard. This operation being performed so as to effect a comparison of the three pairs, which can be made from three end-standards (the sum of each pair being compared with the double line-standard), we have three simple equations, from which the lengths of the true end-standards can be deduced. The end-bars are constructed, some of bronze, some of iron or steel, but in all the ends are of agate, ground to the curvature of a large sphere, whose centre is the middle point of the bar. The lengths of three bronze end-bars and of four iron or steel end-bars were determined by this process.

Mr. Airy concludes his paper by giving a statement of the closing official proceedings connected with the construction of the national standard of length, together with extracts from the Act of Parliament legalizing the new standard, a table of standard temperatures for the compared bars, and an account of the disposal of the bars. The Act of Parliament (18 and 19 Vict. c. 72) requires the bar to be deposited at the Exchequer Office, and numbered 1, as being the genuine standard of the measure of length called a yard, and recognises four copies as available for restoration of the standard in case of loss. These copies are—No. 2, deposited at the Royal Mint; No. 3, in charge of the Royal Society, and now in a fire-proof vault in Burlington House; No. 4, immured in the cell of the recess on the east side of the lower waiting-hall in the New Palace at Westminster; and No. 5, deposited at the Royal Observatory, Greenwich.

The total number of bars accurately compared is 78. Of these, 4 tubular scales were not the property of the British Government; 7 are end-measures; all the remainder are line-measures. They have been distributed liberally to foreign Governments and to British offices. Several, however, remain at the Royal Observatory, Greenwich, still disposable. The whole of the documents relating to the preparation and comparison of the standards are preserved at the Royal Observatory.—*Abridged from the Saturday Review*, No. 86.

FIGURE AND DIMENSIONS OF THE EARTH.

LIEUT.-COL. JAMES, R.E., F.R.S., Superintendent of the Ordnance Survey, has communicated to the Royal Society a paper "On the Figure, Dimensions, and Mean Specific Gravity of the Earth, as derived from the Ordnance Survey of Great Britain and Ireland," commenced in 1784, and recently completed. We have only space to quote the following.

One of the first practical results arising from the completion of the triangulation is, that it is now possible to engrave the latitude and longitude on the marginal lines of the old sheets of the one-inch Map of England, and this is now being done.

The following account of the Trigonometrical operations and calculations has been drawn up by Captain Alexander R. Clarke, R.E.; this account may be considered an abridgment of that more detailed account which is now in the press, and will be shortly published.

It will be seen that the equatorial diameter of the earth, as derived from the Ordnance Survey, is 7926·610 miles, or about one mile greater than it is given by the Astronomer-Royal in his "Figure of the Earth," and that the ellipticity is $\frac{1}{299.33}$, or, as the Astronomer-Royal conjectured, something "greater than $\frac{1}{300}$," which he gives in the same paper.

The mean specific gravity of the earth, as derived from the observations at Arthur's Seat, was stated in a former paper to be 5·14; the calculations have since been revised, and it is now found to be 5·316.

The mean specific gravity of the earth, as derived from the only other observations on the attraction of mountain masses on which any reliance has been placed, viz., the Schehallien observations, is, as finally corrected by Hutton, $\frac{99}{20}$, or almost 5·0.

From the experiments with balls we have the following results:—

By Cavendish, as corrected by Baily	5·448
By Baily	5·67
By Reich	5·44

From the pendulum experiments, at a great depth and on the surface, the Astronomer-Royal obtained 6·566.

Two copies of the new National Standard Yard have recently been received through the Astronomer-Royal, and it is obviously necessary that the geodetic measures should be given in reference to the standard; but not knowing from what scale the standard has been taken, Col. James is unable to say at present in what way the reduction is to be made; that is, whether by reference to the comparison of the old standards which have been already made, or by the mechanical process of a direct comparison of the Ordnance Standard with the new National Standard.

This introductory explanation by Col. James is followed by an account of the Trigonometrical operations and calculations; the following is a brief statement of the results:—

"1st. The four bases of verification, when their measured lengths are compared with their lengths as calculated from a mean of the Lough Foyle and Salisbury Plain bases, show the following discrepancies:—

Hounslow.	Misterton Carr.	Rhuddlan Marsh.	Belhelvie.
+ 0·173	— 0·167	+ 1·596	+ 0·240

"2nd. The elements of the spheroid most nearly representing the surface of Great Britain:

	Feet 0.	Miles.	
Equatorial semidiameter	= 20926249	= 3963·305	compression = $\frac{1}{299·33}$
Polar semidiameter	= 20856337	= 3950·064	

"3rd. The elements of the spheroid most nearly representing the whole of the measured arcs considered in this paper are—

	Feet 0.	Miles.	
Equatorial semidiameter	= 20924069	= 3963·064	compression = 1/—
Polar semidiameter	= 20854743	= 3949·760	

"4th. The lengths of the degrees of latitude and longitude in Great Britain are as in the following table:—

Mean latitude.	From Ordnance Survey.		From the 2nd Spheroid.	
	Length in ft. of 1° of latitude.	Length in ft. of 1° of longitude.	Length in ft. of 1° of latitude.	Length in ft. of 1° of longitude.
50	364936·33	235227·42	364912·65	235215·15
51		230312·27	364975·74	230300·33
52	365061·50	225326·39	365038·38	225314·75
53	365123·34	220271·15	365100·51	220259·79
54		215148·11	365162·03	215137·12
55				209948·14
56		204704·93	365282·94	204694·56
57	365363·96	199387·90	365342·20	199377·84
58		194009·37	365400·57	193999·63
59	365479·20	188571·00	365457·97	188561·57
60		183074·50	365514·32	183065·41

THE FIGURE OF THE EARTH, AND THE TIDES.

THE President, in his inaugural Address to the British Association, at their late Annual Meeting, observed: — The results of the Ordnance Survey of Britain, so far as they relate to the earth's figure and mean density, have been lately laid before the Royal Society by Col. James, the Superintendent of the Survey. The ellipticity deduced is $\frac{1}{299.33}$. The mean specific gravity of the earth, as obtained from the attraction of Arthur's Seat, near Edinburgh, is 5·316; a result which accords satisfactorily with the mean of the results obtained by the torsion balance. Of the accuracy of this important work, it is sufficient to observe, that when the length of each of the measured bases (in Salisbury Plain and on the shores of Lough Foyle) was computed from the other, through the whole series of intermediate triangles, the difference from the measured length was only 5 inches in length of from 5 to 7 miles. Our knowledge of the laws of the *Tides* has received an important accession in the results of the tidal observations made around the Irish coasts in 1851, under the direction of the Royal Irish Academy. The discussion of these observations was undertaken by Professor Haughton, and that portion of it which relates to the diurnal tides has been already completed and published. The most important result of this discussion is the separation of the effects of the sun and moon in the diurnal tide—a problem which was proposed by the Academy as one of the objects to be attained by the contemplated observations, and which has been now for the first time accomplished. From the comparison of these effects, Professor Haughton has drawn some remarkable conclusions relative to the mean depth of the sea in the Atlantic. In the dynamical theory of the tides, the ratio of the solar to the lunar effect depends not only on the masses, distances, and periodic times of the two luminaries, but also on the depth of the sea; and this, accordingly, may be computed when the other quantities are known. In this manner Professor Haughton has deduced, from the solar and lunar co-efficients of the diurnal tide, a mean depth of 5·12 miles—a result which accords in a remarkable manner with that inferred from the ratio of the semi-diurnal co-efficients, as obtained by Laplace from the Brest observations. The subject, however, is far from being exhausted. The depth of the sea, deduced from the solar and lunar *tidal intervals*, and from *the age* of the lunar diurnal tide, is somewhat more than double of the foregoing; and the consistency of the individual results is such as to indicate that their wide difference from the former is not attributable to errors of observation. Professor Haughton throws out the conjecture that the depth, deduced from the tidal *intervals* and *ages*, corresponds to a different part of the ocean from that inferred from the *heights*.

THE DIRECTION OF GRAVITY AT THE EARTH'S SURFACE.

PROFESSOR HENNESSY, in a paper read by him to the British Association, observes:—If the earth's surface be considered to coincide with that of the liquid which covers three-fourths of the entire spheroid, gravity should be considered as perpendicular to it at every point. If, however, the earth were stripped of all its seas and oceans, the surface would present considerable inequalities. From what is now known regarding the depth of the ocean, the continents would appear as plateaus elevated above the oceanic depressions to an amount which, although small compared to the earth's radius, would be considerable when compared to its outswelling at the equator, and its flattening towards the poles. The surface thus presented would be the true surface of the earth, and would not be perpendicular to gravity. If a kind of mean surface be conceived intersecting this, so as to leave equal volumes above of elevations, and of depressions below it, it is not allowable to assume that such a surface is perpendicular to gravity. The mean surface of the solid crust of the earth would not be perpendicular to gravity, if, after the process of solidification had commenced, any extensive changes in the distribution of matter in the earth's interior could take place. If the fluid matter in solidifying underwent no change of volume, the forms of the strata of equal density within the earth would be the same at every stage of its solidification. But if, as observation indicates, such fused matter, on passing to the solid crystalline state, should diminish in volume, the pressure on the remaining strata of the fluid would be relieved, and they would tend to assume a greater ellipticity than they had when existing under a greater pressure. The general result of this action would manifestly be to produce a change in the direction of the attractive forces at the outer surface of the solid crust. The direction of a plumb-line would be slightly altered so as to slightly increase the apparent latitudes of places over a zone between the equator and poles.

M. D'Abbadie stated several cases which he had met with, where monuments existed which showed that the direction of gravity at some former period must have been very different in relation to those particular portions of the earth from what it now was. Other members also noticed deviations of the plumb-line from its normal position, and some of them which seemed to depend on the season.

Dr. Robinson stated that he was the first to direct attention to those changes of level which depended on the season of the year. This he was led to observe from the fact, that the entire mass of rock and hill on which the Armagh Observatory was erected was found to be slightly, but to an astronomer quite perceptibly, tilted or canted at one season to the east, at another to the west. This he had at first attributed to the varying power of the sun's radiation to heat and expand the rock throughout the year; but he since had reason to attribute it rather to the infiltration of water to the parts where the clay, slate, and limestone rocks met in their geological arrangement. The varying quantity of this through the year he now believed exercised a powerful hydrostatic energia by which the position of the rock was slightly varied.—*Athenæum Report.*

CRYSTALLIZATION.

PROFESSOR BLUM (Heidelberg) has made to the German Association some interesting remarks "On the Causes of the Formation of Different Combinations of Crystals in the same Species of Mineral."

On this subject, he observed, our knowledge was exceedingly scanty. We had scarcely a single observation or inquiry to which we were able to refer. Experiment alone presented us with facts by the aid of which we might possibly make some progres. It was a familiar fact that when an easily soluble salt (alum) crystallized from a pure solution, the forms exhibited differed from those which were obtained from impure solutions. This fact was sufficient in itself to show beyond a doubt that *the medium* in which substances crystallize exerts an influence upon the form of the crystal. Taking this for our principle, and applying it to nature, we find it to be a fact that certain minerals, when they occur in certain rocks, appear under one and the same form of crystal—when magnetic iron ore, for example, occurred in chlorite-schist, it was found in the general case to occur in the form of an octohedron.

Director Nanck reported the result of a series of experiments undertaken with a view to the arbitrary production of secondary surfaces on artificial crystals. He described the method employed by him, by means of which he found that the number of surfaces became greater in proportion to the slowness with which crystallization proceeded, a fact of which he cited several examples.*

SOLIDIFICATION OF FLUIDS BY PRESSURE.

PROFESSOR HENNESSY has submitted to the British Association certain views deduced from some propositions in the dynamical theory of heat contained in the writings of Professor W. Thomson and Professor Clausius. The general result arrived at regarding the influence of pressure on a fluid so circumstanced as to lose no part of the heat acquired by condensation would be, that so long as the matter continued in a fluid condition, the resistance to compression from this cause would be very small. If, however, the fluid were on the point of changing its state to that of solidity, the effect of the latent heat of fusion, which by hypothesis could not be emitted, would interpose a resistance of great magnitude compared to that resulting from simple compression. The fused matter of which the interior of the earth most probably consists, would be under conditions similar to those mentioned, from the slow conducting power of the materials composing the earth, and from the pressure of all the outermost strata of equilibrium of the fluid upon those near the centre, and thus the influence of pressure in promoting solidification would be less than at its surface.

DEVIATIONS OF THE COMPASS.

IT seems to be still a doubtful point among nautical men whether the Compasses on board ship are really affected by *fogs* to any dangerous extent, or whether the irregularities which are found to

* The general belief that only organic beings have the power of reproducing lost parts, has been disproved by the experiments of Jordan on crystals. An octohedral crystal of alum was fractured; it was then replaced in a solution, and after a few days its injury was seen to be repaired. The whole crystal had of course increased in size, but the increase on the broken surface had been so much greater that a perfect octohedral form was regained.—*G. H. Lewes.*

prevail in iron vessels are attributable more to the material of which they are built than to any extraneous cause. This difference of opinion was brought out during the investigation into the case of the *Charlemagne* at Campbelton. Captain Small adjusted the compasses, to the sluggishness of which Captain Reid ascribes the disaster. Captain Small disputes this view, and with much reasonableness and force, says:—"It would really be conferring a great boon upon iron shipbuilders, shipowners, shipmasters, underwriters, and all concerned, were a committee of disinterested scientific men appointed by the underwriters, or by Government, to make special inquiry into the different methods adopted of adjusting iron ships' compasses, and of determining their error, so that, when a wreck occurs, the compass may not come in for a larger share of the blame than it is entitled to. I may here state, that the steering compass of the *Charlemagne* was made by one of the first compass makers in London, on Sir Snow Harris's principle, and adjusted by magnets on Professor Airey's principle—which, so far as magnetic adjustments go, has never been disputed; and if Captain Reid has found it to be sluggish, as he asserts it was, he had a spare one to resort to. The standard compass was one patented by myself, for which I hold satisfactory testimonials. I have no hesitation in saying that no ship ever went from the Clyde provided with better instruments; and had the pilot and the men who were steering the ship when she went on shore been examined as witnesses, in place of those who were in their bed at the time, or on the maintopsailyard, we might have heard a different version about courses and errors of the compass."—*Greenock Telegraph.*

STRUCTURE AND MAGNETIC PHENOMENA OF THE GLOBE.

DR. STEVELLY has brought under the notice of the British Association, a theory by Mr. James Drummond. It started from the generally received hypotheses that the earth had cooled from a molten to a solid state, and assumed the existence, within an external crust constituting the earth's surface, of a fluid nucleus agitated by a system of internal tides similar to those of the ocean, and also of mountainous inequalities upon the inner surface of the crust. The internal agitations of the fluid nucleus accounted for earthquakes, volcanic and magnetic phenomena, on the exterior of the earth.

MAGNETISM.

PROFESSOR HANSTEEN of Christiania, the eminent magnetical philosopher, has presented a memoir to the Swedish Academy, proving, from his own observations, that the magnetic dip partakes of the daily, annual, and eleven-yearly periodic changes (the last coinciding with Schwabe's period of the solar spots), which have been already detected in the other magnetic elements. The same distinguished philosopher (who is now in his seventy-third year) expects soon to complete the reduction and publication of the magnetical results of his Siberian journey in the years 1828-30, which have been so long desired by the scientific world.—*Edinburgh New Philosophical Journal*, No. 12.

DOES MAGNETISM INFLUENCE VEGETATION?

MR. H. F. BAXTER states that the results of his inquiry into this subject are negative: that is, no positive evidence has been obtained to show that Magnetism either does or does not Influence Vegetation. After noticing the opinions of Becquerel, Dutrochet, and Wartmann, the author says:—"As it may be considered a law in vegetable physiology that all plants have a tendency, during the germination of their seeds, to develop in two diametrically opposite directions (the root and the stem), the question arose—Might not this direction be influenced or counteracted by submitting the seeds whilst germinating to the influence of magnetic force?" Accordingly, a series of experiments were undertaken by the author, which are classed under two principal heads: 1st, Those in which the line of magnetic force was directed *perpendicularly* to the plants; and 2nd, In which the line of force was directed *transversely* to the plants. The author gave details of the experiments, which were varied and multiplied. No definite conclusions, however, could be drawn from them relative to the effect of magnetism.—*Proceedings of the Botanical Society of Edinburgh.*

INFLUENCE OF MAGNETISM OVER CHEMICAL ACTION.

THE following inquiry, by Mr. H. F. Baxter, originated in an endeavour to ascertain whether *Magnetism* possessed any influence over *Organic Forces;* and the kind of experiments that were undertaken for the purpose of solving this question, was that of submitting seeds *during* vegetation to the influence of magnetism. These experiments, however, having failed to give any definite or decided result, Mr. Baxter was ultimately, and perhaps naturally, led to ask the question—*Does magnetism possess any influence over chemical action?* The solution of this question appeared to be almost a necessary preliminary step to the continuation of Mr. Baxter's original inquiry.

The author's investigations will be found detailed in the *Edinburgh New Philosophical Journal*, No. 10. The following are the general conclusions deduced from his investigations:—

1. That *Magnetism* (in its *static* or quiescent condition) does not *excite* or *originate chemical action*.

2. That when substances *undergoing* chemical action are submitted to the *influence* of magnetism (in its *static* or quiescent condition) *no increase* in the *chemical action* is observed; but that,

3. Under certain conditions *during* chemical action, the influence of magnetism is such as to indicate a *directive* influence over chemical action; this influence being shown by a [illegible]

4. That it is not necessary for the production of this *rotatory motion* that the solution should act chemically *upon* the iron bar forming the pole; for, if the pole be surrounded by a metal ring, the *rotation* occurs, provided the solution is capable of *acting chemically* upon this metal ring.

5. That the *influence of the magnet*, as well as the *existence* of the *chemical action*, and its *continuation*, are essential for the production of this *rotation*; and

6. That the *direction* of the *rotation* is dependent upon the *poles* of the magnet, being *contrary* for each *pole*.

MOLTEN SUBSTANCES.

MR. J. NASMYTH has read to the British Association a paper "On some Phenomena in Connexion with Molten Substances." The author stated his object to be to direct the attention of scientific men to a class of phenomena which, although in their main features might be familiar to practical men, yet appeared to have escaped the attention of those who were more engaged in scientific research.

The great fact which Mr. Nasmyth desired to call attention to is comprised in the following general proposition—namely, that all substances in a molten condition are specifically heavier than the same substance in an unmolten state. Hitherto water has been supposed to be a singular and special exception to the ordinary law—namely, that as substances were elevated in temperature they became specifically lighter; that is to say, water at temperature 32° on being heated does on its progress towards temperature 40° become more dense and specifically heavier until it reaches 40°, after which, if we continue to elevate the temperature, its density progressively decreases. From the facts which Mr. Nasmyth adduced, it appears that water is not a special and singular exception in this respect, but that, on the contrary, the phenomenon in relation to change of density (when near the point of solidification) is shared with every substance with which we are at all familiar in a molten state; so entirely so, that Mr. Nasmyth felt himself warranted in propounding, as a general law, the one before stated—namely, that in every instance in which he has tested its existence, he finds that a molten substance is more dense, or specifically heavier, than the same substance in its unmolten state. It is on account of this that if we throw a piece of solid lead into a pot of melted lead, the solid, or unmolten metal, will float in the fluid, or molten metal. Mr. Nasmyth stated, that he found that this fact of the floating of the unmolten substance in the molten holds true with every substance on which he has tested the existence of the phenomenon in question — as, for instance, in the case of lead, silver, copper, iron, zinc, tin, antimony, bismuth, glass, pitch, rosin, wax, tallow, &c.; and that the same is the case with respect to alloys of metals and mixtures of any of the above-named substances. Also, that the normal condition as to density is resumed in most substances a little on the molten side of solidification, and in a few cases the resumption of the normal condition occurs during the act of solidification. He also stated that, from experiments which he had made, he had reason to believe that by heating molten metals up to a temperature far beyond their melting point, the point of maximum density was, as in the case of water, at 40° about to be passed; and that at such very elevated temperatures the normal state, as regards reduction of density by increase of temperature, was also resumed, but that as yet he has not been able to test this point with such certainty as to warrant him to allude further to its existence.

Mr. Nasmyth considered this to be worthy of the attention of geologists, who might find in it a key to the explanation of many eruptive or upheaving phenomena which the earth's crust, and especially that of the moon, present—namely, that on the approach to the point of solidification, molten mineral substances then beneath the solid crust of the earth must, in accordance with the above-stated law, expand, and tend to elevate or burst up the solid crust; and also express upwards, through the so cracked surface, streams more or less fluid of those mineral substances which we know must have been originally in a molten condition. Mr. Nasmyth stated, that the aspect of the lunar surface, as revealed to us by powerful telescopes, appeared to him to yield most striking confirmation of the above remark. He concluded by expressing a hope, that the facts which he had brought forward might receive the careful attention of scientific men which their important bearing on the phenomena in question appeared to him to entitle them to.

A gentleman in the Section asked Mr. Nasmyth whether the facts well known to chemists, that cast iron, and one or two other metals, in the act of solidifying, enlarged so as to fill out sharply the minute parts of the mould—which was indeed the property on which their great use chiefly depended—were not at variance with his general principle?—Mr. Nasmyth replied, that so far from that, they were the most striking examples of its application.

INSPIRATION OF AIR.

A VERY interesting paper has been read to the Royal Society, by Dr. Edward Smith, Assistant-Physician to the Hospital for Consumption, entitled, "Inquiries into the quantity of Air inspired at each five minutes, one quarter, and half-hour of the Day and Night, and under the influence of various kinds of Exercise, Food, and Medicine, Temperature, &c."

The communication consists of three parts, and comprises the results of 1200 series of observations. The first part contains the results of three investigations as to the quantity of air breathed during the whole of the twenty-four hours, and registered every fifteen and thirty minutes. The second part describes the influence of posture, riding on horseback, travelling by omnibus and railway, rowing, swimming, walking, carrying of weights, the labour of the treadwheel, ascending and descending steps—also of sunlight and darkness, artificial heat, various diets, &c. The third part is devoted to certain inquiries in relation to the temperature of the body. There are not any records of inquiries similar to those contained in the first part of this paper, and extremely few in reference to any portion of the second. The aim of previous observers had been to determine the chemical effects of respiration.

The author was himself the subject of all the investigations. He is thirty-eight years of age, six feet in height, healthy and strong, and with a vital capacity of the lungs of 280 cubic inches. The instrument employed was Glover's patent dry gas meter of improved manufacture, and arranged to register from one to one million cubic inches. The action was reversed so as to measure inspiration. The mouthpiece employed was Sibson's, and it was connected with the spirometer by vulcanised caoutchouc tubing, and could be fastened upon the head by elastic straps. The determination of the quantity of air inspired in the twenty-four hours was effected by three inquiries—1st, by using the spirometer whilst in the quiet sitting posture, during five minutes at the commencement of each quarter of an hour, from 5 A.M. to 6¼ P.M., and of each half-hour from 6¼ P.M. to 3¼ A.M. Exercise was taken in the intervals, and food was eaten at 8¼ A.M., 1, 5½, and 8½ P.M. 2ndly, by using the spirometer without intermission during the whole of the twenty-four hours, excepting at intervals amounting collectively to forty minutes. 3rdly, by an inquiry similar to the second, but continued through the night only. In all these inquiries, the rate of respiration and pulsation, with the temperature of the wet and dry bulbs, and the barometric pressure, were recorded.

Among the most important and interesting results are the following. The inquiry made during five minutes at the beginning of every quarter of an hour from 5 A.M. to 6¼ P.M., and at the beginning of every half-hour from 6¼ P.M. to 3¼ A.M., gave the following average quantities in the sitting posture:—after supper, 354 cubic inches per minute; before breakfast, 358; after breakfast, 445; after dinner, 448; and after tea, 454. Mental excitement on several occasions did not influence the quantity of air inspired when the registration took place only once in five minutes. Sleep occurred with the lowest quantity of air inspired—viz., with 334 cubic inches per minute, but the quantity increased during sleep to 371 per minute. Posture increased the quantity of air inspired—in the sitting over the lying posture, and in the standing over the sitting posture. The increase in the standing over the lying posture varied from 20 to 96 cubic inches per minute. Riding in or upon an omnibus increased the quantity about 250 cubic inches per minute over that inspired when sitting at rest. Riding on horseback increased it—at the walking pace, 450 cubic inches, cantering 900, and trotting 1300 cubic inches per minute. Railway travelling on the engine increased it 200 cubic inches—in the third-class carriages nearly 200, in the second-class 150, and in the first-class 100. The quantity was the greatest at the speed of from thirty to forty miles per hour. Gentle walking increased the respiration from 169 to 692 cubic inches per minute; when moderate it increased it about 500, and when fast the increase was from 1206 to 1611. Gentle running increased it 1900, and fast running 2325 to 2500 cubic inches per minute. Carrying weights from 20lbs. to 118 lbs., at the speed of three miles per hour, increased the quantity of air inspired about 1900 cubic inches per minute. Heat and sunlight increased the rate of respiration from 16·8 to 17·8 per minute. Darkness lessened the quantity of air inspired to the extent of 32 cubic inches per minute. Considerable increase of artificial heat caused increased respiration, and considerable decrease the contrary, and these changes increased by continuance.

The author next gives the effects of a great variety of food and drink on respiration. The most remarkable changes were produced by the following articles. Milk increased the respiration 33 to 49 per minute; potatoes, only 0 to 6; coffee, 19 to 25; tea, 28 to 96; sugar, 60 to 88; rum, 34 to 42; whilst, on the other hand, cod-liver oil decreased the quantity of air inspired 10 to 65 cubic inches per minute, and olive oil 94 per minute. The temperature of the breath varied with that of the inspired air, but not proportionately. It was, on the average, 94°·7 in the room, and 89°·1 in the open air.

In the last part of the paper, Dr. Smith proceeded to notice the most remark-
[illegible] ions which may be drawn from his investigations. The detailed and
[illegible] him at various periods of the day, and
[illegible] an approximative estimate to be made

of the quantities breathed by various classes of the community, and of the quantities of chemical elements required to combine with the oxygen. Thus an unoccupied gentleman probably spends nine hours in the lying posture, eleven in the sitting posture, one in walking at the rate of two miles per hour, and three hours in standing, or walking at the rate of one mile per hour. The quantity of air thus inspired by him daily may be estimated as follows:—

9 hours	in the lying posture	243,000	cubic inches.
11	„ sitting	351,780	„
1	„ walking	66,000	„
3	„ standing	144,000	„

giving a total of 804,780 cubic inches of air breathed daily. An ordinary tradesman may be estimated to pass eight hours and a half in the lying posture, six in the sitting posture, three in walking, and four in standing. He will then breathe a total daily quantity of 968,580 cubic inches. The hard-working labourer will probably breathe 1,368,390 cubic inches of air daily. The three classes thus differ greatly in the quantity of oxygen which they inspire, and therefore in the quantity of food required by them; and if each obtained a suitable quantity of material to unite with the oxygen, the labourer would still have greater wear of system than the unoccupied man.

The estimation of the wear of system from various kinds of labour may be made from this inquiry, if the quantity of air inspired may be regarded as a tolerably fair indication of that result—such, for example, as the hard labour of felons, the marching of soldiers, and the ordinary mode of travelling by the community. We may consequently infer the amount of food and rest which each condition requires. It is also possible to increase or lessen the needful quantity of food (within limits) with some degree of certainty; and we learn how much more costly the maintenance of soldiers must necessarily be in time of war than peace, and that of felons at forced labour than in idleness. We further learn how to lessen the wear of system arising from such exertion as the carrying of burdens, by reducing the speed at which they are borne.

These inquiries also enable us to account for the inability of many persons to make an ascent, except at the slowest pace, and for the great inequality in all persons between the effect of ascending steps and walking on level ground at the same speed. From his investigations and experience in Switzerland, the author believes that his views account for such accidents as the spitting of blood, which have occurred whilst ascending mountains, without reference to the degree of atmospheric pressure. This is, in part, independent of chemical changes, and is due mainly to the capacity of the lungs and trachea to receive a certain quantity of air in a given time, and of the heart and bloodvessels to carry on the current of blood, and especially to maintain a due relation between the pulmonic and systemic circuits. They also explain the conservative influence of dark rooms in eastern and southern climes, and of night in all climates. In like manner, they indicate the reason of the unhealthiness of buildings with deficient light—as prison cells and many dwellings of the poor—and also of nervous persons living much in seclusion. It is [illegible] hat change of season varies the quantity of air [illegible] to exhaustion indirectly, by increa[illegible] activity of every function. Cold, when applied to the skin, [illegible] l air lessens the quantity of air inspired. Sleep and quietude are naturally associated with darkness and diminished activity of functions: and therefore wakefulness and labour at those periods of the day must induce more wear of system. Hence the ill effect of night labour. At the same time, the ease with which some persons pursue mental labour at night may be owing to the lessened vital actions at that period.

Breakfast seems to be the most important meal to the system, since it is taken after a long interval, and produces a greater effect upon the frame than any other meal. The effect of food does not pass away between the meals, or during the working day. Since a due relation between the respiratory function and the food supplied to the system is one of the most important problems of life, these inquiries are of great value, as they serve to prove how wisely our natural appetites lead us to a due combination of food, while at the same time they explain the ill consequences of what is termed "high living." Dr. Smith's interesting paper was accompanied by an extensive series of tables and curves illustrating his investigations. —*Saturday Review*, No. 80.

ATMOSPHERIC DISTURBANCES.

MR. THOMAS HOPKINS has communicated to the Royal Society, a paper "On the Action of Aqueous Vapour in Disturbing the Atmosphere." The author maintains that the great disturber of the equilibrium of atmospheric pressure is the aqueous vapour which is diffused through the gases. These gases, when ascending, cool (say 5°) through expansion by diminution of incumbent pressure, whilst the vapour that is within them cools only 1°; and a consequence is, that when a mixed mass ascends, the vapour is condensed by the cold of the gases. It is well known that condensation of vapour gives out much heat, and this heat warms and expands the gases when they are forced to ascend, taking vapour with them; and the process being repeated and continued, an ascending current is produced in the atmosphere, cloud is formed, the barometer sinks, rain falls, and winds blow towards the part.

This was shown to take place in all latitudes, producing disturbances great in proportion to the amount of vapour condensed. In tropical regions, where the aqueous material is abundant, the disturbances are great, but take place principally in the higher regions of the air. The diminution of atmospheric pressure within the tropics at the surface of the earth, as measured by the barometer, extends over a large surface, but is not great in any one place. In cooler latitudes condensation takes place nearer to the surface of the globe, and then reduction of pressure is confined to a smaller area; but in parts on the surface within that area the reduction is great, because the lower and therefore heavier gases have been warmed and expanded; hence the falls of the barometer in certain cool localities are the greatest. In very cold and dry regions, as a consequence of there being but little vapour in the air to be condensed, the barometer sinks only a little, and that sinking is generally confined to a small area. In accordance with this view, it was shown that, in certain places, where much continuous rain falls, the barometer has a low average; and towards these areas winds blow from distant parts, as in the great trade and other winds. Sea-breezes were also shown to be consequences of the condensation of vapour, which had been produced by the morning sun ascending to sufficient elevations; whilst the land-winds at night are attributable to the cooling of those elevated parts by evaporation during the absence of the sun.

Various objections that had been made to this theory of atmospheric disturbances were noticed by the author of the paper, which, though admitted to be plausible, were stated to be invalid, whilst the most important meteorological phenomena were asserted to be in accordance with it.

VELOCITIES OF CURRENTS OF AIR.

DR. W. D. CHOWNE has read to the Royal Society a paper supplementary to one presented in 1855, an abstract of which will be found in the *Year-Book of Facts*, 1856, p. 129. The author having ascertained that an upward current of air becomes established in a vertical tube placed in as quiescent an atmosphere as can be obtained, and having demonstrated its existence by means of anemometric discs placed in tubes as described in that paper, proceeds here to ascertain the velocity of the currents by which the discs were moved.

In order to estimate the velocity of the currents, one of the anemometric discs was placed within a short zinc tube three inches in diameter, the lower end of which was accurately fitted into an aspirator capable of containing thirty-six gallons of water. By drawing off in a given time a quantity of water equal in bulk to the cubic contents of one of the tubes described in the former paper, the velocity of a current required to produce a given number of rotations of the disc was determined.

The experiments were varied by altering the height of water in the aspirator, and thereby changing the velocity, while the exit-orifice remained unaltered.

By ascertaining the number of rotations of the anemometric disc, caused by currents of air of different velocities thus produced, he was enabled to arrive at a measure of the velocities in tubes placed in a still atmosphere, as described in his former paper.

The author in that paper pointed out a correspondence between the variations of force in the upward currents of atmospheric air in the tubes and variations in the humidity of the atmosphere, and expressed his belief that the variations were attributable in great measure to the varying hygrometric conditions of the atmosphere.

In further proof of this position he has appended two tables, showing that both natural and artificial increase of atmospheric humidity are accompanied by increase in the velocity of the rotations, and that in each case increase of humidity is attended by increase of velocity, independent of temperature.

THE SUN, THE MOON, AND THE EARTH.

THE President, in his inaugural Address to the British Association, at their late Annual Meeting, observed: The constitution of the central body of our own system presents a nearer and more interesting subject of speculation. Towards the close of the last century many hypotheses were advanced regarding the nature and constitution of the Sun, al[illegible] opaque body, surrounded at some distance by a luminous envelope. But the only certain fact which has been added to science in this department is the proof given by Arago that the light of the sun emanated (not from an incandescent solid, but) from a gaseous atmosphere, the light of incandescent solid bodies being *polarized by refraction*, while the light of the sun, and that emitted by gaseous bodies, is *unpolarised*. According to the observations of Schwabe, which have been continued without intermission for more than thirty years, the magnitude of the solar surface obscured by spots increases and decreases *periodically*, the length of the period being 11 years and 40 days. This remarkable fact, and the relation which it appears to bear to certain phenomena of terrestrial magnetism, have attracted fresh interest to the study of the solar surface; and, upon the suggestion of Sir John Herschel, a photoheliographic apparatus has lately been established at Kew, for the purpose of depicting the actual macular state of the sun's surface from time to time. It is well known that Sir William Herschel accounted for the solar spots by currents of an elastic fluid ascending from the body of the sun, and penetrating the exterior luminous envelope. A somewhat different speculation of the same kind has been recently advanced by Mosotti, who has endeavoured to connect the phenomena of the solar spots with those of the *red protuberances* which appear to issue from the body of the sun in a total eclipse, and which so much interested astronomers in the remarkable eclipse of 1842.

Next to the sun, our own satellite has always claimed the attention of astronomers, while the comparative smallness of its distance inspired the hope that some knowledge of its physical structure could be attained with the large instrumental means now available. Accordingly, at the Meeting of the Association held at Belfast in 1852, it was proposed that the Earl of Rosse, Dr. Robinson, and Professor Phillips be requested to draw up a Report on the physical character of the Moon's surface, as compared with that of the Earth. That the attention of these eminent observers has been directed to the subject, may be inferred from the communication lately made by Professor Phillips to the Royal Society, on the mountain Gassendi, and the surrounding region. But I am not aware that the subject is yet ripe for a Report. I need not remind you that the moon possesses neither sea nor atmosphere of appreciable extent. Still, as a negative, in such case, is relative only to the capabilities of the instruments employed, the search for the indications of a lunar atmosphere has been renewed with every fresh augmentation of telescopic power. Of such indications, the most delicate, perhaps, are those afforded by the occultation of a planet by the moon. The occultation of Jupiter, which took place on the 2nd of January last, was observed with this reference, and is said to have exhibited no *hesitation*, or change of form or brightness, such as would be produced by the refraction or absorption of an atmosphere. As respects the sea, the mode of exalong since suggested by Sir David Brewster is probably the most effective. If water existed on the moon's surface, the sun's light reflected from it should be completely polarized at a certain elongation of the moon from the sun. No traces of such light have been observed; but I am not aware that the observations have been repeated recently with any of the larger telescopes. It is now well understood that the path of astronomical discovery is obstructed much more by the earth's atmosphere than by the limitation of telescopic powers. Impressed with this conviction, the Association has, for some time past, urged upon Her Majesty's Government the scientific importance of establishing a large reflector at some elevated station in the southern hemisphere. In the mean time, and to gain (as it were) a sample of the results which might be expected from a more systematic search, Professor Piazzi Smyth undertook, last summer, the task of transporting a large collection of instruments—meteorological and magnetical, as well as astronomical—to a high point on the Peak of Teneriffe. His stations were two in number, at the altitudes above the sea of 8840 and 10,700 feet respectively; and the astronomical advantages gained may be inferred from the fact, that the heat radiated from the moon, which has been so often sought for in vain in a lower region, was distinctly perceptible, even at the lower of the two stations.—*Athenæum Report.*

EXPERIMENT ON THE SUN'S ACTINIC POWER.

PHOTOGRAPHERS will be interested in perusing the following account of an experiment made by Mr. J. J. Waterston, in Bombay, and recently communicated to the Astronomical Society, on the limit of photographic power of the Sun's Direct Light. It was made with the view of obtaining data in an inquiry as to the possibility of measuring the diameter of the sun to a very minute fraction of a second by combining photography with the principle of the electric telegraph: the first being employed to measure the element space, the latter the element time. The result is, that about one twenty-thousandth of a second is sufficient exposure to the direct light of the sun to obtain a distinct mark on a sensitive collodion plate, when developed by the usual processes.

A circular wooden disk, nineteen inches diameter and half-an-inch thick, was mounted on an iron axis, so that it revolved easily by an impulse given by pressing the finger with a jerk on the outer edge.

About half-an-inch from the rim there was a circular aperture, half-an-inch diameter, at the back of which the black paper was pasted. This paper was perforated by a needle, leaving a hole $\frac{1}{80}$-inch diameter. It was found that the utmost velocity that could be given to the disk was five revolutions in a second; and after four seconds, it was reduced to three revolutions per second. At each revolution the space described by the hole was about fifty inches.

The revolving disk was placed behind the folding-doors of a darkened chamber, so that when one wing was opened to the extent of a few inches, the sun's light struck the disk at the lower part of its revolution. Having made the preliminary arrangements, the observation was as follows:—

First, the maximum rotatory motion was given to the disk. A prepared sensitive plate was held close behind the disk (about ¼-inch from it), at the part where the sunshine struck. This plate was kept slowly moving in the direction of the radius of the disk. An assistant quickly opened and shut the door, allowing the sunshine to act for about a second. The latent image on the plate being developed, was found to consist of four or five concentric lines. This was repeated several times with different plates.

Taking the velocity of the aperture to be 150 inches per second, which is certainly under the mark, and the breadth of the hole $\frac{1}{80}$th of an inch, the duration of the sun's full action on any one point must have been about $\frac{1}{12000}$th of a second.

The photographic process employed was as follows:—"Albumen on glass iodized by tincture of iodine, 20 gr. to 1 oz. of spirit. The silver bath, 50 gr. nitrate of silver to 1 oz. water, and 12 drops nitric acid. The developing solution three parts water to one of acetic acid, and the mixture nearly saturated with protosulphate of iron."

The above was afterwards tried comparatively with the collodion process, and found to be considerably inferior in quickness of taking an impression, the ratio being 2 or 3 to 1.—*Literary Gazette*, June 6.

TEMPERATURE AND LUNAR INFLUENCES.

MR. J. P. HARRISSON has communicated to the British Association a paper "On a Law of Temperature depending upon Lunar Influence." The author commenced by saying that, although the question of Lunar Influence on the atmosphere of our planet was very generally considered as set at rest by the investigations of M. Arago, yet he felt very confident that he was in a position to prove the law he was now about to announce without fear of contradiction. He had reduced and thrown into the form of tables and of curves 280 lunations, with the corresponding mean temperatures; and the laws at which he had arrived were, first, between the first and second octant the temperature immediately after the first quarter, both on the average, and also, with rare exceptions, in each individual lunation, is higher than the temperature shortly before the first quarter; secondly, and more particularly, the mean temperature of the annual means of the second day after the first quarter (or the tenth day of the moon's age) is always higher than that of the third day before the first quarter (or the fifth day of the lunation). The tables and curves accompanied the essay, which illustrated these laws at great length.

ACOUSTIC EXPERIMENTS.

PROFESSOR TYNDALL has described to the Royal Institution, M. Lissajous' Acoustic Experiments. The speaker briefly noticed the physical cause of musical sound; referring to the bell, the tuning-fork, the tended string, &c., as sources of vibration. The propagation of impulses through the atmosphere to the tympanum was illustrated by causing a brass rod to vibrate longitudinally: a disk was fixed to the end of the rod perpendicular to its length, and this disk, being held several feet above a surface of stretched paper on which sand was strewn, communicated its motion through the air to the paper, and produced a complex model figure of great beauty. Optical means had been resorted to by Dr. Young, and more especially by Mr. Wheatstone, in the study of vibratory movements. M. Lissajous had extended and systematized the principle; and had exhibited his experiments before the Société d'Encouragement, and more recently before the Emperor of the French. When he became acquainted with the speaker's intention to introduce these experiments at the Royal Institution, he in the most obliging manner offered to come to London and make them himself. This offer was accepted, and the speaker also congratulated the audience on the presence of M. Duboscq, who took charge of his own electric lamp; this being the source of light made use of on the occasion.

The experiments proceeded in the following order:—1. A sheaf of light was thrown from the lamp upon a mirror held in the speaker's hand: on moving the mirror with sufficient speed, the beam described a luminous ring upon the ceiling. The persistence of impressions upon the retina was thus illustrated.

2. A tuning-fork had a pointed bit of copper foil attached to one of its prongs: the fork being caused to vibrate by a violin bow, the metallic point moved to and fro, and being caused to press gently upon a surface of glass coated with lamp-black, the fork being held still, a fine line of a length equal to the amplitude of the vibrations was described upon the glass; but when at the same time the whole fork was drawn backwards with sufficient speed, a sinuous line was described upon the glass. The experiment was made by placing the coated glass before the lamp; having a lens in front of it, and bringing the surface of the glass to a focus on a distant screen. On drawing the fork over the surface in the manner described, the figure started forth with great beauty and precision. By causing a number of forks to pass at the same time over the coated glass, the relations of their vibrations were determined by merely counting the sinuosities. The octave, for example, had double the number of its fundamental note.

3. This was the first of the series of M. Lissajous' experiments. A tuning-fork, with a metallic mirror attached to one of its prongs, was placed in front of the lamp; an intense beam of light was thrown on the mirror, and reflected back by the latter. This reflected beam was received on a small looking-glass, held in the hand of the experimenter, from which it was reflected back upon the screen. A lens being placed between the lamp and tuning-fork, a sharply defined image of the orifice from which the light issued was obtained. When a violin bow was drawn across the fork, this image elongated itself to a line. By turning the mirror in the hand, the image upon the screen was resolved into a bright sinuous track, many feet in length.

4. A tuning-fork was placed before the lamp, as in the last experiment. But instead of receiving the beam reflected from the mirror of the fork upon a looking-glass, it was received upon the mirror of a second fork, and reflected by the latter upon the screen. When one fork was excited by a bow, a straight line described itself upon the screen; when the other fork was subsequently excited, the figure described was that due to the combination of the vibrations of both the forks. This is the principle of the entire series of experiments now to be referred to. When a single fork vibrates, the image which it casts upon the screen is elongated in a direction parallel to the prong of the fork. In order to have the vibrations rectangular, one fork stood upright, the other was fixed horizontally, in a vertical [illegible]

5. Two forks, in perfect unison with each other, were placed in the positions described, and caused to vibrate simultaneously. If both forks passed their position of equilibrium at the same instant—that is, if there was no difference of phase—the figure described was a straight line. When the difference of phase amounted to one-fourth, the figure was a circle: between these it was an ellipse. The perfect unison of the two forks was proved by the immobility of the figure upon the screen. On loading one of them with a little weight, the figure no longer remained fixed, but passed from the straight line through the ellipse to a circle, thence back through the ellipse to the straight line. So slight is the

departure from unison which may be thus rendered visible, that M. Lissajous states that it would be possible to make evident to a deaf person a discrepancy of one vibration in thirty thousand.

6. Two forks, one of which gave the octave of the other, were next made use of. When there was no difference of phase, the figure described upon the screen resembled an 8. If the unison was perfect, the figure, as in the former case, was fixed; but when the unison was disturbed, the figure passed through the changes corresponding to all possible differences of phase. The loops of the 8 became distorted, formed by superposition a single parabola, opened out again, became again symmetrical, and so on.

7. The fifth of the octave, the major third, and other combinations succeeded, the figures becoming more and more complex as the departure from simple relations between the vibrations increased.

8. Finally, two forks which, when sounded together, gave audible beats, were placed both upright upon the table. The beam reflected from the mirror of one was received upon that of the other, and reflected upon the screen. When both forks were sounded, they sometimes conspired to elongate the image; sometimes they opposed each other; and thus a series of elongations and shortenings addressed the eye at exactly the same intervals in which the beats addressed the ear.

At the conclusion of this beautiful series of experiments, which, thanks to the skill of those who performed them, were all successful, on the motion of Mr. Faraday, the thanks of the meeting were unanimously voted to MM. Lissajous and Dubosoq.

NEW ACOUSTIC PHENOMENON.

Mr. Donovan has described to the British Association a new and singular Acoustic Phenomenon. The author explained the beats which are experienced when two strings tuned nearly, but not exactly, to unison, are struck at the same time. He then stated that the Earl Stanhope had observed that when a tuning-fork whilst vibrating was held to the teeth, similar beats were heard, which he (Earl Stanhope) attributed to the two prongs of the tuning-fork not being in exact unison. This effect the author often tried to experience, but never could succeed until upon one occasion, just after he had ceased from violent exercise, having applied the fork to his teeth, he distinctly heard the beats. He was thus led to the true origin of the phenomenon, which he could now experience whenever he wished, by running a short distance, particularly up and down stairs. The effect was caused by the beatings of his own heart, or the pulsations of the circulating blood. Mr. Ninnis, one of the secretaries, would explain the phenomenon described by the author, to arise from one set of vibrations propagated to the auditory nerve through the bones of the teeth, and of the head, modified by the action of the heart interfering with other pulses propagated in the ordinary way through the air to the organ of hearing.

COLOUR-BLINDNESS.

Professor G. Wilson, M.D., has read to the Scottish Society of Arts a note on the Statistics of Colour-Blindness. The case in question occurred in the practice of Mr. White Cooper, the oculist, and had been examined by him and by Professor Tyndall, of the Royal Institution, Albemarle-street. It was described by the last-named observer, in the *London and Edinburgh Philosophical Maga-*

zine for May, 1856, and is in many respects the most remarkable example of colour-blindness on record. Its peculiarity consists in its having occurred in one whose vision of colour was originally normal, but who suddenly became colour-blind several years ago, and has remained so ever since. Captain C., commander of a small coasting vessel, was in the habit of spending some portion of his leisure in working with coloured worsteds—a practice not unusual among our merchant seamen. On one occasion he was anxious to complete a flower, but found himself unable to distinguish the colour; thinking the light at fault, he changed his place more than once, but without bettering matters, and he finally went on deck, where he realized before long that he had lost his former perception of tints. No pain, inflammation, or other morbid symptom showed itself in the organs of vision, nor do they now betray any abnormal appearance; but he has ceased in ordinary circumstances to perceive any colour but blue, and exhibits all the peculiarities of congenital colour-blindness, with the additional defect of inability to distinguish yellow from white, so that he mistakes a half sovereign for sixpence. Yet his sense of colour is only dormant; for, when red glass was shown him in front of the electric light, he recognised it as red, and spoke of it as a colour he had not seen for years. It was only, however, when very near the glass, and with the very bright light in question shining through it, that he saw red. At a little distance from the electric lamp, or quite close to a candle-flame, he could not tell the tint of an interposed red glass. In accordance with this, he mentioned to Professor Tyndall that the Portland light, which he has occasion frequently to pass, has recently been changed in colour, but he has not observed any difference. The interest of the case lies partly in the fact of its not being an example of congenital colour-blindness, but chiefly so far as practice is concerned, in its occurring in a sea captain, to whom the present Admiralty system of night-signals on board steamers—which tell only by their colour, viz., red or green, in what direction the steamer is sailing—is totally useless. So also are many of the lighthouse combinations of coloured lamps. Captain C., were he to trust to his own eyes at night, would certainly shipwreck his vessel, so carefully have the Admiralty put it out of the power of a colour-blind pilot to help himself, by making the significance of the most important night-signals used on board steamers turn solely on colour; and it is rumoured that this dangerous system of signalling is about to be rendered imperative on sailing vessels. In continuance of this communication, the author stated that he had the authority of one of the civil engineers of the Board of Trade for mentioning that the Government inspectors of railways had found 3 per cent. of the railway servants and porters disqualified for their duties by defective vision of colour.

ON A NEW STEREOSCOPIC PHENOMENON. BY M. A. CIMA.

I TAKE a drawing of a head seen in front, of 3 or 4 centimetres in height; it may be lithographed, or engraved, or drawn with a pencil. I cut this drawing in the direction of the vertical axis of the nose, and arrange these two parts of the drawing in the same vertical plane, before the eyes, at a less distance than that of distinct vision. I remove or bring together the two parts of the drawing until the two images which result from their duplication combine so as to form the entire face. The image of this face thus obtained presents the appearance of a solid object, or of a modelled figure in which the nose, the cheek-bones, the chin, and the eyebrows are detached, as in an object in relief. This sensation of relief increases in proportion to the length of time during which the two images are viewed; to obtain the maximum of effect, the two half-faces must be held at a suitable distance, which varies according to the observer. A similar, but much less perfect effect is obtained by looking at the drawing of the entire face, either with one or both eyes, at a distance much less than that of distinct vision.

I think that the explanation of these phenomena must be founded upon the two following facts, which led me to make the observation which is the subject of this note. The eye sees of a gray colour a series of very small alternate black and white spaces, very close to each other, and seen at a distance less than that of distinct vision. In looking at a single face divided into small squares alternately black and white, at a distance less than that of distinct vision, the white squares appear larger, the lines of contact between the white and black squares become of a gray colour, which extends gradually, and the black squares appear larger; at the same time the white squares appear to be raised at the centre and the black squares to be hollowed. This double property of our eye, which is due to *ocular irradiation*, furnishes us with a sufficient explanation of this new stereoscopic appearance.—*Comptes Rendus; Philosophical Magazine*, No. 95.

THE PRISM.

DR. GLADSTONE has read to the British Association a paper "On the Novel Use of the Prism in Detecting Impurities." The author described the methods of examining substances by means of a Prism, especially the instructive results obtained with liquids when the ray of light traverses them in a wedge-shaped vessel. He suggested this as a means of detecting coloured impurities when they do exist, and of proving their absence when they are wrongfully suspected. He showed the value of the means in respect to coloured confectionery, tea, and mustard, and remarked on its use in examining wines, liquors, pigments used in the fine arts, gems, pharmaceutical preparations, &c. He stated that the prism and hollow wedge were already used as a commercial means of ascertaining the purity of certain substances.

NEW FORM OF TELESCOPE.

AT the American Association for the Promotion of Science, Mr. Alvan Clarke, of Cambridge, has described a new instrument of his own invention, for measuring the distance apart of stars too distant to be brought into the field of view of a telescope. Within a year from the first thought of the instrument entering his mind, he has built a telescope of six inches aperture, and 103 inches focal length, mounted it equatorially, governing its motion by Bond's spring-governor clock, provided the two eye-pieces, and as a substitute for a filar micrometer, arranged a mode of using pieces of glass ruled with a ruling machine. Experiments have demonstrated the feasibility of using the two eye-pieces in this way, and of obtaining by them very accurate measures of the distances of stars, which are from three to one hundred minutes of space apart. The success of the instrument is, however, greatly due to the spring-governor, which keeps each star upon the wire accurately bisected.

TELESCOPE SPECULUM OF SILVERED GLASS.

M. LEON FOUCAULT, in a paper read by him to the British Association, in French, upon a "Telescope Speculum of Silvered Glass," after a brief but lucid description of the telescope, pointed out the difficulties which were found in its construction in the two different kinds of instrument—those which formed the image by refraction, and those in which the reflection was thrown upon a metal surface. He pointed out the difficulties of working out the achromatic telescope and their causes, and the still greater difficulty which was found in giving the precise form to the metal surface before it was capable of producing accurate images. The great and almost insuperable difficulty of repolishing the metal speculum was explained, as but a very minute fault rendered the instrument valueless. He remarked upon this branch, that as the metal surface was of course easily tarnished, and therefore requiring to be repolished frequently, there was the more danger of destroying the mirror altogether. It occurred to him, he said, that it might be possible to form a reflecting surface, which should be easily figured, easily restored, and which should possess far more illuminating power than either the achromatic or the ordinary reflector, of which the specula are composed of alloy of copper and tin. The process at which he arrived was this:—To form a speculum of glass, no matter how imperfect the material, or how untransparent, provided it was free from air-bubbles. Then he deposited on this a film of silver by a process invented some years ago, and which had latterly been much improved. He found that it could be deposited in uniform thicknesses, exceedingly thin, and that when looked through it was then found to be transparent, and to transmit a blue light, familiar to those experienced in optics. He explained, that when it became necessary, owing to depositions made by the atmosphere, by which the silver became infinitesimally oxidized, it was possible, by light friction of soft leather, charged, if necessary, with peroxide of iron, to remove that obstruction. Thus the speculum was light, unalterable, and extremely strong, and the reflecting surface was extremely brilliant. Inequalities in thickness were at once detected by the transparent quality of the speculum. He also stated the process which he used for depositing the silver, and showed that the co-efficient was not less than 0·91. He exhibited one of the specula, and a reflecting telescope, upon the new principle, was placed in one of the windows.

Dr. Greer said that he had the pleasure of frequently looking through different mirrors constructed upon the novel principle of M. Leon Foucault. He had put them to a severe test, and he had compared one of seven inches with an excellent achromatic of five inches, and unquestionably that of M. Foucault was the superior.

MOVEABLE HORIZONTAL SUN-DIAL.

MR. DONOVAN has described to the British Association a Moveable Horizontal Sun-dial, which shows correct solar time within a fraction of a minute. The author first gave a short account of common horizontal dials, showing that, in consequence of the penumbral shadow of the gnomon, they could scarcely ever give the time within three minutes, even when they were well constructed and carefully set. He then explained his own dial, which, though large, was portable, with means of setting it in the meridian and truly horizontally, which he explained. The circle of the dial was about thirteen inches diameter; towards its south point a fine needle rose, from which two human hairs proceeded, one in a fixed position, parallel to the earth's axis at the place; this was supported by a stout brass arch, which could be shortened or lengthened, and which had a fine slit at its upper part to hold the fixed hair. The shadow of this hair, the author stated, was always sharp and well defined for about three inches from the needle, around which a small hour-circle of about that diameter was graduated. The floating hair, as the author called it, being taken by the hand and laid along the shadow of the fixed hair so as to bisect it where it was sharp, was stretched out to an outer graduated hour-circle, where the induction could be easily read off to a fraction of a minute, amounting to a few seconds.

SEA SAWDUST.

MR. MACDONALD, who is attached to H.M. surveying ship *Herald*, in a paper read to the Royal Society, observes that floating fields of minute algæ were seen by Cook and subsequent voyagers in the South Pacific. Mr. Macdonald found it difficult to determine whether the species which he saw in the Pacific is to be referred to the Oscillatoridæ or to the Confervidæ. In the latter, a linear series of tubular cells compose the filaments, which are said to be jointed; but in the former, although the filaments are tubular, simple, and continuous, without actual joints, a pseudo-jointed appearance is presented by the apposition of little masses of colouring matter. Notwithstanding that the author submitted the "Sea Sawdust" of the Pacific to microscopical examination on several occasions, he is much inclined to believe that the filaments are actually jointed; and this view is supported by the circumstance that an empty tubule, or one in which the parietes may be traced continuously without being interrupted by joints or internal septa, has never fallen under his notice; besides which, the filaments are exceedingly brittle, usually suffering cleavage in the transverse direction. It, however, undoubtedly belongs to the Oscillatoridæ. When the filaments are first removed from the water, they may be observed adhering side by side in little bundles or fasciculi; and besides the colouring matter, the little cells, or at least the intervals between the septa, contain globules of air, which sufficiently account for their buoyancy; and, moreover, in this respect, although their abiding-place is the open ocean, their habit can scarcely be regarded as very different from that of those species which flourish in damp localities exposed to the atmosphere. The filaments are all very short compared with their diameter, with rounded extremities; and when immersed some little time in fluid, so that the contained air-bubbles make their escape, or are taken up, the pale colouring matter appears to fill the cells completely, and a central portion, a little darker than the rest, may be distinctly perceived in each compartment, intersected by a very delicate transverse partition. The author found this species off the coast of Australia and in Moreton Bay. He has also found it among the Polynesian Islands, and on two separate occasions off the Loyalty group, in nearly the same geographical position.

THE GULF-STREAM.

PROFESSOR HENNESSY has communicated to the British Association a paper "On the Influence of the Gulf-Stream on the Climate of Ireland." He showed on a large map of the British Isles the isothermal lines, or lines indicating the equal degrees of temperature; and these ran, not horizontally in the direction of the parallels of latitude, as might be expected, but in curves almost concentric, and following very nearly the windings of the coast. These curves were laid down from the results of a long series of observations on the climate and temperature, by Dr. Lloyd, the President of the Association; and one of these results, founded on a series of both day and night observations, was, that the mean temperature of the sea off the west coast of Ireland was four degrees higher than the main temperature of the land. All these facts were easily explained by the phenomenon of the Gulf-Stream, or warm current of water, which, as was well known to navigators, flowed from the Gulf of Mexico in the direction of this country and the north-west coast of Europe. That current of water, heated in the warm regions where it commenced, exercised its influence very sensibly on the atmosphere, raising its temperature, and charging it with vapours, which were known to give out a certain amount of heat. In Dr. Wilde's historical "Report on the Diseases and Cosmical Phenomena of Ireland," presented with the Census returns, they read of several extreme changes of temperature having taken place in remote ages in this country; and those might have been caused by the temporary deflexion or deprivation of the Gulf-Stream, arising from some perturbation in the tropical regions, and leaving this country for the moment in the same position it would be in if no Gulf-current

THE DEPTH OF THE MEDITERRANEAN.

SOUNDINGS have not yet been made in the Mediterranean by the improved methods lately adopted in the Atlantic, and conducted so systematically by Lieutenant Maury, in some parts of that ocean. But they suffice to indicate depths equal to the average height of the mountains girding round this great basin; and, if one particular experiment may be credited, reaching even to 15,000 feet; an equivalent to the elevation of the highest Alps. This sounding was made about ninety miles east of Malta. Between Cyprus and Egypt 6000 feet of line had been let down without reaching the bottom. Other deep soundings have been made in other places with similar results. We have not yet obtained any official account of the soundings very recently effected by the *Tartarus* in the lines of sea between Egypt and the Archipelago; but it is stated, on apparently good authority, that one sounding between Alexandria and Rhodes reached bottom at the depth of 9900 feet; another between Alexandria and Candia, gave a depth of 300 feet beyond this. These single soundings, indeed, whether of ocean or sea, are always open to the certainty that greater as well as lesser depths must exist, to which no line has ever been sunk—a case coming under that general law of Probabilities so largely applicable in every part of physics. In the Mediterranean especially, which has so many aspects of a sunken basin, there may be abysses of depth here and there which no plummet is ever destined to reach.—*Edinburgh Review.*

THE ATLANTIC TELEGRAPH PLATEAU.

THE ocean bed of the North Atlantic is a curious study; in some parts furrowed by currents, in others presenting banks, the accumulations perhaps of the *débris* of these ocean rivers during countless ages. To the west, the Gulf-Stream pours along in a bed from one mile to a mile and a half in depth. To the east of this, and south of the Great Banks, is a basin, eight or ten degrees square, where the bottom attains a greater depression than perhaps the highest peaks of the Andes or Himalaya,—six miles of line have failed to reach the bottom; but of this more presently. Taking a profile of the Atlantic basin in our own latitude, we find a far greater depression than any mountain elevation on our own continent. Four or five Alleghanies would have to be piled on each other, and on them added Fremont's peak, before their point would show itself above the surface. Between the Azores and the mouth of the Tagus, this decreases to about three miles. Further north, there is an apparent decrease of depth, with increasing regularity of bottom, though it is problematical whether this is not owing to the greater accuracy with which these observations have been conducted. This appears to be the natural route for the Transatlantic telegraph. Other plans have been proposed—one a northing circuit, between the several points of Scotland, Iceland, Greenland, and the Labrador coast, each span being some 500 miles, or to use one or two of the island groups of the Atlantic. In the route selected we have many advantages—convenient harbours at either terminus; a depth of water at every point sufficient to place the wire beyond the reach of any surface causes, such as ice or the anchor of any ship, yet not at an impracticable depth, being at the shoalest several hundred feet, and in mid-Atlantic not materially over two miles. During a thousand miles of its course, the gradual depression of the ocean bed does not exceed 500 fathoms. On either side lie Ireland and Newfoundland, the breast-works of either continent, approaching within 1700 miles, and forming the natural terminus of its route. Trinity Bay is its western head, and Valentia Bay, on the south-western point of Ireland, its eastern. Specimens of the bottom, when subjected to a powerful glass, exhibit delicate shells and infusoria, fragile as if carved in egg-shell, and yet as perfect in all their delicate formation as any of the more durable works of Nature. The least attrition would crumble all this to powder. The inference is, that all agitation of winds and currents is confined to the surface, and that at these sunless depths the great mass of water remains in almost a quiescent state, and that the telegraphic wire, if once laid in safety, would lie for ever beyond the reach of harm, sinking among and covered by these fleecy particles.—*New York Times.*

HEIGHT OF THE HIMALAYAS.

It appears, from a late survey made of the Himalaya range, by Colonel Waugh, that the Khanchinjinga, which has been hitherto supposed to be the highest summit, is in fact not so—a higher mountain having been discovered, situated between Katamandoo and Khanchinjinga. This last named is 28,156 feet above the level of the sea; but the new summit reaches the enormous height of 29,002 feet. It has been proposed to call this Mount Everest, after a former surveyor-general of India.

REPULSION OF WATER.

Dr. Buist, F.R.S., has communicated to the Royal Society, a paper "On the Causes and Phenomena of the Repulsion of Water from the Feathers of Water-fowl and the Leaves of Plants." When Dr. Buist was residing in Bombay, in the neighbourhood of a number of small tanks or ponds abounding with the lotus or sacred bean of India, and also with four different varieties of water lily, he was struck by the different appearances presented by these when immersed in water, or when water was sprinkled on them. The leaves of the lily, like those of the lotus, floated with considerable buoyancy on the surface, but never, like the lotus, rose above it on a tall independent stem. The leaf of the lily is full of holes about the size of a pin's head, and serrated at the edges. Through these, when the leaf is pressed down, the water perforates freely. The upper surface of the leaf is smooth and shining, and water runs off it as it does off a piece of glass, or greased surface. When placed under the water at an angle of about 45°, the leaf of the lily seems to change colour. The dark purple leaf of the red lily appears of a bright rich pink; and the dark green or bluish-green of the white, pink, and blue lilies, seem to become of a bright emerald-green, the intensity of their hues varying with the angle at which the immersed leaf is seen.

When the lotus leaf is placed under water, it reflects light like a mirror, so that the image of any object, if presented to it at a proper angle, is seen by the spectator as distinctly as if the surface were one of polished metal. When water is thrown on the surface of a floating leaf, it flows off like a pool of quicksilver, reflecting light from the whole of its lower surface. This holds good on all occasions—the repellent property of the leaf exists, however, only on the upper surface.

On examining carefully the cause of this natural phenomenon, Dr. Buist found that the lotus leaf is covered by short microscopic papillæ, which entangle the air and establish a kind of air plate over the entire surface of the leaf, with which in reality the water never comes in contact. Another singular peculiarity connected with the structure of the lotus leaf is the curious respiratory pores which dot its surface. The leaves of the lotus, when full-sized, are from a foot to sixteen inches in diameter. On cutting off a leaf six inches broad, the stem of which was a little less than the third of an inch in diameter, thirty cubic inches of air were collected in an hour, while the vital energies of the plant must have been injured by its mutilation. At this rate, a tank covered by lotus leaves throws off a large proportion of air daily.

Dr. Buist considers that sensible respiration is not at all essential to the repelling power of leaves. The most beautiful manifestation of it that he has met with is in the Pistia, a little floating water-plant, abounding in shallow tanks in India, and much resembling common endive. When pressed under the surface of the water, the leaves present the appearance of molten silver. The same appearance is presented on cabbages, young clover, and a vast variety of other leaves, and it is the cause of the bright pearl lustre of dew. Precisely the same phenomenon is manifested on the wings and backs of divers when they plunge into the water. In this case Dr. Buist conceives that the explanation has been ascribed most erroneously to the existence of grease or oil in feathers; whereas he conceives that it is due to the presence of an air plate repelling the water, so that it never comes in contact with the feathers. The trimming process so carefully performed by water-fowl is probably an application of oil or grease, with the object of separating or dressing the little fibres of the feathers so as to produce an arrangement fitted to entangle the air. The reflection of light from the lower surface of the water is the proof of want of contact, when absolute contact exists even without diffusion or permanent wetting. A piece of polished marble or of glass readily throws off the water without remaining wetted, but no reflection is in this case observable. Dr. Buist throws out a hint to the manufacturers of waterproof cloths, conceiving that they might produce a surface which would entangle and retain a film of air, rendering the substance impervious to water, while, at the same time, the texture would admit the free transmission of respiration or moisture.—*Saturday Review*, No. 89.

Electrical Science.

ELECTRICAL PHENOMENA IN THE UNITED STATES.

THE following paper, by Professor Loomis, has been read to the British Association:—

Atmospheric electricity is very abundant in the United States, and often exhibits phenomena more remarkable than are witnessed in most of the countries of Europe, especially in England and Germany. These phenomena are not confined to any particular season of the year; but the exhibitions in summer appear under a different form from those of winter. In summer, free electricity exhibits itself chiefly in the form of lightning during thunderstorms; and these exhibitions are often among the most sublime and impressive phenomena witnessed in any part of the globe. The telegraph wires are exceedingly sensitive to the approach of a thunder-storm. The wires are often charged with electricity from the effects of a storm so distant that no thunder is heard, or lightning seen. I have often stood at such times in a telegraph office, and introduced my own body into the electric circuit, by taking hold of a telegraph wire with one hand, and with the other hand grasping a wire which communicated with the earth. A frequent twinge is felt in the arms, and sometimes through the breast. The shock is pungent and painful, even when scarcely the slightest spark can be obtained by bringing the two wires nearly in contact. Such experiments are unsafe when the electric cloud is near. If, during the passage of a thunder shower, the telegraph apparatus is left in communication with the long telegraph wires, the fine wires of the electro-magnets are almost sure to be melted, and the magnets thereby rendered useless. Sometimes, in telegraphic offices, there occurs an explosion, which melts large wires, and is dangerous to human life. The effect of a feeble current of atmospheric electricity on the telegraph wires is the same as of a current from a galvanic battery. It makes a dot on the telegraph register; and, when a thunderstorm passes in the neighbourhood of a telegraph line, those dots are of constant occurrence, and being interposed between the dots of the telegraph operators, they render the writing confused, and often illegible. The operators are, therefore, commonly compelled to abandon their work when a thunder shower prevails in the vicinity of any part of the line.

The aurora borealis is very common in the United States, even in summer; but, on account of the long-continued twilight, it is seldom witnessed with such brilliancy in summer as in winter. During winter, thunderstorms in the United States are of very rare occurrence, but even at this season they are not entirely unknown. Sometimes in mid-winter, after a series of unusually warm days, a strong wind suddenly springs up from the west, attended by a shower, during which several flashes of lightning, accompanied by thunder, are noticed. Such a shower is invariably followed by a great and sudden fall of the thermometer. But, while electrical discharges in the form of lightning are rarely witnessed in winter, other electrical phenomena of great interest are of almost daily occurrence. Those phenomena consist of free electricity residing upon almost all bodies resting on the earth, but sufficiently insulated. This free electricity is particularly noticeable on the clothes and hair of the human body. During the cold months of winter, the human hair is commonly electrical, and especially when it is brushed with a fine comb. Often at such times the fine hairs are seen to stand erect; and the more you comb to make them smooth, the more obstinately they refuse to keep their proper place. If you present your fingers to those electrified hairs, they fly to meet you, like a lock of dry hair attached to the prime conductor of an electric machine. In such cases there is but one remedy: the hair must be thoroughly moistened; after which it lies quietly in its place. During the same season of the year, all woollen articles of clothing become highly charged with free electricity. The pantaloons in particular are found to attract light, floating particles of dust, down, &c., especially near the feet: and it is impossible to cleanse them by brushing. The longer you brush, the more your clothes are covered with dust and lint. Nothing less than a wet sponge is efficient to cleanse them. At night, when you take off your pantaloons, you hear a distinct crackling noise, and, in a dark room, perceive a succession of flashes. You draw your fingers down over them, especially near the lower extremities, and you perceive a repetition of the crackling noise, accompanied by distinct flashes of light. As you take off your flannel drawers, the crackling is again heard, louder than before, and the flashes of light are more vivid. If you take a woollen blanket from your bed, hold it suspended in your left hand, and draw the fingers of your right hand over it, the crackling is equally loud and long continued. Your fingers seem enveloped in a blaze of light, and the flashes can be several times renewed. Brute animals do not escape the general electrical influence. In a cold, frosty night, you draw your hand gently over a cat's back, and you hear a distinct crackling noise, while the cat shows unmistakeable signs of bad temper, and refuses her consent to play the philosopher with you.

Persons riding on horseback during a snow-storm in the night have frequently noticed the extremities of their horse's ears tipped with light, like that of a pale, steady flame. The preceding phenomena are either unknown in summer or are only noticed occasionally, and in an inferior degree; but the aurora borealis is often witnessed in the United States during winter, and frequently attains a splendour such as is surpassed in but few portions of the globe. During the severity of winter, and especially in houses which are furnished with heavy carpets and kept thoroughly warmed, even more remarkable electrical phenomena are often witnessed. If you walk across such a carpet with a slight shuffling motion, and then present your knuckle to some metallic object, as the knob of a door, you perceive a decided spark and a faint snap. By walking rapidly two or three times back and forth, the spark may be increased, and becomes, perhaps, a quarter of an inch or more in length, and has great intensity accompanied by a smart snap. This phenomenon is not peculiar to any particular house or style of carpet, but in the cold months can be witnessed in almost every house in New York where there is a thick woollen carpet, and the room is kept habitually well heated and dry. In some houses these phenomena are so remarkable that persons who have never witnessed them have listened to the accounts with evident incredulity.

A few winters ago I received from a female friend an account of some phenomena which she had witnessed at the house of Mrs C., in New York, and which appeared so remarkable that I concluded the account must be greatly exaggerated. I was induced to call on Mrs. C., and request her to favour me with an exhibition of her electrical powers, to which request she readily acceded. We were sitting in a parlour covered with a heavy velvet carpet, and lighted with gas by a chandelier suspended from the ceiling. Mrs. C. rose from her chair, advanced one or two short steps, and gave a slight spring towards the chandelier, which was above her reach when her feet rested upon the floor. As her finger approached the metal, I perceived a brilliant spark, and heard a snap such as would have attracted the attention of a person casually walking through the hall, separated from the parlour by a closed door. The spark was more brilliant than that which is furnished by an ordinary electrophorus when most highly excited, but its length was not so great. A few steps upon the carpet were sufficient to renew the electric charge, and the spark was perceived whenever Mrs. C. touched a metallic object, like the knob of a door, or the gilded frame of a mirror. The facts which had been before recited to me now no longer appeared incredible, and most of them I verified by my own observations. On approaching the speaking tube to give orders to the servants, Mrs. C. repeatedly received a very unpleasant shock in the mouth, and was very much annoyed by the electricity until she learned first to touch the tube with her finger. In passing from one parlour to the other, if she chanced to step upon the brass plate which served as a slide for the folding-doors, she received an unpleasant shock in the foot. A visitor upon entering the house, in attempting to shake hands with Mrs. C., received a shock which was quite noticeable and somewhat unpleasant. A lady on attempting to kiss her was saluted by a spark from her lips. Her little girl on taking hold of the knob of a door received so severe a shock that she ran off in great fright. Larger children frequently amused themselves by shuffling about on the carpet, and giving each other sparks from their fingers.

The preceding is the most remarkable case I have myself witnessed; but I have heard of several other houses in New York which appeared about equally electrical; and most of these phenomena have become so familiar in New York that they have ceased to excite surprise. The electricity thus developed exhibits the usual phenomena of attraction and repulsion, and is capable of igniting combustible bodies. By skipping a few times across the room with a shuffling motion, and then presenting the knuckle to an open gas burner, the gas may be ignited. This experiment generally fails unless the burner be warm; but if, after a jet has been some time burning, you extinguish the flame, and then draw a spark with your knuckle from the warm burner, the gas is readily ignited.

After a careful examination of several cases of this kind, I have come to the conclusion that the electricity is excited by the friction of the shoes of the inmates upon the carpets of the house. I have found by direct experiment, that electricity is developed by the friction of leather upon woollen cloth. For this purpose I stood upon an insulating stool, and spreading a small piece of carpeting upon a table before me, rubbed a piece of leather vigorously upon it; and then bringing the leather near the cap of a gold-leaf electrometer, found that the leaves were repelled with great violence. The electricity of the leather was of the resinous kind. Electricity must, therefore, necessarily be excited whenever a person walks with a shuffling motion across a carpet; but it may be thought remarkable that the electricity should be intense enough to give a bright spark. In order to produce the highest effect, there must be a combination of several favourable circumstances. The carpet, or at least its upper surface, must be entirely of wool, and of a close texture. From my own observations, I infer that heavy velvet carpets answer this purpose best. Two thicknesses of ingrain carpeting answer very well. A drugget spread upon an ingrain carpet yields a good supply of electricity. The effect of the increased thickness is obviously to improve the insulation of the carpet. The carpet must be quite dry, and also the floor of the room, so that the fluid may not be conveyed away as soon as it is excited. These conditions will not generally exist except in winter, and in rooms which are habitually kept quite warm. The most remarkable cases which I have heard of in New York have been in close, well-built houses, kept very warm by furnaces. These furnaces are erected in the cellar, and are filled with anthracite coal, which is kept constantly burning from autumn till spring. The heated air is conveyed to the hall, the parlours, and to every room in the house, as far as is desired, through large flues built in the walls, the flues having a section of about one square foot. In such a house the wood, during winter, becomes very dry, and all the furniture shrinks and cracks. The electricity is most abundant in very cold weather. In warm weather only feeble signs of electricity are obtained. The rubber, viz., the shoe, must also be dry like the carpet, and it must be rubbed upon the carpet somewhat vigorously. By skipping once or twice across a room with a shuffling motion of the feet, a person becomes highly charged; and then upon bringing the knuckle near to any metallic body, particularly if it have good communication with the earth, a bright spark passes. In almost any room which is furnished with a thick woollen carpet, and is kept tolerably warm and dry, a spark may thus be obtained in winter; but in some rooms the insulation is so good, and the carpets are so electrical, that it is impossible to walk across the floor without exciting sufficient electricity to give a spark. It may be thought that in walking across a room there is but little friction between the shoe and carpet; but it should be remembered that the rubber is applied to the carpet with uncommon force, being aided by the entire weight of the body, so that a slight shuffling motion of the feet acts with great energy.—*Athenæum*, No. 1558.

ELECTRIC FISHES.

PROFESSOR GEORGE WILSON has read to the British Association a paper "On the Employment of the Living Electric Fishes as Medical Shock Machines." He stated that in prosecuting researches into the early history of the electric machine, he did not at first contemplate going further back than the seventeenth century, or commencing with an earlier instrument than Otto Guericke's Sulphur Globe of 1670. His attention, however, had been incidentally directed to the employment of the living torpedo as a remedial agent by the ancient Greek and Roman physicians; and he now felt satisfied that a living fish was alike the earliest and most familiar electric instrument employed by mankind. In proof of the antiquity of the practice, he adduced the testimony of Galen, Dioscorides, Scribonius, and Asclephiades, whose works proved that the shock of the torpedo had been used as a remedy in paralytic and neuralgic affections before the Christian era. A still higher antiquity had been conjecturally claimed for the electric silurus or malapterurus of the Nile, on the supposition that its Arabic name, Raad, signifies thunder-fish, and implied a very ancient recognition of the identity in nature of the shock-giving power and the lightning force; but the best Arabic scholars have pointed out that the words for thunder (raad) and for the electric fish (ra'a'd) are different, and that the latter signifies the "causer of trembling," or "convulser," so that there are no grounds for computing to the ancient Egyptians, or even to the Arabs, the identification of silurus-power with the electric force. In proof of the generality of the practice of the zoo-electric machine at the present day, the writer referred to the remedial application of the torpedo by the Abyssinians, to that of the gymnotus by the South American Indians, and to that of the recently-discovered electric fish (Malapterurus Beninensis) by the dwellers on the old Calabar River, which flows into the Bight of Benin. The native Calabar women were in the habit of keeping one or more of the fishes in a basin of water, and bathing their children in it daily, with a view to strengthen them by the shocks which they receive. These shocks are certainly powerful, for living specimens of the Calabar fish are at present in Edinburgh, and a single one gives a shock to the hand reaching to the elbow, or even to the shoulder. The usages referred to appear to have prevailed among the nations following them from time immemorial; so that they furnish proof of the antiquity as well as of the generality of the practice under notice. The writer concluded by directing the attention of naturalists to the probability of additional kinds of electric fish being discovered, and to the importance of ascertaining what the views of the natives familiar with them are in reference to the source of their power, and to their therapeutic employment.

AN IMPROVED ELECTRIC LAMP.

MESSRS. LACASSAGNE and THIERS, of Lyons, France, have exhibited at Paris and Lyons an Electric Light of unusual brilliancy, obtained by means of a lamp, which is thus described.

The objects of their invention are—1. To regulate and to keep constant the distance between the two electrodes of electric lights, whatever may be the rapidity of the combustion of the graphite of which they consist 2. To obtain this constant separation of the electrodes by self-acting means, operating by the action of the current which produces the light, combined with the action of a spring, or with the action of a current derived from the light current. 3. To obviate the necessity of any daily regulating of the apparatus. These results are obtained by the passage of mercury from a reservoir into a receiving cylinder placed underneath. The tendency of the mercury to rise in this cylinder lifts with little friction a piston supporting the lower electrode, which approaches the upper electrode according as the mercury of the reservoir flows down into the cylinder. The action of the electrodes approaching each other is produced by means of a valve opening and closing the tube communicating from the reservoir to the cylinder. This tube passes through one of the soft iron arms of an electro-magnet, which receives its magnetic action from the current producing the light, and which shuts the valve by its action upon an armature of soft iron, which it presses against the valve. The armature which shuts the valve by the action of the current producing the light is attracted in an opposite direction by a spring, or by a second electro-magnet receiving magnetic action from the derived current, the intensity of which is determined by the resistance offered to it by a coil interposed for that purpose; consequently the passage of the mercury from the reservoir to the cylinder tends to establish itself under the action of the derived current, which opens the valve, and to be interrupted under the action of the principal current, which closes it; the resistance afforded to the derived current is invariable. The resistance afforded to the principal current increases by the widening of the distance or space between the two electrodes, and diminishes by their coming near to each other. If the distance between them increases, the principal current, meeting a greater resistance, diminishes in its intensity, which also diminishes the magnetic power of the electro-magnet due from the principal current which closed the valve; the intensity of the derived current (the resistance of which is invariable) increases in the same ratio, and tends also by its action on the second electro-magnet to open the valve. If the electrodes approach each other, the contrary effect is produced; the principal current increases by the diminution of resistance through the electrodes, while the derived current diminishes in the same proportion, and tending to close the valve to prevent the further passage of the mercury. It is then evident, that after having determined the resistance of the derived current by the length of the wire of the resisting bobbin or coil, there will be established between the two currents a kind of equilibrium, which will maintain a passage for the exact quantity of mercury that should necessarily flow from the reservoir to the electrode cylinder to lift and regulate the space between the electrodes.—*Mechanics' Magazine*, No. 1765.

IMPROVED MAGNET.

MR. JONES has invented "an Improved Magnet or Loadstone for the person, by which an extraordinary power and permanency of influence is obtained for hypotnists, somnolists, and physcheists." This instrument is in the shape of a watch; the interior is a number of powerful magnets, or iron-dust made into a pulp with oil, &c., dried before the fire, and then magnetized in the ordinary manner; a wire is placed to each of the poles, and covered with a plate of aluminium or other perfect metal, the wires still protruding; over the plate of aluminium is another plate of the same metal, and so on *ad libitum*, the wires continuing to protrude. The magnets and plates are of the form of a parallelogram; over these is a ball of gutta percha, or other non-conductor, allowing entrances for the wires, which are rolled round the ball *ad libitum*; the whole is enclosed in another ball of gutta percha, and the wires are conveyed to the "poles of the body" (a magnetic phenomenon)—the neck and abdomen; the influence is thus equalized, and health is an additional result, as well as correctness of hypotnism, for it is not the mind alone which is hypotnized. The greater the length of wire between the two balls, the greater the power; the plates of iron and aluminium alone produce electro-magnetic fluid with the moisture of the human body, without the assistance of the inner magnet, as well as generating the fluid. The extraordinary power of the inner magnet is thus explained: the sum of two powers acting in unity is greater than the sum of their powers acting separately—the French fleet is more powerful together than in two separate parts; again, the sum of three powers acting in unity is greater than the sum of their powers acting severally, and also the resultants of forces, as seen at the battle of Aboukir Bay.—*Mining Journal*.

A MAGNETIC GIRL.

THE *Northern Daily Times* says:—"We never believed in table-turning nor spirit-rapping; but here we have a child who does not profess to anything like the latter, yet who can turn and twist, and make a table dance about the room, despite the power of half a dozen strong men to hold it. There is no mistake in this; we saw it; we held the table hard and fast, along with several others, and yet this tiny girl whirled it out of our hands by one touch of her fingers. We all held on with might and main, yet could not resist the power; and the best of it is, the child herself is totally iguorant of the power she possesses. All she knows is, that her touch completes what three or four men would fail to accomplish. She can lift (and cannot be resisted) half a dozen men sitting on a chair in each other's lap—she whirls them about like straws. *We* tried to resist this, but in vain. The most wonderful portion—even more mysterious than the above, which seems very little short of miraculous—of her performance is the astounding manner with which she plays with irons of some 24 pounds weight. These, by a touch, and without any muscular exertion, she rolls and tumbles about with more ease than we could a feather. We saw several strong persons trying to raise the irons into the same position which the child puts them in, but, with all their strength, failed. Her powers of magnetism over other persons, both juvenile and adult, are just as great and remarkable as over inanimate matter; and the little prodigy laughs as heartily as the audience at the pranks she is enabled to make other people play, despite themselves, but why or wherefore neither she nor any one else can tell."

IMPROVEMENTS IN GROVE'S BATTERY.

PROFESSOR G. J. STONEY has read to the British Association a paper on this subject. He first exhibited a few cells of Grove's Battery in the ordinary way in which the plates of zinc and platina are arranged; if any accident occur to any one cell or plate, it cannot be removed from the battery without taking down, cell by cell, the whole system that precedes it. Much inconvenience, also, is experienced from the fuming of the acids when the operator has finished his day's work, and in taking the plates in the ordinary manner each out of its place and dipping it into water. In the improvement which Professor Stoney has devised, stout iron wires are bent into the form ∞ (123). To 1 and 2, plates of zinc are soldered, and to 3 a plate of platina, and so on with each of the rest of the elements. He had feared there would be much difficulty in soldering the platina plate to the bend of the iron wire 3, but it was found not to be so, as upon dipping the iron into chloride of zinc, and then laying the platina plate against it, it was found that the soldering iron, with a small globule of solder, made a perfect joint along the entire extent. To prevent any chance contact of the wire 3 with 1 or 2 of the next element, a little cylinder of gutta percha was put over each of these wires 3 which carried the platina plate. In putting the elements of the battery together, the platina plate 3 of each element was simply inserted between 1 and 2 of the next element, and so on throughout, and each element was then perfectly distinct from every other, and could be taken out or put in, or the cells belonging to it re-arranged as to charge of acids or otherwise, as occasion might arise, without interfering with the rest. When it is desired to stop work, the whole of these ∞ formed wires, with the zinc and platina plates attached to them, are lifted together out of their cells by an oblong mahogany frame, one side of which slides in a groove, so that the sides at first are at a sufficient distance to go over the entire system of ∞'s; one side of the frame is then brought under one line of the bends of the wires, and the moveable side is then pushed in so as to come under the bends on the opposite side; the entire frame is then lifted with all the plates at once, and they are all plunged together into a trough of water placed near. Thus the fuming is almost entirely avoided.

ELECTRIC CONDUCTIVITY OF COPPER.

PROFESSOR W. THOMSON has read to the Royal Society, a paper on the Electric Conductivity of commercial Copper of various kinds. It is an important and notable circumstance, and surprised the experimenter himself, to find that there are differences of resistance between different specimens of wires manufactured for submarine telegraphs, so great as most materially to affect their value in the electrical operations for which they are designed. None of the circumstances, such as twisting of wires, or covering with india-rubber, peculiar to each strand, produced any sensible influence on the whole resistance. Different qualities of the copper-wire itself were proved to be the real cause of difference; and while the conducting power of a wire from one manufactory was as 100, that from another was only as 54·9! Professor Thomson's inference from these experiments is, "that a submarine telegraph constructed with copper wire of the quality of the manufactory A. of only $\frac{1}{21}$ of an inch in diameter, covered with gutta percha to a diameter of a quarter of an inch, would, with the same electrical power, and the same instruments, do more telegraphic work than one constructed with copper wire of the quality D., of $\frac{1}{16}$ of an inch diameter covered with gutta percha to a diameter of a third of an inch." One of the specimens of copper wire with low conducting power was found to contain lead ·21, iron ·3, and tin or antimony ·01, the remainder being copper 99·75. All the samples were described by the manufacturers as remarkably pure. Doubtless even though copper were considerably adulterated with a better conductor than itself, this would only diminish *its* conducting power all the more: purity of metal appears to be the essential principle. Brittleness from tension does not alter the conductivity $\frac{1}{8}$ per cent. There is another paper by the same author on the electro-dynamical qualities of metals, showing the effects of magnetization on the electric conductivity of nickel and of iron. It had been shown by Professor Thomson that iron, when subjected to magnetic force, acquires an increase of resistance to the conduction of electricity along, and a diminution of resistance to the conduction of electricity across, the lines of magnetization. By experiments more recently made, he has ascertained that the electrical conductivity of nickel is similarly influenced by magnetism, but to a greater degree, and with a curious difference from iron in the relative magnitudes of the transverse and longitudinal effects. With the same magnetic force, the effect of longitudinal magnetization, in increasing the resistance, is from three to four times as great in nickel as in iron; but the contrary effect of transverse magnetization is nearly the same in the two metals, with the same magnetic force. When magnetic force is applied to iron, we may here observe, it is along the bar that the magnetic attraction operates, each successive series of particles *in the line* being a kind of minor magnet with its poles in the direction of the length. When electric force is applied under such circumstances, is it not simply because the electric force is absorbed, and assumes the form of magnetic force itself, *augmenting its intensity*, that the passage of the electric force, *as such*, appears to be resisted? The magnetic force not operating across the line of polar direction, the electric force of course cannot be so absorbed in that direction, or assume the form of magnetic force, and hence appears to flow in that direction without diminution, and all the more freely that the metal is magnetized already in the contrary direction, and may not afford so facile an opportunity for its diversion and absorption, or assumption of the magnetic force itself, in the contrary direction, as when the metal is not yet magnetized. In nickel, again, it would be interesting to know whether the absorbed electricity has really rendered it more capable of magnetization *and more completely magnetized*, than when only exposed to the operation of the magnetic force. The relationship of diamagnetism to these phenomena would be a curious and important subject for further experiment.

THREE NEW ELECTROTYPE PROCESSES.

THESE new processes, by the Abbé Moigne, have been described to the British Association. The first of these improved processes consisted in the employment of platina wires instead of copper, and of making a skeleton figure resemble roughly the outline of the cast sought to be obtained, by means of which, according to M. Lenoir's process, busts, statues, and groups can be produced in full relief by a single operation. The second of these consisted in M. Oudrey's process for galvanizing or coppering iron and cast iron to any thickness required without the cyanide bath, with remarks upon its employment in commerce and in the navy. The process was not fully communicated, as it is commercially desirable to keep it a secret; but sufficient was communicated to show that the cyanide bath, which is not only expensive but dangerous, can be dispensed with, and the present system, according to which there was a great waste of material, avoided, although the substance that was placed upon the iron to induce the deposit of the copper was not stated. The last branch of the paper treated of Messrs. Christofe and Bouillet's process for strengthening electrotypes, the principle of which was to leave an opening in the back of the thin electrotype obtained by precipitating, and to put into it various little pieces of brass, which, on being melted with an oxy-hydrogen blast, became diffused all over the interior surface of the copper without injuring it in any way, and thereby imparted to it the strength of cast iron.

SINGULAR EFFECT OF ELECTRICITY.

WE find the following in the *Detroit Free Press*:—"A locomotive was being moved from the manufactory to the Central depot, and had arrived in the middle of the street, when suddenly all hands dropped the bars with which they were moving the machine, and fell back in amazement. Resuming them at the order of the man in charge, they applied them again to the wheels, and again fell back paralysed the instant they touched the iron. The director of the job caught up one of the bars, and making a savage thrust, planted it under a wheel, preparatory to giving a huge lift. No sooner had it touched, however, than he saw it fall from his grasp to the ground, as it had done in every case before. Such singular occurrences excited attention, and an examination was made as to the cause, when it was found that the locomotive, in passing under the telegraph line, had come in contact with a broken wire that hung sufficiently low to reach it. The whole mass of iron composing the locomotive had thus become charged with electricity, which had communicated itself to the bars that the men held in their hands, and caused the effect above described. The wire was then removed, and the difficulty obviated in a moment."

A GIRDLE ROUND THE WORLD.

THE *Abeille du Nord*, of St. Petersburg, proposes a communication round the world, by a railway crossing Siberia in the direction of Irkutz, and which, in the opinion of that journalist, will be constructed sooner or later. It points out the utility of such a commercial communication, which would unite to Europe by the Russian railways the commerce of Central Asia, China, and Japan. The Euphrates line and that of Suez are, says this journal, only useful to England, and the Panama route does not offer the advantages to be expected from a railway in Siberia (which would be in the power of Russia). It adds, that no want of security need be feared in Russia, as may be the case on the Euphrates and Suez lines.

NEW INDUCTION APPARATUS.

MR. WHITEHOUSE'S Relay and Induction Coils in action on short circuits have been explained to the British Association, by Professor Thompson. The peculiarities of Mr. Whitehouse's induction coils fit them remarkably for the purpose for which they are adapted, as distinguished from the induction coils by which such brilliant effects of high intensity were described. The chief part of the receiving apparatus, the relay, was fully described, and was shown in action after some introductory remarks, explaining the general nature of a relay, an electrical hair trigger. The relation of Mr. Whitehouse's relay to the Henley receiving-instruments was pointed out. The author expressed his conviction that, by using Mr. Whitehouse's system, to take advantage of each motion for a single signal instead of the to and fro motion, as in all systems hitherto practised, the Henley single needle instrument might be easily used so as to give as great a speed on one line of wire alone as is at present attained by two with the double-needle instrument. The beautiful method of reading by bells would be most ready and convenient for giving the indications to be interpreted as the messages; but the author believes that either by the eye or ear the messages may be read off with the rapidity and care which will render the use of one telegraphic wire in all respects as useful as that of two.

The effects of Induction in long submarine lines of Telegraph have also been illustrated to the British Association, by Professor Thompson. A general explanation of the theory was given, and the law of squares was demonstrated to be rigorously true. It was pointed out, that when the resistance of the instruments employed to generate and to receive the electric current are considerable in comparison with the resistance of the line, the phenomena do not fulfil the law of squares, because the conditions on which that law is founded are deviated from. The application of the theory to the alternate positive and negative electrical actions used by Mr. Whitehouse for telegraphing was explained, and the circumstances which limited the speed of working were pointed out. Curves illustrating the enfeeblement of the current towards the remote end, and the consequent necessity of the high-pressure system introduced by Mr. Whitehouse, were shown. The embarrassment occasioned by the great electrical effect through the wire which follows the commencement of a series of uniform signals with a full strength of electric force, was illustrated in one diagram, which showed a succession of eight impulses, following one another at equal intervals of time, and giving only one turn of the electrical tide at the remote end, or two motions of the relay, including the initial effect. The remedy was illustrated by another diagram, in which a succession of seven equal alternate applications of positive and negative force, following a first impulse of half strength, was shown, proving seven turns of the tide at the remote end, following one another at not very unequal intervals of time, and consequently giving eight turns of the relay, or eight distinct signals.

Mr. E. S. Ritchie, of Boston, United States, proposes an improved construction of *Ruhmkorff's Induction Apparatus.* The improvements consist in making the strata of the wire in the secondary helix perpendicular, instead of parallel, with the axis; in making the insulation more perfect, and obviating in great measure the danger of a discharge of the spark from one stratum to another; in substituting for De la Rive's interrupter one which makes the breaks instantaneously, and is entirely under the operator's control. In the apparatus exhibited by Mr. Ritchie, the length of wire is 60,000 feet, and he has obtained from it a spark of 10½ inches, with a battery of four elements. The largest spark yet obtained in Europe has been 4½ inches. The original machine is the result of the researches of Faraday, Henry, and Fiziam, and gives a current of high intensity, with a quantity immensely greater than can be obtained from the electrical machine.

Improved Medical Induction Coil.—The only difference between Ruhmkorff's machine and Hearder's Medical Coil, is that Hearder used from 100 to 300 yards of secondary wire wound upon a bobbin with wooden ends, and Ruhmkorff used from 5000 to 20,000 yards laid upon a bobbin with glass ends, paper being the only insulating medium used by both. The superiority of Ruhmkorff's over Hearder's simply depended upon the increased length, and the additional application of the condenser. Reasoning out some of the phenomena which have presented themselves in the complicated action of his new induction coil, Mr. Hearder has been led to discover a peculiar relationship between the magnetic intensity of the iron wire, developed under various conditions of length, thickness, &c., and the quantity of electricity set in motion in the induced coil, and by attending to circumstances apparently trifling, he has ceeded in producing a medical coil possessing an extraordinary power in a very small compass—a most valuable desideratum. In addition to this, he adopts a very ingenious contrivance for regulating the shock by the use of two indexes, on the principle of the hour and minute hands of a clock, the first producing equal increments of power, and the second subdividing each of those increments so as to render the advance of power still more gradual. The whole of the apparatus, viz., coil, battery, a bottle containing the requisite quantity of dilute acid, insulated directors, conducting wires, and metallic plates for administering the shock, are cleverly packed in a small mahogany box, and are so contrived as to be used without taking out either the machine or battery. The machine extends to twenty or more degrees of power, the smallest being almost imperceptible, and the highest very much more than the strongest nerve can bear. The apparatus, altogether, is the most perfect of the kind that we have ever met with. At the late annual meeting of the British Medical Association, at Plymouth, Mr. Hearder exhibited and explained his machine in the course of the conversazione, and showed its value as an adjunct to restore respiration in recovery from drowning. He mentioned a case which occurred some time since at Dartmouth, in which his apparatus had proved effective in the hands of Mr. Precy, surgeon, of that place, in restoring a drowned person after all other appliances had failed, and life had been despaired of; and he also showed the facility with which the machine could be brought into action, by opening the box in which it was packed, and exciting it ready for use in less than thirty seconds.—*Mechanics' Magazine*, No. 1775.

Induction Coil has been thus described by the inventor:—

'My induction apparatus differs from Ruhmkorff's in three important parts of its structure: first, in the method of insulation; secondly, in the contact breaker; and thirdly, in the formation of the condenser. Ruhmkorff, as your readers are aware, insulated his secondary wire with shell-lac; but as this substance, though an excellent insulator, is liable to crack, I have adopted gutta percha tissue for the insulation of my wire; and I apply it in the form of ribbon an inch wide, which I obtain by cutting slices from a firm roll of that substance; four or five layers are necessary between each layer of wire, as the current from a single layer is sufficiently intense to strike through one-tenth of an inch of air.

"The contact breaker is a more important part of the apparatus, for without the one I have contrived I do not obtain nearly so great a quantity of static electricity. It consists of a strong steel spring, fastened firmly at one end, and having the platinum contact piece in the centre, behind which is a piece of iron to be attracted by the iron core; at the other end of the spring is a screw by which I can force the two contact pieces together with a force of one ounce to ten pounds; the steel spring therefore vibrates from its centre, and it is only when the whole of the battery current has traversed the primary wire that the iron core has sufficient power to draw the two contact pieces asunder. It may be interesting to state, that the condenser has not the slightest effect on the *quantity* of electric force developed in the secondary wire, but increases the intensity to an enormous extent; and as it is better to have it as large as possible, I have formed mine of 120 sheets of tinfoil, 6 × 12, placed between double that number of varnished sheets of paper, the alternate sheets of foil being brought out and soldered to appropriate binding-screws. The length of secondary wire in the coil described is 2 miles, and its gauge No. 35. The primary helix is formed of 30 yards of No. 14 wire, and is wound on an iron wire core 9 inches long and 1¾ inches diameter, in which is placed as an axis an iron rod to support the coil, which I place in a box constructed for that purpose.

"The instrument gives an induction spark two inches long in air of ordinary density when excited by four or five cells of Grove's battery; and the quantity of static electricity is so great, that it will charge a quart Leyden jar two hundred times per second, the discharge taking place through an interval of one inch and a quarter.

"The thermal phenomena are also very striking; for when the secondary wires are separated about three-quarters of an inch, an arc of flame passes the interval, and fuses electrodes presenting twenty times the sectional area of the wire from which the current is produced: the flame can at the same time be acted upon by a permanent magnet in the same manner as the voltaic arc. This heating power appears to depend, not upon the *quantity* of electricity passing, but upon the resistance it can overcome; consequently the thermal effects disappear *in vacuo*, to be reproduced upon the gradual admission of air or other resisting media."—*Mechanics' Mag.*, No. 1769.

Callan's Electro-dynamic Induction Machine.—At the late Meeting of the British Association, the Rev. Professor Callan, after stating that he had discovered the induction coil in 1836, that in 1837 he had devised an instrument for getting a rapid succession of electrical currents from the coil, and that thus he had completed the coil in 1837, as a machine by which a regular supply of electricity might be furnished, he said that he would lay before the Association the results of a long series of experiments on the induction machine.

The first of these results is a means of getting a shock directly from the armature of a magnet at the moment of its demagnetization. By using, not a solid piece of iron, but a coil of very fine insulated iron for the armature of an electro-magnet, between the poles of which the coil would fit. When the helix of the magnet is connected with a battery, the armature is magnetized on account of its proximity to the magnetized iron; and when the battery connexion is broken, if the ends of the insulated iron wire be held in the hands, a shock will be felt.

The second result is the discovery of the fact, that if iron wires be put into a coil of covered copper wire the ends of which are connected with a battery, and if another coil be connected with the same battery, the quantity of electricity which will flow through the latter will be greater when the first coil is filled with iron wires than when they are removed.

The third result is, a core for the primary coil, which consists of a coil of insulated iron wire, and which has five advantages over all the cores in common use. First, there is no complete circuit for any electrical current excited in any section of the core, because all the spirals of the coil are insulated from each other, and no spiral returns to itself. In the common cores, even when the wires are covered with thread, there is a complete circuit for every current induced in each section of every wire. Secondly, the currents in the various sections of the iron do not oppose each other; but the currents in each section of every wire are opposed by the currents flowing in the surrounding wires. Thirdly, in the iron coil all the currents in the various spirals flow in the same direction, and form one strong current, which may be used by connecting the ends of the coil with any body to which we wish to apply its force. But in the common cores all the currents in the sections of each wire remain within the wires, and cannot be used.

Fourthly, the effect of the condenser on the currents produced in the iron core can be ascertained when an iron coil is used, but not with the common cores. By using an iron coil as a core, it is found that the condenser increases the intensity of the currents induced in the core.

Fifthly, the ends of the iron coil, used as a core, may be connected with the coatings of a Leyden jar, and then the sparks from the coil are diminished in length, but increased in brightness. By the use of cores consisting of coils of insulated iron wires, electrical currents of considerable quantity and intensity may be obtained. These currents of quantity and intensity may answer for working the Atlantic telegraph, and for producing the electric light.

Besides the cores just described, and the common core, Professor Callan uses three other kinds of cores—viz., a flat or elliptical bundle of wires; a core made by coiling uninsulated iron wire on an iron bar; and a core consisting partly of a bundle of iron wire, and partly of a coil of insulated iron wire. The fourth result of his experiments is a new mode of insulation, in which imperfect insulation is used when imperfect insulation is sufficient, and perfect insulation is employed where such insulation is required. The advantage of this mode of insulation is, that each spiral in the secondary coil is brought nearer to the other spirals, as well as to the primary coil and core, than it can be in the common method of insulation, without at all diminishing the efficiency of the insulation. A coil in which the secondary wire was iron, and insulated in the manner described, was shown to the meeting, which, with a single cell, 6 inches by 4, gave sparks half an inch long without a condenser. The insulation of the large condensers made by Professor Callan, in which the acting metallic surface of each plate exceeded 600 square feet, gave way before the coil which he exhibited was made; and, therefore, he could not say what the length of the sparks would be with the aid of a condenser. But were a condenser of the proper size to have the effect of increasing the sparks in a thirty-fold ratio, as in M. Gassiot's great coil, the length of the sparks produced by Professor Callan's coil with a single cell should be 15 inches. The outer diameter of the coil was about 4 inches, its length 20 inches, and the length of the secondary coil about 21,000 feet.

The fifth result is, a contact-breaker in which the striking parts are copper, and which acts as well as if they were platina. The sixth result is a mere explanation of the condenser, which is confirmed by the effect of the condenser on the electrical currents produced in the core. The last result consists in the discovery of some new facts relating to the condenser, from some of which it follows, that the ordinary mode of making the condenser is defective; for condensers are generally made so that the entire surface of each of the metallic plates must act. But the condenser for every coil should be constructed in such a way that a small, or a considerable part, or the whole, of the surface of each plate may be applied to the coil. For a large condenser which would make the effect of a coil excited by a single cell less than it would be without a condenser, will increase the effect of the same coil when it is connected with a battery of 10 or 12 cells.

ELECTRIC TELEGRAPHING BY STEAM.

A PLAN for Telegraphing by Steam has been invented by Mr. Baggs, the well-known electrician, and which, if carried out, is likely to effect a postal revolution. Electric telegraphs of all kinds are either worked by voltaic or magnetic electricity, the current of which along the wire is alternately transmitted and broken according as the circuit is completed or interrupted by means of a handle, which is worked by a clerk. As a matter of course, while a message is being thus slowly transmitted as it were by hand, the whole length of the wire is entirely occupied, while, whatever the emergency, nothing can be done towards forwarding the messages which are to follow until the wire is entirely unoccupied and reported free. Mr. Baggs's invention proposes to work the electric telegraph by steam, and so get over the great obstacle which now exists against its more general use—namely, its slowness. It may seem paradoxical to speak of the slowness of the electric telegraph as being the only bar to its more general adoption; but in truth such is the literal fact, for the time occupied, and therefore expense incurred, in using the telegraph wires, makes a message rather the resort of commercial or domestic emergency than of a thing of daily use, almost rivalling the post as a means of daily communication.

The invention, then, which is to supersede these tedious processes, and work the telegraph by steam instead of by hand, is generally as follows:—A series of gutta percha bands, about six inches wide and a quarter of an inch thick, are coiled on wheels on drums arranged for the purpose. These bands are studded down both sides with a single row of holes at short intervals apart. When a message is to be sent, the clerks wind off these bands, inserting in the holes small brass pins, which, according to their combinations in twos and threes (with blank holes between), represent certain words or letters. In this manner the message is, as it were, "set up" in the bands with great rapidity, and if the number of bands employed is sufficiently large—say as numerous as the compositors employed in a large printing office—messages equal in length to five or six columns of a newspaper could be set up and ready for transmission in the course of a single hour. Of course this operation in no respect interferes with the telegraph wire itself, which continues free for use until the bands of messages are actually being despatched. The gutta percha bands when full are removed to the instrument-room, a most simple appliance preventing any derangement or falling out of the pins while being moved about. In the instrument-room the bands are connected with ordinary steam machinery, by which they are drawn in regular order with the utmost rapidity between the charged poles of an electrical machine, in such a manner that, during the moment of each pin's passing, it forms electrical communication between the instrument and the telegraph, and a signal is transmitted to the other end of the wire, where the spark perforates a paper and records the message. The only limit to the rapidity of the operation is at the rate at which the bands can be drawn, since the electrical contact of each pin, even for the 200th part of a second, is more than sufficient to transmit a word or signal from London and register it in America. Of course, as the message is recorded, we will say in America, with the same rapidity as that in which it is transmitted in London, a number of reading clerks will be requisite in order to translate it, by dividing it into small portions, with almost as much facility as it has been sent.

THE ELECTRIC TELEGRAPH.

A NEW Electric Telegraph has been erected to connect the establishments of Messrs. Waterlow and Sons, Birchin-lane and London-wall. This is the first instance, it is believed, of a telegraph being carried over houses in any large town in England, and also the first instance of a private firm having called to its aid this important and useful invention. The distance between the two establishments is about one-third of a mile, and the whole space is traversed by a single wire, suspended from pole to pole, at a great elevation above the intermediate houses; indeed, so much so, as to be scarcely perceptible to the eye. Messrs. Waterlow have erected this telegraph, not only to assist in their business transactions, but from a desire to give a practical illustration to a scheme which Mr. S. H. Waterlow submitted some time since to the police authorities, for uniting the police-courts, the police-stations, and the fire-brigade stations throughout the metropolis, by an economical system of overhead telegraph, devoting one wire to detective police purposes, and one to fire purposes: the argument being that the cost of erection (which, by this plan, is exceedingly small, say 30*l*. for each station, including bell and single needle instrument) would be met by the saving of property at any one large fire.—*Morning Herald*.

ELECTRIC TELEGRAPH CABLES.

MR. ALLAN has patented plans for making Telegraphic Cables much lighter than those at present used. Instead of the ponderous cable weighing six or eight tons, and costing from 300*l*. to 500*l*. a mile, hitherto used for submarine communication, he proposes a cable weighing only eight cwt., costing only 70*l*. per mile, and about one inch in diameter. "Another great difficulty in submarine telegraphic communication is in getting the electric current along a great length of wire. Propelling a message, so to speak, requires an intensity of electricity which at present cannot be produced without quantity, and which in long distances charges the conducting wire, and produces a retarding influence, the proper means to overcome which are to this hour an enigma among the most profound electricians. Mr. Allan meets this difficulty by a novel application of a secondary coil, by means of which he produces an induced current, the great intensity of which is almost equal to the coil of Ruhmkoff. The result of the experiments that have been as yet tried with this apparatus have been in the highest degree satisfactory. The only doubt that exists in our mind is that, in case of only one wire being laid, as with the newly-contrived cable, the water must be used for the return current, which supposes a perfection of insulation in the conducting wire such as, for a distance of 2000 or 3000 miles, it will be difficult, and indeed almost impossible, to attain. But we presume the subject of a return wire to complete the circuit will be a matter for the subsequent consideration of the Company. It is proposed by the Company that is about to avail itself of these patents, to establish, in the first instance, a system of telegraphic communication throughout the United Kingdom almost as complete and extensive as our present postal arrangements. The cost of each wire, it is estimated, will not exceed 10*l*. per mile. It is intended to convey messages to all parts of the kingdom at one uniform rate of 1s. a message, or a penny a word, irrespective of distance. The ocean lines are, at the outset, to be confined to laying a cable from the Land's End to Flores, in the Azores, and thence to Halifax, making the deep-sea stretch, it is alleged, about 400 miles shorter than the route between Newfoundland and Ireland, and avoiding the land lines, which are expensive to maintain, and therefore create an extra charge on messages between the two termini."

THE SUBMERGING OF ELECTRIC TELEGRAPH CABLES.

At the late meeting of the British Association, at Dublin, an elaborate discussion of various papers on machinery for lowering Submarine Telegraph Cables occurred. Professor Rankine objected to the friction-brake as a means of controlling the speed of the machinery, on the ground of the impossibility of accurately adjusting or gradually varying its resistance, which is of uncertain amount, and subject to abrupt changes. He described the machinery patented in 1855, by himself and Mr. John Thomson, C.E., an engineer of great practical experience in laying submarine cables. It was stated by Professor Rankine, that two of the chief peculiarities of that invention were, the substitution of grooved pulleys for cylindrical drums (an improvement which was said to have been used by the Atlantic Telegraph Company), and the employment instead of the friction-brake of the hydraulic-brake, in which the resistance, being that of a fluid forced through a valve, can be accurately adjusted, and cannot vary abruptly. He considered that the use of the hydraulic-brake would prevent such accidents as that which had recently occurred to the Atlantic cable. It should be understood that, while it is quite true that Professor Rankine and Mr. Thomson patented, in the early part of 1855, an invention which comprised the employment of a certain arrangement of grooved pulleys for laying submarine cables, the arrangement used by the Atlantic Telegraph Company was by no means the same as theirs, and of course the use of such pulleys for similar purposes, under some arrangement or other, is universal.

Mr. W. Wilkins, of the firm of Wilkins and Weatherly, rope-makers, Wapping, has obtained provisional protection for an invention which consists in the use of a flexible tube or trail, attached to the stern of the ship, from which the cable is laid, the cable being passed through this tube on its way into the sea. By this means, trails can be constructed in various ways, and may, if desirable, be made of the same specific gravity as the cable itself. "A wire rope with a light metallic vertebrated tube in the centre," says the inventor, "would probably answer well. It may be partially sustained in the water for the first half mile from the ship by small gutta percha buoys made in the form of a fish's float, attached to it at intervals, or by an air-tight gutta percha tube. A strong gutta percha tube, strengthened for the first half mile from the ship with a covering of wire, would also be a good conductor. It should be of sufficient length to reach into still water at such a distance from the ship as would place the extreme end beyond the influence of any motion which may be given to the inner end by the pitching of the ship or from any other cause; or it may be of sufficient length to reach to the bottom of the ocean. The trail being, as it were, part and parcel of the ship, acts as a carrier for the cable, and thus virtually annihilates the distance between the ship and the bottom of the ocean, or still water, except to the extent of the friction of the cable in the tube; and as the motion at the extreme end of the trail would be steady and uniform in its passage through the water (the speed of the ship being uniform, however unsteady its motion), the delivery of the cable would also be steady and uniform; and as the cable cannot enter into the tube at the upper end faster than it passes out of it at the lower end, it follows that any strain which otherwise would be thrown on the cable at its point of contact with the ship, from any cause whatever, would be borne by the trail itself, instead of by the cable. In fact, the cable, in its passage through the tube, is completely protected from any strain, and from all other circumstances which might be injurious to it. To obtain the proper declivity for the trail, it would be only necessary to ascertain the velocity at which the cable would sink in the water, and, after making due allowance for the increasing or diminishing depth of the ocean, to regulate the speed of the ship accordingly. The friction of the cable in the tube would act as a brake, with the great advantage of its operating throughout the entire length of the tube, instead of on a few yards or fathoms of the cable on board the ship. Without enumerating all the advantages that would attend the use of a trail, it may be well to observe that its adoption will enable a comparatively inexpensive description of cable to be used, as great strength would not be required. The insulation of the telegraphic wires would, perhaps, scarcely need any other protection in deep oceans than would be necessary to prevent abrasion in its passage through the tube."

Mr. John De la Haye has submitted to a meeting at Manchester a patented invention for Submerging Electric Cables. He proposes to encase a cable, prepared like that for the Atlantic Ocean, in a soluble compound (the composition of which he would not now mention), capable of floating it for a time on the surface of the water. The coating he proposed to use for this purpose he supposed would hold it on the surface of the waves, whilst about five miles of cable were payed out from the vessel, before it began to dissolve, and as it would dissolve gradually, so the cable would sink gradually to the bed of the ocean. By this means he calculated that there would always be about five miles of cable lying on the surface of the water in the wake of the vessel, and the remainder would describe an incline to within one or two hundred feet of the bed of the ocean, so that there would be comparatively little strain, and consequently less liability of breakage. The cable would descend into the ocean almost horizontally, instead of nearly perpendicularly.

ON SUBMARINE ELECTRIC TELEGRAPHS.

MR. F. R. WINDOW has read to the Institution of Civil Engineers, a paper commencing by stating the Submarine Electric Telegraph not to have been the invention of any one person, but rather the result of the combined researches and exertions of many experimenters. The first mention that Mr. Window can find of any method of sufficiently insulating wires as to enable them to conduct a current when submerged in water, was in an account of some experiments made in India by Dr. (now Sir W. B.) O'Shaughnessy, in recorded in the Journal of the Asiatic Society. In these experiments the wire was covered with tarred yarn, and enclosed in a split ratan, which was again enveloped in another coating of tarred yarn.

Shortly after this (in 1840), Professor Wheatstone gave it as his opinion, before a Committee of the House of Commons, that a submarine communication between England and France was practicable. And in October of the same year, a paragraph in the *Bulletin de l'Académie Royale des Sciences de Bruxelles*, stated that Professor Wheatstone had discovered a means of joining Belgium and England by a submarine telegraph. The nature of the discovery was not, however, mentioned. All these experiments were made previous to the suggestion of Professor Faraday to use as an insulating agent gutta percha, which up to the present time had been universally employed. An extract from an American newspaper was given, containing an account of a submarine telegraph stated to have been successfully constructed by Colonel Colt, from Hell Gate to Fire Island, and in which it was also said that the same gentleman had applied to the United States Government for funds for the purpose of forming a telegraphic line from America to Europe.

In 1848, a submarine telegraph wire, insulated with gutta percha, was laid by Lieutenant Siemens, of the Royal Prussian Artillery, under the Rhine, from Deutz to Cologne, a distance of about half a mile. And in January, 1849, Mr. C. V. Walker towed a similar wire two miles in length out to sea, off Dover, and sent signals to London through it.

In August, 1850, a gutta percha covered wire was laid by Mr. Wollaston from Dover to Calais, through which signals were sent with success, but it lasted perfect only about twenty-four hours.

On the 25th of September, 1851, a cable consisting of four insulated wires encased in a sheath of ten No. 1 iron wires, was laid down from Dover to Calais, by Mr. Crampton, assisted by Mr. Wollaston, and was stated to have remained perfect to the present

It was stated that it was entirely owing to the energy and skill of Mr. Crampton, who undertook the responsible task of carrying out a scheme, up to that time looked upon with distrust by some of the leading engineers of this country and France, and believed by the public generally to be impossible, that the world was now indebted for the benefits of submarine telegraphs; and the leading circumstances of the case were briefly explained. The author then proceeded to give a detailed account of the construction of the Dover and Calais cable, which was the first laid down; and the system of construction of all the principal submarine telegraphs in Europe up to the present day, with all particulars relative to them, was shown in a comparative table.

The author discussed the respective merits of the compound cable system, or the collection of many insulated wires into one cable, as in the Calais and Ostend telegraphs, and the simple cable, containing but one wire, as in the lines of the International Telegraph Company to Holland and Ireland: the greater facility which these latter afforded for repair, and the less chance of having the business stopped by rupture, since one wire only, and not all, would be affected by the cause, was pointed out; and it was shown that the cost of the two systems did not materially differ.

The conductive power of submerged wires was then theoretically investigated, and it was shown that a considerable difference as to time existed between the transmission of signals upon suspended wires, and upon insulated wires immersed in water, or buried in the earth. That while with the former it appeared that the only limit of practical speed was the possibility of deciphering the signals, that in the latter the electric current required an appreciable period of time to arrive at its destination, and another longer period to escape from the wire into the earth, and that this period of time increased regularly with the length of the wire; consequently upon a line formed of submerged wires of considerable length, there would always be a limit of possibility of the number of signals that could be transmitted in a given time. These effects were stated to be caused by lateral induction, the insulated wire assuming the nature of a Leyden arrangement of vast dimensions, where the copper wire represented the inner coating, and the film of moisture surrounding the gutta percha acted as the outer coating. This latter amounted to upwards of 320 square feet per mile. The practical effect produced by this lateral induction was chiefly the retardation of the signals, and consequently, to a certain extent, placing a limit to the quantity of messages that could be transmitted along a submarine line. This effect was visible upon every submarine line of upwards of 10 miles in length, and even upon some of less length, but upon the longest line yet constructed the inconvenience was not very great; it was not until the line was prolonged to upwards of 700 miles that the retardation became a serious obstruction. It was argued, from some experiments that were made at Lothbury, by Mr. Latimer Clark, upon 1600 miles of subterranean wire, that signals upon the line which was about to be laid down between Ireland and America, would require about 2½ seconds to arrive at their destination, and that after each signal another 4½ seconds must elapse before the line was free to receive another electric wave. Each word of average length would thus occupy about a minute; and each despatch of twenty words would, with the necessary code signals, and unavoidable repetitions, require about half-an-hour, thus making the limit of possibility about fifty messages in twenty-four hours.

The author argued, that since submarine lines were more costly than suspended lines, and nevertheless a smaller amount of business could be sent along them in an equal time, it was important that no pains should be spared whereby this lateral induction, and consequently the evils arising from it, might be reduced, though, being in accordance with a law of nature, it could not be entirely avoided.

The discussion on Mr. Window's paper occupied two evenings. A description was given of the two kinds of submarine cables employed—the simple cable, composed of one wire in each non-conducting envelope, a certain number of them being laid down side by side, so that in case of a casualty occurring to one wire the others might be made use of; and the compound cable, wherein a given number of wires were covered by one envelope of iron wire. The recent casualties occurring to these cables were quoted in support of the advantages offered by the simple cable; as, in consequence, the Calais cable, which was of the compound kind, being torn asunder by the anchor of a vessel during the late gales, there had ensued considerable inconvenience, until the transit of messages could be arranged by another route; whereas the simple cables, although partially injured, had never ceased to be capable of conveying messages.

The chief point suggested for discussion was the difficulty of working, at a satisfactory rate, through such a length of cable as that now being constructed to connect Europe with America. There was reason to believe that the effects of the phenomena of induction and retardation were exaggerated. The electrical conditions of an underground wire coincided with those of a submarine wire. The first English underground line of any importance coated with gutta percha was that laid by the Magnetic Company in 1851, between Liverpool and Manchester.

Some time since, Mr. Charles Bright, in conjunction with Mr. Whitehouse, had made some experiments through 2000 miles of wire, connected so as to form a continuous circuit, terminating at both ends in the earth. Intermediate instruments were placed at each loop, to test the thorough action of the electrical waves through the entire length, and signals were clearly defined at a rate of ten to twelve words per minute. Two large induction coils, three feet in length, excited by a powerful "Grove" battery of fifty pint cells, but connected for quantity in sets of ten, were used to generate the currents, which were very powerful. From all that had been shown in the paper, it was contended that no difficulty was likely to arise in working from Ireland to Newfoundland that could not be effectually dealt with.

It was observed that, although Mr. Crampton's name had been prominently mentioned in connexion with the first successful and permanent application of submarine cables, he did not in any way claim the merit of the invention, and was most anxious to bring forward the legitimate claims to priority of all those who had made the investigations upon which the system was based, and to give their share of merit to all who had co-operated with him, in the actual operation of laying down the first working cable. The invention, or discovery, resulted in fact from the combined investigations and experiments of several gentlemen, as had been observed in the paper; and, in corroboration of this, a tracing was exhibited of a drawing made for Professor Wheatstone in 1840, showing the submarine cable in its details of construction, insulated by tarred yarn, and covered with iron wire; and the mode of laying down and picking up was also shown. There could not be any doubt of the authenticity of the drawing, and it was known that Lutwiche, who made it, went to Australia in 1841, and had not since been in this country. It was always said of him that he had aided Professor Wheatstone in working out the mechanical details of the proposed system of submarine telegraphs, stated by the Professor, before a Parliamentary committee, to be practicable.

The names of Mr. Wollaston, an early labourer in the field,—of Messrs. Wilkins and Weatherly, who attended to the machinery for constructing the cable,—of Mr. Newall, who made the cable,—of Mr. Statham, who effected the gutta percha insulation,—of Messrs. Davis and Campbell, solicitors, to whose energy and confidence the ultimate success was so greatly due,—and of Mr. Brett, whose indomitable perseverance had kept the subject constantly before the public, were successively mentioned, and their respective shares in the merit of the submarine telegraph duly apportioned.

From investigations it appeared, that without any direct trial in long subterranean or submarine wires, but by reasoning on the known facts and measurements regarding electric conduction through copper, and electric induction across solid insulators, there were strong grounds for confidence, in expecting that a message of twenty words would not require more than seven minutes for its delivery, and that 200 such messages could be sent during the day of twenty-four hours, through such a cable as was proposed to be laid across the Atlantic. There was even reason to think that rate might be ultimately exceeded, by the perfecting of the system introduced by Mr. Whitehouse.

In some experiments through a length of 1600 miles of wire, made with varying battery powers, gradually increased, by successive additions, from thirty-one cells to sixteen times thirty-one cells, there was no sensible variation in the velocity of the currents, which was found on an average to be about 1000 miles per second.

It was observed, that the statement of Professor Faraday, that different and distinct waves of electricity might co-exist in any long submarine conductor, at the same instant of time, was fully borne out by the recent researches of Mr. Whitehouse. In a length of wire of 1020 miles, three signals of a signal-stroke bell had been distinctly heard after the hand had ceased to transmit; and in a length of 498 miles, two such signals in arrear had been heard.

It was remarked that the subject under discussion involved two principal questions, which should be discussed separately—namely, the mechanical one of [illegible]g, shielding, and submerging the metallic conductor; and the electrical [illegible] of transmitting messages through the same when laid. With regard to [illegible], it was shown that Mr. Werner Siemens, of Berlin, discovered the non-conducting property of gutta percha in 1846; and that in the spring of 1847, he proposed to the Prussian Government the establishment of underground line wires coated with that material. In the autumn of that year an experimental line of 20 miles in length, from Gros Beren to Berlin, was completed, and was found to work so successfully, that in the years 1848-9 about 3000 miles were laid on this system. In March, 1848, several miles of copper wire, coated with gutta percha by means of the cylinder machine, were submerged in the harbour of Kiel, for the purpose of establishing an electric communication between the shore and several points in the deep channel, and this was asserted to be the first attempt ever made to establish submarine communications. It was suggested that the passage of an electric wave through a cable might be accelerated to nearly four times its natural velocity, by simply returning the current through a second insulated wire within the cable, instead of through the earth. The present successful submarine cables were a combination of a perfectly insulated wire, contained within exterior strong iron wires, running in a longitudinally spiral direction. The invention of this kind of cable was claimed for Mr. Edward Highton, on the authority of a judgment stated to have been given in the Cour Impériale de Paris, and it was asserted that the Solicitor-General for England concurred in this opinion. Although gutta percha, when buried in the earth, and acted upon under peculiar circumstances, was subject to decay, yet, as far as past experience had gone, sea water seemed to be a preservative of that gum. It was suggested that the conducting wire of a subterranean or submarine telegraph might be protected from oxidation or decay at any point of leakage, by means of an electric current.

THE ATLANTIC TELEGRAPH CABLE.

THE great event in the electro-telegraphy of the past year has been the attempted submersion of the Electric Cable, by which the Old and New World were to be united. The cable, with Mr. Whitehouse and Mr. Bright's experiments, soundings, &c., was described in the *Year-Book of Facts*, 1857, pp. 168-171; but it may be as well here to recapitulate the details of the cable. It is 2500 miles in length; half being manufactured by Glasse and Elliott, of East Greenwich, and the other half by Newall, of Birkenhead. The axis in the centre is formed, not of a single copper wire, but of a *strand*, made up of seven fine copper wires, twisted together, into a neat cord about one-sixteenth of an inch thick; six wires being twisted round one in the centre. The strand is coated with gutta percha, forming a small rope, three-eighths of an inch thick; then with an envelope of hempen twine steeped in pitch and tar; and lastly, with an external sheathing of eighteen iron wires, twisted round the cable as a core, each wire being a strand of seven finer wires—making 126 wires in all.

The cable was completed within six months—in July, 1857—and the preparations were made for the submersion. The English

Government placed at the disposal of the Company, the fine screw steamship *Agamemnon*, with others as tenders; while the United States Government sent over the *Niagara*, one of the largest war-ships in the world; and with this was associated the *Susquehanna*. The *Agamemnon* took in the half-cable from Greenwich; the *Niagara* the other half from Birkenhead; and the flotilla proceeded towards the south-western coast of Ireland. The plan, after some modification, was to begin the submersion at the Irish end, the ships sailing in company, and the *Agamemnon* commencing to deliver its portion when the *Niagara* had finished; the two portions being joined before finally dropping them into the sea. The cables were shipped by steam power: one was placed in the hold of the *Agamemnon*, wrought into one compact coil around a central core, forming a solid mass of metal and gutta percha; but the cable in the *Niagara* could only be placed in three coils.

On August 5, operations were commenced at Valentia. The shore end of the cable was taken on land from the *Niagara* by a number of boats. The cable, as it was drawn up from the hold of the ship, swept round a central block or core, and reached the open space above deck; it was there wound round grooved sheaths, geared together by cogs, and planted firmly on girders. From these sheaves the cable ascended, and passed over a fifth grooved sheave, standing out upon rigid arms over the stern; from this it plunged into the sea, dragged out, as the vessel moved away, by its own weight, and by the hold which it acquired upon the bottom of the sea.

The mechanism for the *paying out* may be described as follows. It consisted of four pulleys or iron wheels, about six feet diameter, with very deep flanges or V grooves, in which the cable was rested. Round two wheels the cable was wound twice, and round two wheels once, so as to form two figures of 8. Each wheel was connected with massive toothed wheels, and the motion of all made equal at the expense of a proportionate strain on the cable. In case of a fault or kink going overboard, there was an auxiliary apparatus, consisting of two wheels, round each of which the cable was wound five times. These were worked by a small engine placed immediately beneath, so that, if necessary, a portion of the cable could be hauled in again, and the kink or fault remedied. The machine which works this could also be made to turn the wheels over which the cable passed, if their friction should be thought too much for its strength. Strong breaks were attached to the wheels of the paying out machinery, which acted powerfully, though very slowly. After passing off the wheels, the cable ran in a protected groove along the quarter-deck over a large wheel at the stern of the vessel. This wheel had a very deep trumpet-shaped groove, and all around it was carefully finished off, and woodwork placed so that not an angle was in the way. The screw of the *Agamemnon* was also caged in to prevent any chance of the wire fouling it. In case of a strong stern wind, before which the vessel would pitch too heavily, or a gale blowing, a simple apparatus was provided to suspend the process of submerging till more favourable opportunities occurred. Two wheels, similar to that at the stern, were fixed one on each side of the bows of the vessel. In case of a strong wind only, a powerful wire rope of great length, and capable of bearing a strain of ten tons, was to be fastened to the coil, which could be severed and allowed to sink as near the bottom of the ocean as the length of the wire mooring-rope would permit. The *Agamemnon* would then turn head to wind, and, steaming against it, take off any undue strain upon the electric cable itself, and so remain until moderate weather allowed the operation to be continued. The wire rope, with the cable attached, could then be hauled in, the cable carefully re-joined, and the submerging gone on with as before.

Notwithstanding these provisions, the engineer was doomed to a mortifying disappointment. A slight accident happened to the cable on the 6th, but this was repaired, and the ships proceeded. By the morning of the 10th they had got 200 miles to sea, and the cable conveyed messages to and from land and the ships with the utmost facility. On the 11th, however, the engineer found that 335 nautical miles, or 380 statute miles, of cable had been submerged; and concluding there to be too much slack or zigzag in the cable's course, by a grip of the machinery, the cable was stretched too tightly; it snapped, and went to the bottom at a depth of *twelve thousand feet*, equal to forty times the height of St. Paul's.

The progress had been as follows:—40 miles by noon on the 8th; 85 miles by midnight; 136 miles by noon on the 9th; 189 miles by midnight; and 255 miles by noon on the 10th—this length of cable being used in a straight line distance of something more than 200 miles. We subjoin the official report of the engineer, Mr. Cyrus Field:—

Although this unfortunate accident will postpone the completion of this great undertaking for a short time, the result of the experiment has been to convince all that took part in it of the entire practicability of the undertaking; for, with some slight alteration in the paying-out machinery, there appears to be no great difficulty in laying down the cable. It has been clearly proved that you can successfully telegraph through 2500 miles of telegraph cable, and that its submergence at a great depth had no perceptible influence on the electric current. There is no practical obstruction to laying it down at the rate of five miles per hour in the greatest depth of water that there is in the telegraphic plateau between Ireland and Newfoundland. The experience now obtained must be of great value to the Company; and it is understood that the directors of the Company will decide whether it is best to have more cable made and try again immediately after the equinoctial gales are over, or wait until another summer.

Upon the return of the *Agamemnon*, the cable was wound from the hold, and placed in the Keyham-yard at Plymouth, in a shed specially built for its reception—120 feet by 50 wide—and divided into four water-tight compartments; so that the perfect insulation of the whole length can be tested under water whenever it may be deemed advisable. The *Niagara* has returned to America, where various alterations suggested by the experience of the late attempt have been made in her internal fittings, that no mechanical aids or conveniences may be wanting to the proper accommodation and paying out of her portion of the coil. It is expected that she will return to this country in the early part of the present year, again to bear her part in the great undertaking, under better auspices, and, we most sincerely trust, with better results. During the winter, Mr. Whitehouse, the chief electrician of the Company, has been engaged in a variety of experiments upon the cable.

In the past year there has been an unusual demand for submarine cables, no less than five or six cables for different places and Governments having been completed. Nearly all of them have been made by Glasso and Elliott. One was for the Swedish Government; one for the Danish, to connect Denmark with Sweden; one to connect Ceylon and Colombo on the main land; and one to join Kurrachee with Calcutta. In nearly all these cases the conducting wires have been formed in the same manner and of the same sized wires as in the case of the Atlantic Telegraph, and all of them display the same admirable construction as to lightness, strength, and durability, more or less strongly according to their length and the depth and nature of the sea in which they are intended to discharge their submarine duties.

SHIPS COPPERED BY MAGNETO-ELECTRICITY.

THE inconvenience of keeping electro-magnetic machines in motion having prevented their taking the place of the battery, which requires no power—it occurred to Mr. Edward C. Shepard, of New York, that by building the magnetic apparatus of such size that it would require a power of one to three horses to keep the helices in continuous motion, a current of electricity would be induced of great quantity and power, sufficient for many purposes to which this agent has hardly yet been applied; and that its cost would be only that of the power employed—no materials being used and consumed, as the acids and metallic plates are in the galvanic battery. Mr. Shepard has constructed such a machine, of very simple arrangement of helices and magnets, and has patented the arrangement in the United States, as well as in the principal countries of Europe. The machine consists of a cast-iron frame about five feet in height, covering a surface upon the floor about four feet by five. A horizontal shaft passes through it, and around this are arranged the helices upon the periphery of several wheels set upon the axis. These helices, or the axis and the wheels it carries, revolve, pass between the poles of steel horse-shoe magnets, which are fixed upon the outer frame, the poles pointing toward the axis. The shaft or axis is made to revolve rapidly by a pulley connected by a belt with the drum of the steam-engine, and by this motion the electrical current is generated in the helices, and conveyed by wires along the axis, and thence to any point where it is desirable to use it. In this operation no material is consumed in the machine. There is nothing to wear out but the gudgeons of the shaft and the boxes in which they run. The acids and apparatus of the galvanic machine are dispensed with, and a quantity of electricity is generated greater and more powerful in its effects than has ever been produced by any other process. By means of it various useful purposes are likely to be served beside the ordinary applications of the galvanic current, as of electro-plating, telegraphing, &c., as well as for generating the now costly electric light. With a view to the employment of these new machines for the electric light, a Commission has been appointed by the Secretary of the United States Navy, to report upon Mr. Shepard's invention; and the result is in favour of its great utility and economy.

Another proposed application of the magneto-electric machine is to the coppering of vessels by the direct deposition of the metal upon their hulls; and experiments have been made in New York with the view of soon carrying them out in a large way.

animal killed shortly after a meal, or by a similar substance artificially prepared. But this theoretical knowledge has not, until very recently, been turned to practical account, to any considerable extent, in the treatment of those numerous and distressing forms of bodily disease and infirmity which arise from impaired powers of digestion. Dr. Landerer of Athens was, we believe, the first person who employed in medical practice an Artificial Gastric Juice, which he prepared from the stomach of the wolf; but even before that, rennet, a substance possessing somewhat similar properties, was occasionally used as a medicine in cases of dyspepsia. The systematic introduction, however, on a large scale, of a medicine capable of performing the functions which properly belong to the digestive organs, is due to Dr. Corvisart, a Parisian physician, and the results of its use appear sufficiently remarkable to merit general attention.

Food, it must be observed, as introduced into the stomach, is not in a condition to enter the blood and be converted into the organized tissues of the body. It requires to undergo the process of digestion —"that process," says Lehmann, "by virtue of which nutriment is transmitted, in accordance with chemical and physical laws, into the circulating system, for the renovation of those portions of the organs which have become effete;" the food being thereby, in the words of the same distinguished chemist, "reduced to a soluble state, or, generally speaking, to such a condition that it is capable of being absorbed into the mass of the juices of the animal body." Numerous experiments have been made, both as to the digestibility of various kinds of food, and as to the exact character of the process. Among the best known are those of Gosse, who had the power of inducing vomiting in his own person at will, and could thus recover for examination portions of food which had been exposed for some time to the action of the gastric juice—those of Beaumont, who employed a man whose stomach was easily accessible through a remarkable gunshot wound—and those of Schultz, who worked upon dogs and cats, which he killed at various intervals after feeding. Very great discrepancies exist between the results arrived at by the different investigators; nor have the experiments with artificial gastric fistulæ been much more satisfactory, so far as regards the degrees of digestibility of different aliments. But it is established that the *modus operandi* by which the change resulting from digestion is effected is one of those mysterious processes classed by chemists under the designation of catalysis, in which a substance, by virtue of the presence of some other body or bodies not themselves affected by what is taking place, becomes converted into something of which the chemical composition is identical with the original substance, but which nevertheless possesses very distinct and peculiar physical properties. The food, in fact, to use a term of organic chemistry, is converted into an isomeric variety of what it originally was; and one of the physical properties which it acquires by the change is its capability of absorption and assimilation by the proper secretive organs of the stomach and intestines. Until it undergoes this change, it can neither be absorbed nor assimilated, and is consequently not only useless, but injurious, and wholly incapable of supporting life.

The solution of food of all kinds in the stomach is effected by the agency of gastric juice, which is, essentially, a combination of a substance called *pepsin* (literally, the *cooking* principle), with an acid—probably lactic acid, the pungent and disagreeable acid which imparts its peculiar flavour to sour milk. Much discussion has taken place among chemists as to whether or not other acids, such as acetic, hydrochloric, and phosphoric, are present in the active natural juice; but it appears certain, at all events, that in *every* case, unless it be one of absolute disease, lactic acid is present in such quantity as to communicate to the gastric juice a decided acid reaction. It attacks iron filings, and decomposes carbonate of soda. It is also matter of discussion whether the lactic acid be a primary and original constituent of the gastric juice, or whether it is produced in a more circuitous manner, the pepsin being secreted in a neutral state, and then acting as a *ferment* upon the amylaceous substances of the food, and so generating the acid. Thus much is certain, that the property of so acting, by causing fermentation, is inherent in the neutral substance—*i.e.*, in pepsin without any lactic acid in composition with it—while pepsin in this neutral condition is destitute of digestive power. M. Boudault, of Paris, who alone has at present succeeded in preparing pepsin on a large scale, is of opinion that the secretion is neutral. The question is of consequence, for if it be so, the part played by the saliva in the whole machinery of digestion assumes additional importance, as we must then conclude that one of its constituents (diastase) is employed in the stomach to convert the starchy matter of the food into grape sugar; and this, in its turn, is converted by the pepsin into lactic acid, without the aid of which, pepsin could not perform its appropriate functions.

Whatever be the precise reaction of pepsin, one fact is clear—it is the principal and indispensable element in producing the change involved in the operation of digestion. Remove the pepsin, and all the other secretions are powerless—acidulate slightly a solution which contains (according to Wasmann) but one sixty-thousandth part of pepsin, and in a few hours it will dissolve coagulated albumen. Hence if, in cases of impaired digestive power, pepsin can be introduced, even in very small quantities, into the stomach at the time of taking food, the operations of nature will be wonderfully facilitated.

So long ago as 1834, it was proved by Eberle that the gastric juice retains its power after removal from the body; but it is an excessively nauseous fluid, and can only be obtained in any available quantities by the destruction of a great number of animals. It contains as much as 97 per cent. of water, about 1·75 of salts, and only 1·25 of pepsin; and if, therefore, the pepsin could be obtained distinct from these diluting elements, a great point would be gained, and its administration rendered comparatively easy. Experiments made by Schwann established the important fact that it is only the glandular structure of the stomach which contains a digestive fluid from which the pepsin may be precipitated; and this led to the preparation of pepsin in the manner now used by M. Boudault. A number of rennet bags—commonly used in making cheese, and which are the fourth stomachs of the ruminants—are turned inside out, very gently washed, and the mucous membrane, which contains the follicles whereby the juice is secreted, scraped off. It is reduced to a pulp, steeped for twelve hours in cold distilled water, and acetate of lead (sugar of lead) added. This precipitates the pepsin; and the precipitate is treated with sulphuretted hydrogen, which separates the lead as sulphuret, and leaves the pepsin in solution. It is then filtered and evaporated to a syrup, or even to a dry powder, at a low heat; for it happens very curiously that, if exposed to a heat of more than 120° F., it loses all power of digestion. In either of these conditions, however, it is very liable to decomposition if exposed to air, is excessively deliquescent, and the taste and smell are repulsive, resembling those of bad broth. The syrupy solution is therefore mixed with starch, and the mixture carefully dried. It then forms a grey powder, like coarse flour, and by addition of starch or pepsin, as the case may require, can be brought to an uniform standard of strength; and it is then fit for medicinal use, either by itself or mixed with muriate of morphia, strychnia, salts of iron, or other reagents, which do not affect its digestive properties.

Thus prepared, pepsin can be taken with the greatest ease, either in water, or between slices of bread, or in any other simple manner; and according to M. Boudault—from whose communication to the Imperial Academy of Medicine some of the foregoing facts have been taken—and to Dr. Ballard, who has introduced it into London practice, it is capable in every way of representing and replacing the normal gastric juice of the human body. Some very curious instances are mentioned by Dr. Ballard, whose character and position render him a witness above suspicion, and whose cases are recorded in sufficient numbers to preclude the possibility of the results being attributable to any accidental circumstances. Perhaps the most remarkable case is that of a lady, sixty-six years of age, who for four years had suffered pain which "she had no words to describe," for three or four hours after every meal. The natural consequences were, excessive prostration and complete disgust for food; and she had for many weeks limited herself to four rusks and a little milk and beef-tea per diem. The first day pepsin was used, she ate, with ease and enjoyment, a mutton chop—though, on the day before, she had endured intense agony for no less than five hours after her ordinary meal. In a few days she ate pretty freely, and gradually improved, and at length was able to give up the pepsin entirely, to eat without pain, and walk some miles without fatigue. (Dr. Ballard, on *Artificial Digestion*, p. 30.) The pepsin appears from this and many other recorded cases, not only to act *per se* on the food, but to restore the lost activity of the secretive organs. The importance of such a result, and the value of the remedy, can only be appreciated by reference to the actual amount of the digestive secretions. According to Lehmann, the juices which flow into the intestinal canal during the twenty-four hours amount to full one-seventh of the whole weight of the body. A man who weighs ten stone, will secrete in twenty-four hours about—

Saliva, 3 lbs. 7 oz., containing about ¼ oz. of solid matter.
Bile, 3 lbs. 7 oz.
Gastric juice, 13 lbs. 12 oz., containing about 6¼ oz. of solid matter.
Pancreatic juice, 7 oz.
Intestinal juice, 7 oz.

After reading this table, no elaborate argument is needed to prove that the consequences of serious derangement to the organs concerned in the production of so important a secretion as the gastric juice must be terrible; and yet no class of diseases is so common. Precious indeed would be a remedy which should enable medical science to cope successfully with any considerable proportion of such maladies.—*Saturday Review*, No. 74.

SPONTANEOUS COMBUSTION OF TREES.

A SINGULAR occurrence is stated to have taken place at Chesterfield, United States. In a field adjoining a large meadow, smoke was seen issuing from a decayed portion of a beautiful tree, and afterwards flames were observable, which were with great difficulty subdued. In a short time afterwards the body of another tree in the same field was discovered to be on fire, and defied every exertion that was made to save it. The flames encircled the whole trunk, until the tree broke off about six feet up. The previous condition of either tree is not stated very fully, nor does it appear exactly how efficient was the fire department which made such heroic efforts to save them.—*Scientific American*.

CLARIFYING SUGAR BY SOAP.

THIS new process, invented by Mr. Garcia, a sugar-refiner, late of Louisiana, has been brought under the notice of the French Academy of Sciences at Paris, by M. Basset. It is founded on the well-known property of lime which combines with fatty substances, whether free or transformed into alkaline soaps. When the saccharate of lime is brought into contact with a dissolution of soap of soda, the sugar is set at liberty, the lime combines with the acid of the soap, and the soda remains in dissolution in the liquid. When the clarification has been effected with an excess of lime, and the liquid has been skimmed a first time, it must be allowed to cool to below 104 degrees Fahrenheit, and the solution of soap is then poured in, the liquid being gently stirred all the while. When the whole has been well incorporated, it is brought again to the boiling point, after which the temperature is suddenly lowered again by the suppression of the steam-current, and the new scum is removed. The latter consists entirely of a calcareous soap, which, in rising to the surface, has carried away with it all the impurities and extraneous substances contained in the liquid, and has an excellent taste.

This process requires no new apparatus, increases the beauty of the sugar, yields more, and is consequently more economical.

A NEW DECOLORIZING AGENT.

DR. J. STENHOUSE, whose improvements in sanitary and other appliances are well known, has patented a highly porous vegetable charcoal, capable of being employed as a Decolorizing Agent. He produces it thus:—He forms a very intimate mixture of either hydrate of lime, unslacked lime in the state of the finest powder, calcined magnesia, or the light sub-carbonate of magnesia of the shops, with certain vegetable substances, such as maize, wheat, and other kinds of flour, common resin, or catophonium pitch, wood tar, asphalte or bitumen coal tar, and coal tar pitch. This mixture of lime or magnesia and vegetable matter is then heated to redness in close vessels—that is, in ordinary covered crucibles, or in cast-iron retorts—until the vegetable matter is entirely carbonized. The mixture, when cold, is then digested with hydrochloric or sulphuric acids, according as lime or magnesia has been employed, and repeatedly treated with water on a filter until everything soluble has been removed. The porous charcoal remaining on the filter is the decolorizing agent.

SOURCE OF LIGHT.

MR. ROBERT HUNT, F.R.S., in a lecture lately delivered by him at the Russell Institution, "On the Physics of a Sunbeam," mentioned some recent experiments by Lord Brougham on the Sunbeam, in which, by placing the edge of a sharp knife just within the limit of the light, the ray was inflected from its previous direction, and coloured red; and when another knife was placed on the opposite side, it was deflected, and the colour was blue. These experiments (says Mr. Hunt) seem to confirm Sir Isaac Newton's theory, that light is a fluid emitted from the sun.

AMMONIO-IODIDES OF METALS.

A PAPER has been read to the British Association, "On a New Method of forming Ammonio-Iodides of Metals," by the Rev. J. B. Reade. It is only within the last few years that the attention of chemists has been directed to the compounds of metals with iodine and ammonia. The fifth edition of Brande's *Chemistry*, published in 1841, is silent on the subject. At the Oxford Meeting of the British Association, in 1847, Mr. Reade exhibited the ammonio-iodide and per-iodide of gold, and since that time other experiments on other metals have furnished Mr. Reade with these results.

Solution of Iodine in Ammonia.—Perhaps the best mode of dissolving iodine in ammonia for the purpose in question, is to place about fifty or sixty grains of iodine in an evaporating dish, hold it over the spirit-lamp till thoroughly warm and the vapour arises, and then add a few drops of Liquor Ammoniæ, which will be immediately charged with a large excess of iodine in solution. This may be poured into a bottle, and more iodine and ammonia added, until the requisite supply is obtained.

Ammonio-iodide of Gold.—Gold-leaf when placed in the iodine solution instantly turns black, (a purple if the solution be diluted,) and immediately dissolves, like sugar in water. If left to evaporate spontaneously in some quantity, we obtain black four-sided prisms of the ammonio-per-iodide, which readily dissolve in water; and if a very weak solution be exposed for some months to the direct action of the sun's rays, a slight precipitate appears, and a drop or two of the clear solution furnishes a most striking microscopic object both as to crystalline arrangement and richness of tint when placed in polarized light.

Ammonio iodide of Silver.—Gmelin says of the ammonio-iodide of silver, that "unfused iodide of silver absorbs with evolution of heat 3·6 per cent. of ammonia, and forms a white compound, which on exposure to the air gives off ammonia and turns yellow again." The phenomena are far more interesting when silver leaf is added to the ammonia solution of iodine. The metallic silver is dissolved, and when a few drops are placed on a slip of glass, beautiful brushes of prismatic crystals shoot out in all directions, which may be mounted as a microscopic object in Canada balsam after the excess of iodine is spontaneously evaporated. Under polarized light the colours of the crystals are brilliant in the extreme.

Ammonio-iodide of Mercury.—The phenomena in forming this compound are varied and interesting. Mercury is added to the iodine solution, and after the application of heat and the addition of a little water, a few drops on a slip of glass give bundles of permanent prismatic crystals, similar to those of silver, and acted on with the same energy by polarized light. If ammonia be added to these crystals, they are immediately covered with tufts of snowy whiteness, and by degrees they are converted into ruby-coloured hexagonal prisms, which are also permanent.

Ammonio-iodide of Cobalt.—Brande observes that "no precipitate is produced in solutions of cobalt either by hydriodic acid, or iodide of potassium, or by iodic acid, or iodate of potassa." I find, however, that cobalt yields to the action of the ammonio-iodide solution after some hours' digestion and a little heat and water. As might be expected, it exhibits very strongly the sympathetic properties of the chloride, for when placed on paper and gently heated it becomes a brilliant green, which of course vanishes as the paper cools.

Ammonio-iodide of Titanium.—As titanium, which resists every direct method of attack in the laboratory, yields after a period of digestion in the iodine solution, it is probable that other of the scarcer metals, which are with difficulty reduced by the ordinary methods, might be exhibited in the form of ammonio-iodides, and thus throw additional light on their respective equivalents. The crystals of ammonio-iodide of titanium were from a pure specimen of the metal obtained by Mr. Waterhouse, of Halifax, from the slag of the neighbouring iron-furnaces at Low Moor.

Ammonio-iodide of Aluminium.—In forming this compound Mr. Reade did not, as on other occasions, use the pure metal, but alumina only, precipitated in the usual way. After allowing the alumina to digest for some time in the iodine solution, the whole was boiled in a little water, which dissolved the new compound, and upon evaporation and the proper measure of heat to volatilize the excess of iodine and ammonia, a white semi-metallic substance remained, as in the case of silver. It is soluble in dilute hydrochloric acid, and yields a blue precipitate on the addition of yellow prussiate of potash. Whether any use can be made of this process towards obtaining the pure metal, is of course a problem for practical men.

CHEMICAL CHANGES IN IRON.

A PAPER has been read to the Chemical Society, by Messrs. F. C. Calvert and R. Johnson, "On the Chemical Changes which Pig Iron undergoes during its conversion into Wrought Iron." Some pig iron was puddled by the ordinary process. At frequent intervals during the operation, samples were obtained, which were subsequently analysed. The general result arrived at was, that during the earlier stage of the process the per centage of carbon increased, while that of silicon underwent a remarkable and rapid diminution. Not until the production of the phenomenon technically known as "the boil," did the carbon sensibly decrease, while the most decided decrease took place just prior to and during "the balling" or agglomeration of the iron by the workmen.

ARTIFICIAL GOLD.

MESSRS. MOURIER and VALLENT, of Paris, have succeeded in forming an alloy which very closely resembles gold. The materials and proportions used by them are—pure copper, 100 parts (by weight); zinc, 17; magnesia, 6; sal-ammoniac, 3·60; quick lime, 1·80; tartar, 9. The copper is melted in a crucible, in a suitable furnace; the magnesia, sal-ammoniac, lime, and tartar are then added, separately and by degrees, in the form of powder; the whole is stirred for about thirty minutes to thoroughly mix the ingredients, and the zinc is then thrown on the surface, having first been ground into very small grains; the stirring is continued until the fusion is complete. The crucible is now covered, and the fusion continued for about thirty-five minutes, when it is uncovered and skimmed with care, and the contents are run into a mould of moist sand or metal. The material which results may be cast at such a temperature that any ornamental forms may be given to it. It is very fine-grained, and is also damascene, malleable, and capable of taking a very brilliant polish. When tarnished by oxidation, its brilliancy can be restored by a little acidulated water. If tin be employed instead of zinc, the alloy will be still more brilliant.

SILVER IN SEA-WATER.

A PAPER has been read to the Royal Society, "On the Existence of Silver in Sea-Water," by Mr. F. Field, communicated by Professor Faraday, F.R.S.

The existence of silver in sea-water was first made known by MM. Malaguti, Durocheri, and Sarzeana. The authors suspected the existence of the metal from the extensive diffusion of silver in the mineral kingdom, the conversion of its sulphide into chloride by the prolonged action of soluble bodies containing chlorine, and the solubility of chlorate of silver in chloride of sodium. The method pursued was by passing sulphuretted hydrogen through large quantities of water, and also by fusing the salts obtained by evaporation with litharge.

As a solution of chloride of silver in chloride of sodium is instantly decomposed by metallic copper, chloride of copper being formed, and silver precipitated, it appeared to the author highly probable that the copper and yellow metal used in sheathing the hulls of vessels must after long exposure to sea-water contain more silver than they did before they were exposed to its action, by decomposing chloride of silver in their passage through the sea, and depositing the metal on their surfaces.

A large vessel being under repair, which had been cruising for seven years in the Pacific Ocean, the author procured a few ounces of her copper sheathing, which was so decomposed and brittle that it could easily be broken between the fingers. Five thousand grains were dissolved in pure nitric acid, and the solution was diluted. A few drops of hydrochloric acid were then added, and the precipitate was allowed to subside for three days. A large quantity of white, insoluble matter had collected by that time at the bottom of the vessel. This was filtered off, dried, and fused with 100 grains of pure litharge and suitable proportions of bitartrate of potash and carbonate of soda, the ashes of the filter being also added. The result was 2·01 grs. of silver, or 1 lb. 1 oz. 2 dwts. 15 grs. Troy per ton. This very large quantity could hardly be supposed to have existed in the original metal, as the value of the silver would, under these circumstances, have been well worth the expense of extraction.

In another case, the author tried experiments on two portions of the same kind of metal—one which had not been immersed in sea-water at all, the other which had formed part of a ship's sheathing while she was in the Pacific for three years. The results were very striking. The metal unexposed to sea-water gave 0·51 grs., or 19 dwts. 14 grs. per ton, and that taken from the ship's hull yielded 400 grs.—equal to 7 oz. 13 dwts. and 1 gr. per ton; that which had been exposed to the sea having thus nearly eight times as much silver as the original sample. Many other specimens were examined from the bottoms of ships, and of pieces which are always kept on board in case of need, and it was invariably found that the former contained more silver than the latter. For instance, a piece from the hull of the *Benjamin* gave 5 oz. 16 dwts 18 grs. per ton; while that stored in the cabin yielded 4 oz. 6 dwts. 12 grs. 200 grs. from a piece from the hull of the *Parga* gave 0·72 grs., and a piece of fresh metal 0·50: while from the *Grasmere*, only coppered a few months, 610 grs. from the hull gave 0·75, and from the cabin 0.72—a very slight difference indeed; thus showing the remarkable silver-yielding action of the salt water.

In order to arrive at further results connected with these interesting experiments, the author has granulated some very pure copper, reserving some in a glass-stoppered bottle, and he has suspended the remainder (about 10 oz.) in a wooden box, perforated on all sides, a few feet under the surface of the Pacific Ocean. He purposes testing these metals, and will communicate the results to the Royal Society.—*Saturday Review*, No. 71.

ARTIFICIAL FORMATION OF SAPPHIRES.

TWENTY years since, M. Gaudin obtained artificial rubies by fusing ammoniacal alum before the oxyhydrogen blowpipe, with the addition of a small quantity of chromate of potash.* He has now succeeded in preparing perfectly isolated and colourless crystals of alumina in the form of the sapphire. For this purpose he introduces into a crucible, lined with charcoal, equal weights of alum and sulphate of potash, both previously calcined and reduced to a fine powder, and exposes the crucible for a quarter of an hour to the full heat of a forge. When the crucible is broken, the crevices of the lining are found to contain a mass consisting of sulphuret of potassium, through which are disseminated the crystals of alumina. The mass is treated with dilute *aqua regia*, and the crystals left in the form of a fine sand, which is well washed with water. The crystals vary in size, according to the mass of the materials employed and the duration of the heat; those obtained by M. Gaudin, operating on a small scale, were about a millimetre in length. They are colourless, because in this process any metallic oxides which may be added for the purpose of imitating the natural colours of the sapphire are reduced by the charcoal. They are extremely limpid, and surpass natural rubies in hardness. The formation of those crystals depends on the solvent action of the sulphuret of potassium; and by means of this substance, as well as by the chlorides, fluorides, and cyanides, M. Gaudin thinks it will be possible to obtain many other insoluble substances in crystals.—*Comptes Rendus*.

SILICON AND BORON.—NEW DIAMOND.

AMONG the most remarkable of the recent discoveries in *Inordinate Chemistry* are those of MM. Wohler and Deville, relative to *Silicon* and *Boron*. Each of these substances is now proved to exist in three very different states, analogous to the three known states of *carbon*, to which they are thus closely allied,—namely, *charcoal*, *graphite*, and *diamond*. The last of these states is of course the most interesting. Crystallized boron possesses a hardness, brightness, and refractive power comparable to those of diamond; it burns in chlorine, without residue, and with circumstances resembling those of the combustion of diamond in oxygen; it is not acted on by any of the acids, and appears to be the least alterable of all the simple bodies. I have been informed that its powder is already used in the arts, instead of diamond dust; and it seems not improbable that, when obtained by the chemist in crystals of larger size, it may rival the diamond as a gem.—*Address of the President of the British Association*.

* See *Arcana of Science*, by the Editor of the *Year-Book of Facts*, 1838, p. 170.

MAGNESIUM.

M. St. Claire Deville, already known for his discovery of aluminium, has, with M. Caron, continued his researches on the other earthy metals that are as yet but imperfectly known, of which Magnesium, the base of magnesia, is one. The method for extracting this metal differs but little from that employed for aluminium. M. Deville mixes 600 grammes (18½ ounces avoirdupois) of chloride of magnesium with 100 grammes (3¼ ounces) of fused table salt and 100 grammes of pure fluoride of calcium, all in powder; to this mixture he adds 100 grammes of sodium in small pieces, and casts the whole into a red-hot crucible, which he covers with its lid. The reaction soon commences, a bubbling noise is heard, and when it has ceased the crucible is uncovered, and the mass is stirred with an iron rod until the upper surface of the saline bath displays globules of magnesium here and there. The crucible is then allowed to cool, and just before the mass is about to coagulate the globules are shoved together with a spatula, and made to run into each other so as to form but one globule. The mass is then poured on an iron shovel, and on breaking the scoriæ the magnesium is obtained in an impure state. To purify it, it is exposed to a red heat, and a current of hydrogen gas in a tube of charcoal, and then again melted with chloride of magnesium, common salt, and fluoride of calcium, after which the metal is obtained in a state of perfect purity. The quantity above mentioned will yield about four grammes (60 grains) of magnesium.—*Galignani's Messenger.*

UREA, A DIRECT SOURCE OF NITROGEN IN VEGETATION.

Professor Cameron has shown to the Chemical Society that Nitrogen is as available as food for plants, when a constituent for Urea, as in its ammoniacal combination; or, in other words, that urea, without being converted into ammonia, may be taken up into the organisms of plants, and there supply the necessary quantity of nitrogen. He described the experiments which led him to this conclusion, which were very elaborate, and were made on barley plants in confined spaces supplied with air freed from ammonia. The following conclusions were deducible from the results of his experiments, viz.:—1. That the perfect development of barley can take place, under certain conditions, in soil and air destitute of ammonia and its compounds. 2. That urea in solution is capable of being taken unchanged into the organisms of plants. 3. That urea need not be converted into ammonia before its nitrogen becomes available for the purposes of vegetation. 4. That the fertilizing effects of urea are little if at all inferior to the salts of ammonia. 5. That there exists no necessity for allowing drainings or other fertilizing substances containing urea to ferment; but that, on the contrary, greater benefits must be derived from their application in the recent or unfermented condition.

THE POTATO.

A paper has been read to the Chemical Society, "On the Chemical

Properties of the Potato, and its Uses as a General Article of Commerce if properly manipulated," by Mr. J. W. Rogers. The object of the paper was to show that the matter of the potato was in reality equal in nutritive value to the dry matter of wheat, whilst the quantum of food produced from a given quantity of land was nearly four times that produced from wheat. He exhibited some interesting specimens of the production of the potato in meal, flour, &c., and gave the following results of analysis :—

	Starch. lb.	Gluten. lb.	Oil. lb.
Components of the potato per cwt.	84·077	14·818	1·104
Ditto of wheat	78·199	17·536	4·265

And gave the following important fact as to the quantum of food from an acre of land :—

	Starch. lb.	Gluten. lb.	Oil. lb.
Dry matter of potato	3427	604	45
Dry matter of wheat	825	185	45

NITRATES OF PLANTS.

PROFESSOR W. K. SULLIVAN has read to the British Association a paper "On a Process for the Determination of the Nitrates of Plants." He pointed out the great importance of finding a process for the purpose, because in determining the amount of nitrogen in plants by the usual processes, a part of the nitrogen of the nitric acid is included in the result, and consequently the true amount of assimilative azotic principles cannot be deduced from ultimate analysis, if nitrates be present. The chief feature of the process is the use of sulphovinate of silver to precipitate the vegetable acids; the silver salts of which are insoluble in absolute alcohol, while the nitrate of silver is soluble. He also pointed out a method of separating lactic and acetic acids from one another when present.

COPPER IN PLANTS.

A PAPER has been read to the British Association "On the Presence of Copper in the Tissues of Plants and Animals," by Dr. Odling and Dr. Dupré. The authors had made more than 100 examinations by a great variety of processes, and had recognised the presence of copper in nearly every instance. In several specimens of wheat grain and human viscera the copper had been estimated. From 100 grains of wheat-ash the authors had obtained 251-thousandths of a grain, and from a sheep's liver rather more than one-half a grain of oxide of copper. The process was to precipitate the copper electrolytically on a platinum wire, to dissolve in nitric acid, and to ignite the residue of the evaporated solution.

THAMES WATER AND SEWAGE.

A PAPER has been read to the British Association "On the Condition of the Thames Water, as affected by London Sewage," by Dr. Barnes and Dr. Odling. They said it was now established that the pouring in of the contents of the drains did not affect the water as seriously as had been thought. The organic matter of the Thames was chiefly in a state of vitality, and therefore there was not so much putrefaction as was generally supposed ; at high water there was the greatest, and at the ebb tide the least amount of organic matter.

SEWAGE IN AGRICULTURE.

MR. DUGALD CAMPBELL has presented to the Chemical Society a Report "On the Application of Sewage to Agriculture." Manure had been prepared from sewage by simple filtration, but with an extremely imperfect removal of fertilizing matters ; also, by chemical precipitation, more especially by means of lime, as at Leicester. Sewage depends almost entirely upon human excreta for its manurial value. Now, while the total amount of dried excreta, per head, per diem, is only two ounces, the average supply of water, per head, per diem, amounts in London to thirty gallons, and that exclusive of rainfall. The problem consequently is, how to extract profitably the two ounces of solid from the thirty or fifty gallons of liquid. This problem is as yet unsolved, for the lime process fails to remove any large proportion of the nitrogenous constituents of sewage, and the resultant manure is not sufficiently valuable to repay the cost of carriage to any distance. The results of the employment of sewage water for irrigation are altogether more satisfactory than those in which a solid sewage manure has been used.

A NEW MANURE.

A NEW kind of Manure has been invented by M. Bichès, a gentleman of some note in the agricultural world. It is a chemical composition, the nature of which is still kept secret by the inventor; but its mode of application is rather curious, the grain intended to be sown being mechanically coated with the compound previously to its being consigned to the earth. The rich principle being thus in immediate contact with the seed to be developed, the soil needs no other kind of manure. Four pounds of the compound are sufficient for an acre of land. According to M. Bichès' experiments, the application of his manure would raise the present yield of France from 82,000,000 of hectolitres of wheat to 410,000,000. Dr. Stockhard, Professor at the Academy in Tharand, in Saxony, has lately pronounced in favour of this system.

A NEW POISON.

M. DE LUCA has communicated to the French Academy of Sciences the discovery of the poisonous principle of the *Cyclamen Europæum*, or common sowbread. This tuberculous plant has long been used in medicine as a violent purgative, and externally as a resolvent and a remedy for the earache ; but it was not known that it contained a powerful poison, producing effects not unlike those of the curara, which the Indians of the Rio Negro use to poison their arrows with. M. de Luca obtains it by digesting the root for forty-five days in alcohol, then pounding the root, digesting it again in a fresh quantity of alcohol, and repeating this process until the pulp had lost its acrid taste. All the tinctures thus obtained are then left to spontaneous evaporation in a cellar. At the end of about forty days a whitish substance is deposited, which, after being repeatedly washed in boiling alcohol, is left to dry in the dark. The cyclamine, or vegetable base of the cyclamen, thus produced, is white, opaque, and brittle, and emits no particular smell; it absorbs the humidity of the air, becomes transparent and gelatinous in water, and assumes a dark colour when exposed to the action of light. It is a curious fact that, while pigs can eat any quantity of the root with impunity, not only the active principle itself, but even the natural juice of the root, acts as a poison on small fish, if mixed with the water in which they are in the proportion of 1 to 3000. Four grammes of the juice injected into the trachea of the rabbit caused it to die in convulsions in the course of ten minutes. Bromine appears to be an antidote to this poison, or at least to mitigate its effects considerably; it has the same neutralizing power over the curara poison.

ARSENIC IN PAPER-HANGINGS.

Dr. Alfred Swaine Taylor, in his evidence before the Select Committee of the House of Lords, on the "Sale of Poisons Bill," after pointing out that arsenic was much used in several manufactures, such as in the manufacture of glass, especially opal glass, of shot, in the steeping of grain, and in killing the fly in sheep, states that the largest quantity of arsenic used in this country is used in the manufacture of paper for covering walls. He considered it very injurious both to those living in houses papered with this article, as well as to those employed in the manufacture. An instance was published in a medical work of some cases of illness occurring to persons living in a room papered with this paper, and the effects were described as those arising from arsenic. The colour, says Dr. Taylor, is put on very loosely indeed; it contains nearly 50 per cent. of the poison. In addition to the above, Dr. Taylor handed in to the Committee an envelope, the green tint on the inside of which he examined, and found to be formed of arsenite of copper. There is also an orange yellow which contains arsenic.

COLOURED CONFECTIONARY.

Dr. M'Namara has drawn the attention of the Chemical Section of the British Association to the large quantity of highly poisonous colouring matters employed in the manufacture of Confectionary. He referred to cases of deaths resulting from this practice. He alluded to the manner in which these substances are coloured by vegetable colouring materials of a harmless nature, and suggested that a list of such colours should be compiled by parties competent to the task, from which alone confectioners should be permitted to select their colours. He gave a sketch of such a list, and exhibited some beautifully coloured confectionary, in which such colouring matter had been detected. These confections he had had for some time in his possession, and their colours did not appear to have faded.

In conclusion, he cautioned the public against buying any confectionary in which green or blue colours exist, as such colours are probably produced by poisonous agencies.

The President said that, in his opinion, the subject of the foregoing paper was a most important one, and that suggestions such as these, as to the employment of innocent colours, were far more valuable than positive prohibitions against the use of poisonous colouring matters, as more likely to promote the object in view—the protection of the public health.

INFLUENCE OF AZOTE ON VEGETATION.

It has hitherto been questionable, whether phosphate of lime, as manure, suffices alone to promote vegetation, or requires the concurrent aid of another principle, which M. Boussingault has endeavoured to solve by the following experiments recently communicated to the French Academy of Sciences. On the 5th of July, he put six seeds of the *Helianthus argophyllus* (a kind of sunflower) into as many flower-pots, two of which only contained a mixture of powdered brick and quartzose sand; in the two others this mixture was enriched with phosphate of lime, vegetable ashes, and nitrate of potash: and in the last, an equal quantity of bi-carbonate of potash replaced the nitrate.

In the first of these experiments, both the seeds produced very small and sickly plants, about four inches in height, with a stalk not exceeding $\frac{3}{100}$ths of an inch in diameter; they each bore a yellow flower a tenth of an inch in diameter. These plants, produced by the sole action of the ingredients of the seed itself, and the water which it received, without any aid either from mould or manure, M. Boussingault calls *plantes limites*, as being the lowest result that can be obtained from a seed. The plants, on being dried and analysed, were found to have absorbed an almost infinitesimal quantity of azote from the air, and about one and a-half grain of carbon from the carbonic acid of the water and the atmosphere. In the second experiment, the plants attained an altitude of about 29 inches, with a diameter of four-tenths of an inch, and flowers three and a-half inches in diameter; they have absorbed 153 grains of carbon and 28 grains of azote, the latter being furnished by the nitrate. In the third experiment, the plants being deprived of the azote of the nitrate, differed but little from those of the first experiment, thus showing that azote is an indispensable ingredient of manure, without which neither phosphate of lime nor any other alkaline salt can produce any useful effect. All manures do, in fact, contain this element in conjunction with the others, and it is to this circumstance they owe their energy.

From another series of experiments, M. Boussingault arrived at the conclusion that the atmosphere alone cannot furnish plants with azote sufficient for vigorous vegetation.

ATMOSPHERIC OZONE.

Professor Rogers, United States, has communicated to the Chemical Society the results of some experiments on Atmospheric Ozone. He showed that the discoloration of Schönbein's test-paper was not perceptibly due to the terebinthinate emanations from plants, or to the oxygen evolved from plants, or to the direct action of sunlight, or to the presence of nitric acid in the atmosphere; and recommended that ozone observations should be made by exposing a definite surface of paper to the action of a definite quantity of air, for a definite period of time, which should not exceed five or ten minutes.—(See "Researches on Ozone," *Year-Book of Facts*, 1857, pp. 192—194.)

ILLUMINATING PEAT GAS.

MR. R. L. JOHNSON, in a paper read by him to the British Association, has stated that it is now nearly half a century since a Parliamentary Committee, appointed by Government to report on Irish Peat, named the town of Sligo and the Hill of Howth as the extreme points of a straight line, and Galway and Wicklow Head as the extreme points of another straight line, between which two straight lines lay the six-sevenths of all the peat in Ireland, the remaining one-seventh being distributed throughout localities on either side of these lines. Having named the different localities where peat is distributed, the total number of which in acres appears to be three millions, Mr. Johnson entered into a detailed description of the mode by which he obtained Illuminating Gas from common Peat or Turf, which he produced by the double decomposition of the constituents of the peat. He stated that works for the production of the gas have been recently erected, and are in actual operation in two places in Ireland. The gas produced was good, and its cost, as stated to him by a gentleman who was using it, less than two shillings the thousand cubic feet. He stated that from one single pound weight of common peat an hour's light may be produced, and that its cost being so very small, it should ultimately be extensively used throughout Ireland, and in its production there was one-third of charcoal.

GAS FROM WOOD.

IT is but recently that successful experiments have been made in the manufacture of illuminating Gas from Wood. A patent was first applied for in America, in 1853, by a German chemist, the assignee of the discoverer, Emil Briesach. Under this patent different gas works have been erected in that country, and with satisfactory results. Where wood is cheap, it is believed this gaseous product will be cheap. The residuum consists of charcoal and tar, and creosote and pyroligneous acid may also be obtained. Different kinds of wood may be used for this purpose—pine, spruce, oak, beech, &c., if it be perfectly dry; and if the wood is as cheap as in many districts in this country, the cost must be very much less—indeed, but a small fraction of the cost of coal gas at its ordinary rates. The following statement of the product of gas from wood, from a reliable source, throws some interesting light on the subject:—"One cord of ordinary pine wood of 128 cubic feet produces gas-light equal to 800 lbs. of spermaceti candles; one cord of oak or maple, of good quality, will yield gas-light equal to 900 lbs. of spermaceti candles." This estimate is upon wood used without a careful drying; when this, however, is thoroughly attended to, a cord of pine wood has produced a light equal to 1300 lbs. of spermaceti candles.

DISTILLATION OF BOGHEAD COAL.

A PAPER has been read to the Royal Society, "On some of the Products of the Destructive Distillation of Boghead Coal," by Mr. C. G. Williams. The action of heat on organic substances has been studied in two great branches; in the one, the relation of the products to the original matters is seen, and we are enabled to draw theoretical deductions in most cases, of great simplicity; in the other, the relation is not capable of being traced; and it would appear, therefore, at a first glance, that the study of bodies produced in this manner would be less conducive to the advancement of theoretical science. But, so far from this holding good, it is not too much to assert that organic chemistry has been more enriched by products of the second kind than by those of the first. The metamorphosis of naphthaline, to which the law of substitution owes so much for its development; the study of amaline, which has so greatly increased our knowledge of the theory of basic combinations; the history of the phenyl resin, and its numerous homologies, are, immense as their influence on the progress of chemistry has been, only a few instances of what may be anticipated from the study of products of destructive distillation. Heat is perhaps the only chemical agent to which we can assign no special function; at one time it acts as a powerful incentive to oxidation—at another to reduction. It is generally recognised as the most potent of disruptive forces, yet we sometimes find it causing the coalescence and reduplication of atoms. Therefore it is evident that allowing heat to possess these various and apparently antagonistic qualities, there are few organic bodies capable of withstanding high temperatures, whose presence among products of destructive distillation can be looked upon as impossible. The progress of chemical science has, moreover, shown in repeated instances that the substances at one time regarded as the rarest and most difficult to be obtained, become in a short time those with which we are most familiar.

The investigation in this paper may be considered a case in point, for its object is to prove the existence, in great quantities, of a commercial product hitherto only procurable by processes founded on purely theoretical considerations, and requiring considerable care in their prosecution. The substance, the distillate from which contains the hydro-carbons forming the subject of this communication, is the Boghead Coal, worked on a large scale at Bathgate, near Edinburgh. The author does not enter on the much disputed and litigated question respecting the nature of this mineral, his object being solely to study the chemical relations of the bodies produced by its decomposition under the influence of heat.

The ordinary Boghead naphtha appears in commerce in the form of a nearly colourless fluid, of characteristic odour, quite different from that obtained from ordinary coal. The specific gravity is only 0·750 at 15°, and is, therefore, greatly lower than that from the latter source, for even when thoroughly purified benzol has a density of 0·850. Notwithstanding its density, the boiling point is high, the lowest fraction that the author could obtain being between 143° and 148°. That the fluid was a mixture of many bodies of very different boiling points, was shown by the fact that the mercury in the thermometer steadily rose to the highest range it was safe to allow.

Having made no less than one thousand distillations for the purpose of obtaining the crude hydro-carbons of nearly constant boiling point, Mr. Williams proceeded to ascertain whether the fluids consisted of more than one substance, and he soon discovered that there were two series of bodies present. The fluids obtained are perfectly colourless, of a pleasant odour—resembling May-blossoms—very volatile, even at low temperatures, and having a density of above 0·725. If pieces of sodium are rapidly cut from a mass, so as to have only a very thin layer of soda, and are then thrown into the perfectly dry hydro-carbon, the coating of oxide is dissolved, the metal appearing of the lustre of silver, and may probably be thus kept for any length of time. After a detail of experiments, the author submits that they prove that the distillate from the Boghead coal contains, in addition to several other substances, a series of hydro-carbons, having the per centage composition density in the fluid and gaseous states, and also the boiling point of the alcohol radicals. It is to be regretted that in investigating these bodies we are unable to avail ourselves of active affinities of a kind which would yield easily procured and definite compounds, the study of which would remove all doubt as to identity. It is also peculiarly unfortunate that the boiling point of simple and compound radicals, as at present determined, show no fixed laws; in fact, if we examine the only data in our possession on the subject, we find no less than nine different values.

MANUFACTURE OF ACIDS.

MR. JONES, of Manchester, has introduced certain improvements in the manufacture of Muriatic and other Acids. In case of muriatic acid, the framework of the tower or cell is lined with aluminium or other conductor of electricity; next to the aluminium is a coat or lining of gutta percha or other non-conductor; the outer is the ordinary slate or flag frame. Through the tower or towers is a shaft of aluminium suspended on branches in the frame, and leaving a space below; to the shaft are scintillations of aluminium, and this shaft communicates with a galvanic battery on the outside. Muriatic acid being volatile, it is suspended in water; to accomplish this, on the summit of the tower is water in a basin, and surrounded by a freezing mixture (original), when the muriatic gas acid is introduced through the bottom entrance, its specific gravity and pressure causing it, on a sufficient quantity of the gas being introduced, and the frozen water descending, to absorb the heat and condense the muriatic acid, which is quickly suspended by the water in its descent. Contemporary is a current of galvanism, which aids the condensing of the acid gas, but prevents the decomposition of the water in which it has to be suspended, which is thus imperfect and of little strength, as by the present method the gas has to traverse several towers, and then go up and down. In another case, as the extent or height of passage is essential, the course is increased by one-third with tubes of aluminium turning round the shaft, and the electric power is increased. The greater the power of electricity, the purer the acid.

APPLICATION OF ANÆSTHETICS.

. M. HEURTELOUP has read to the French Academy of Sciences, a paper "On the Application of Anæsthetics." When ether or chloroform is administered by means of a sponge held at a short distance from the nostrils there is no ascertaining the quantity inhaled, since the breath of the patient or the slightest draught may cause the vapour to deviate. Moreover, in spreading and mixing with the ambient air, it may cause convulsive coughs and other inconveniences; and sometimes, after long and fruitless efforts to produce stupefaction, this effect is suddenly obtained to an alarming degree, ending, perhaps, in death. All this, M. Heurteloup observes, is owing to the impossibility, under the present system, of regulating the application of the anæsthetic; to remedy which inconvenience, he proposes an apparatus of his own invention, consisting of a glass tube, having each of its orifices closed with cork, into which another tube of a smaller diameter is inserted. One of the latter communicates by means of a flexible tube with a reservoir containing chloroform, which is blown into the larger tube by a small pair of bellows. The chloroform passes thence into the tube at the opposite extremity, which ends in a point, having the smallest possible aperture for the escape of the vapour. It is through this aperture the patient inhales the anæsthetic, which issues in a conical form, expanding as it rises, and mixing with the air; so that as the apparatus is brought nearer to or removed from the nostrils of the patient, the power of the anæsthetic is increased or diminished at will, and the operator may stop or resume its emission by stopping or renewing the action of the bellows.

AMELYNE, A NEW ANÆSTHETIC AGENT.

DR. SNOW has read to the Medical Society, some researches into the anæsthetic, or sensation-destroying power of a substance which he has ascertained to possess properties similar to those of chloroform, and for which, he said, that it might be substituted with advantage in surgical operations. The substance in question is Amelyne, a highly volatile fluid, prepared chemically from fusil oil. Dr. Snow stated that he had performed a number of experiments with it upon animals, and that he had also administered its vapour in above 20 operations in London hospitals with the most satisfactory results. The insensibility to pain was perfect, and in none of the cases was its use followed by sickness, sometimes a very disagreeable consequence of the administration of chloroform. The anæsthetic effects of amelyne are more transient than those of chloroform, which may, under certain circumstances, be an objection to it. It is not likely that amelyne will supersede chloroform; but there is reason to expect that in a considerable number of cases it will be found to be a preferable anæsthetic.

In the *Dublin Medical Press* we read—"'Amylene,' as an anæsthetic, still maintains its ground; it has been tried in midwifery. Though it does not seem to act so much on the muscular system as chloroform, it lessens some of the pain. The sleep of amylene is very peculiar: it puts one in mind of the sleep in the lines of Coleridge; it is it, in fact, to the letter—

'I moved, and could not feel my limb;
I was so lost in life,
I thought that I had died in sleep.'

The patient, on the other hand, under chloroform, does not think at all. The sense of touch, or common sensation, seems first obtunded or blunted by amylene, as the patient seems to hear and see what is going on. The pulse, too, is excited. On the other hand, under chloroform, the sense of annihilation, or agony of falling into nothingness, points more to the sensorium or grey matter of the brain."

ANÆSTHETICS DESTROYING INSECTS.

MARSHAL VAILLANT has communicated to the French Academy of Sciences, a paper by M. Doyere, on the curious and important fact that Anæsthetics—as ether, chloroform, &c.—have the power of destroying all kinds of insects injurious to the preservation of corn. Experiments on a large scale were made at Algiers by order of the Minister of War; and M. Doyère states as the result, that two grammes of chloroform per metrical quintal of wheat are sufficient to destroy every insect in the silos (corn pits hermetically closed, common both in Algeria and Italy) in the course of four or five days. Five grammes of sulphuret of carbon will effect the same in twenty-four hours. Not only the insects, but even the larvæ inside the grains are completely extirpated; and the corn, after being shovelled four or five times in the open air, does not retain a trace of the operation. Cattle will eat the barley thus treated even while still infected with the odour, and without any injurious effect.

A NEW MODE OF PRESERVING CORPSES.

MM. NOUALHIER and PRÉVOST, of Paris, have patented the following mode of Preserving Corpses. They first stop all the apertures, such as the mouth, nostrils, &c., with modellers' wax, then place the corpse in a suitable attitude, and spread over the skin a layer of metallic salt, by preference pulverized nitrate of silver, which is very easily applied. This salt penetrates into the pores of the skin, and when a sufficient quantity of it has been applied to the body by means of a brush, the body is put into a vessel of sulphate of copper, and a galvanic current being established, the whole surface becomes covered with a deposit of copper, thus producing a metallic mummy.

ON ROSOLIC ACID.

SINCE the discovery of this body by Runge, no mention has been made of its re-occurrence, and even its existence has been called in question. Dr. Hugh Miller met with it accidentally, as a result of the slow action of caustic lime upon the crude carbolic acid of coal tar. After long exposure to the air, the mass assumed a red colour; and when acted upon by water, yielded a deep-red solution of crude rosolate of lime. From this salt Rosolic Acid was obtained and purified. Its empirical formula was found to be $C_{46}H_{22}O_{8}$. It is a very feeble acid, uniting only with caustic alkalies and earths. The solutions of these salts are of a most magnificent crimson colour, but are very unstable. The carbonic acid of the air liberates the rosolic acid, which is eventually destroyed by continued exposure to air and light.

SPIRITS FROM BEETROOT AND MANGEL-WURZEL.

EXPERIMENTS have been made at a new distillery in Lincoln, in producing Spirits from Beetroot and Mangel-wurzel. It is estimated that a ton of beetroot will yield from 18 to 20 gallons of spirits, and a ton of mangel-wurzel about 16 gallons. The residue of the roots after distillation will be sold as food for cattle; and if the calculations of scientific men as to its value for such a purpose be verified by experience, the farmer will derive a double advantage from this new mode of producing spirits. According to the analysis made by Dr. Letheby and Professor Mitchell, and published by the Central Farmers' Club, the nutritive properties of mangel-wurzel and beetroot are increased instead of being diminished by the process of distillation. It is true that the saccharine and starchy elements are abstracted, but the other solid constituents are nearly doubled in consequence of the saturation of the root during the macerating process in a liquid which is rich in various organic matters. "The residue," says Professor Mitchell, "contains less of the non-nitrogenized or least useful elements in nutrition, for it just contains half the amount present in the fresh root; whilst of nitrogenized, or flesh-forming nutriment, the amount of the residue is in round numbers to that in the root as one and a half to one; or, in other words, 66lb. of the residue have the same nutritive value as 100 lb. of the fresh root, as far as the formation of flesh is concerned." The proportion of residue after distillation is one-half; so that, theoretically, two tons of root would make about 32 gallons of spirits, and leave one ton of pulp, which would be equal, in respect of its nutritive properties, to one ton and a half of the original root, thus reducing the cost of the raw material of that quantity of spirits to the price of half a ton of roots.—*Lincoln Times.*

NEW SUGAR-REFINING PROCESS.

DR. DAUBENY has described to the British Association a new method of Refining Sugar, conducted at Plymouth by Mr. Oxland, and known by his name. It consists in the adoption of the superphosphate of alumina in conjunction with animal charcoal as a substitute for the albumen usually employed for that purpose. In both cases the object is to separate and carry down the various impurities which colour and adulterate the pure saccharine principle present in the syrup expressed from the cane or other vegetable which supplies it. As, however, bullocks' blood is the material usually procured for the purpose of supplying the albumen, a portion of uncoagulated animal matter, together with certain salts, is left in the juice in the ordinary process of refining, which impairs its purity and promotes its fermentation—thus occasioning a certain loss of saccharine matter to result. Nothing of the kind happens when the superphosphate is substituted, and so much more perfect a purification of the feculent matters, under such circumstances, takes place, that several varieties of native sugar, which, from being very highly charged with feculent matters, are rejected in the ordinary process of refining, are readily purified by this method. The employment of superphosphate of alumina also gets rid of so much larger a proportion of the impurities present in the sugar, that much less animal charcoal is subsequently required for effecting its complete defæcation than when bullocks' blood has been resorted to. The quantity of superphosphate necessary for effecting the object is, for ordinary sugars, not less than twelve ounces to the ton; whereas, for the same quantity, as much as from one to four gallons of bullocks' blood is found to be required. Dr. Daubeny suggested that this re-agent might be advantageously resorted to not only in the purification of sugar, but also in other processes of the laboratory, when the removal of foreign matters, intimately mixed with the solution of a definite component, becomes a necessary preliminary in its further examination.

ON RHUBARB.

A PAPER has been read to the Chemical Society, by Messrs. Warren De la Rue and Hugo Muller, "On some Constituents of Rhubarb." The authors showed that the deposit which generally takes place in freshly-made tincture of rhubarb consists principally of apo-retin, but also contains erythro-retin, phœo-retin, and chrysophone. Benzol was strongly recommended as a solvent for extracting chrysophone from the residue of the process for making tincture of rhubarb, or from the deposit which takes place in the tincture, or from the crushed root itself after maceration with water. The authors succeeded in separating from crude chrysophone an entirely new body, "emodin," crystallizing in fine mono-clinic prisms of a deep orange colour. When apo-retin was acted upon by nitric acid, there resulted a nitro-acid closely resembling, if not identical with, chrysommic acid, a product hitherto obtained only from aloes. A paper was furnished by Professor Pettenkofer, of Munich, "On the Volumetric Determination of Carbonic Acid in the Air." A bottle, holding about six pints, and having its exact capacity noted, is filled by means of bellows, with the air to be examined. A definite measure of lime water, of known strength, is then introduced to absorb the carbonic acid, and the amount of lime water in excess finally determined by a standard solution of oxalic acid. The method is calculated to give very rapid and apparently exact results, due corrections being, of course, made for variations of pressure and temperature.

HAY TEA.

M. ISIDORE PIERRE has read to the French Academy of Sciences, a paper on the chemical ingredients of what agronomists call the "De Foin, or Hay Tea," being an infusion of hay, which is administered to calves in order to make them gradually pass from milk to solid food. To analyse this liquid, M. Pierre made an infusion of 16¼ lb. of good hay in distilled water, keeping it for a space of six hours at a temperature of about 90 deg. centigrade (194 deg. Fahr.), then drawing off the water, and renewing the infusion on the residue. On evaporating the liquids, he obtained 1310 grammes (nearly 3lb.) of a dry extract entirely soluble in water, being 15·94 per cent. of the weight of hay employed. The latter retained its natural colour after the operation, and on being dried emitted very nearly the same sweet smell it had before, and might have passed for common hay of good quality. It was found to have lost 28 centigrammes (43 grains) of azote, out of 146 which it had contained before. In a second operation, in which the infusion was continued for twelve hours at a temperature of about 25 deg. centigrade (72·50 deg. Fahr.), the quantity of dry extract obtained was 16·57 per cent., and the hay lost 20 per cent. of its azote. The extract, on being analysed, was found to contain 2 per cent. of silex, ½ of phosphoric acid, 1½ of lime, 1½ of soda, 1¼ of potash, and one-fifth per cent. of magnesia. M. Pierre hence concludes that hay tea is an excellent beverage for cattle; that hay may lose one-third of its nutritive qualities by infusion; and that consequently, when hay has been exposed to continual rains, the effect must be to deprive it of a considerable quantity of nutritive matter.

ECONOMY OF FOOD.

A PAPER has been read to the Society of Arts "On the Economy of Food," by Dr. Letheby, Officer of Health for the City of London. The investigations of chemists and physiologists during the last twenty years have determined that the various alimentary substances made use of by man and animals contain at least four classes of constituents, each of which performs its own assigned function in the living animal economy. If human milk be regarded as the type of what food should be, it is found that an almost universal instinct leads men and animals, if they partake of any aliment deficient in any of the necessary constituents, to associate others with it which may supply the want. Many familiar instances of this were adduced. Interesting particulars were then given of many of the dietaries now in use in the prisons and workhouses of the kingdom, as well as of the military and naval rations, which tended to show that the proportions maintained were very various. It is, therefore, of the utmost consequence that some fixed principles should be decided on for the direction of so important a matter. The convict is found to be better fed than the debtor, and both than the inmate of the workhouse. The influence of climate and occupation upon the diet adopted was then discussed. Experience has shown that there are certain articles of food which are not particularly nourishing in themselves, but which serve some very important purposes in the animal economy. This is the case with tea, coffee, cocoa, &c.; in fact, the use of a vegetable infusion, containing astringent matter and an active principle, rich in nitrogen, has been almost universal among mankind from the earliest times. The importance of a scientific method of cookery was then insisted on, and some useful hints given on the subject. It is a matter of national importance how we can best preserve food without depriving it of its nutritive power, for by so doing we not only guard against the dangers of famine, but we also facilitate, even in times of plenty, the equal distribution of food, by making the excess of one season or district the means of supplying the deficiencies of another.

WHEAT, FLOUR, AND BREAD.

A PAPER has been read to the Chemical Society by Mr. Lawes and Dr. Gilbert, "On the Composition of Wheat, Flour, and Bread." The authors described the results of an extended course of experiments, in which the wheat was traced throughout, from the field to the bakery. The crops under examination were grown each successive year from 1845 to 1854 inclusive. In 1846, which year yielded altogether the most fully matured crops, the proportion of nitrogen was lowest; and in 1853, when the crops were altogether poorest, the proportion of nitrogen was highest. The characters of a highly matured crop are, low proportion of water, low proportion of ash, and low proportion of nitrogen. In reference to the effect of manuring, it appeared that in crops manured with both nitrogenized and mineral matters, there was the best produce and the greatest reduction in the proportion of nitrogen. The character of the ash of wheat, though subject to considerable variations in poor crops, was found in well-matured produce to have great fixity of composition. The character of the ash, moreover, was very independent of the nature of the manure, but it was observed that the proportion of lime increased with the high maturation of the crop. In reference to the products of the mill, the bran was found to yield 10 times as much ash, and 1½ times as much nitrogen, as did the household flour. The authors estimated the amount of water in bread at from 36 to 38 per cent., and considered that 100 lb. of flour yielded on the average 138 lb. of bread. Their experiments showed that the loss of dry matter in fermentation is extremely small, certainly less than 1 per cent. They considered that the average amount of nitrogen in bread was 1·3 per cent. It is well known that millers and bakers consider the excellence of flour to be in proportion to the amount of starch. Contrary to the opinion of Liebig, and of most chemical physiologists, the authors maintained that the bakers' standard is the correct one; or at any rate that the least nitrogenized bread contains an ample sufficiency of nitrogen, and that the great demand for food is for its respiratory or carboniferous constituents. From a large number of analyses of flour, in which the gluten was separated mechanically, it appeared that, both in Europe and America, in proceeding from the north to the south, the proportion of gluten gradually increased, and, consequently, according to the authors' criterion of high maturation, the most matured crops were grown in the coldest latitudes. Dr. Marcet was indisposed to admit the authors' conclusions in reference to the low value of the nitrogenized constituents, and referred to some experiments showing, that the more highly nitrogenized is the character of the food, the less is the quantity of food required.—*Athenæum*, No. 1526.

ALUM IN BREAD.

MR. E. A. HADOW has read to the Chemical Society a paper "On the Detection of Alum in Bread." The author shows conclusively that the method frequently adopted for the separation of alum from bread, namely, by digestion in cold water, is altogether fallacious. He considers Kuhlman's method as perfectly satisfactory, though somewhat troublesome, and suggests a summary mode of detecting alum, founded on the mordant properties of alumed bread, which has been found to retain and brighten the colouring matter of logwood to an extent sufficiently distinctive.

PHOTOGRAPHY APPLIED TO ASTRONOMY.

IN a Boston (United States) newspaper of the 7th May, 1857, Mr. Bond, the eminent astronomer, announces the interesting fact, established by successful experiment, that stars down to the fifth magnitude, indeed "*all stars usually visible to the naked eye, may be mapped by the aid of photography with a degree of accuracy unsurpassed by the most refined measurements.* This accuracy is abundantly proved by measuring the distances of the photographic images taken on different nights." Six years ago he was able to take daguerreotypes of Vega and Castor (stars of the first magnitude) with the great Equatorial, but failed with those of smaller size. For his present success he is indebted to an improved driving-clock regulated by a pendulum, and daguerreotype plates of increased sensibility, both the work of Boston artists. It will be seen at a glance that the means thus furnished of *making the heavens map themselves*, and with unerring accuracy, will greatly facilitate the detection of those minute changes of position among the stars, which has within a few years quintupled the number of known planets, and produced so many other discoveries.—*Mr. Maclaren, in the Scotsman.*

PHOTOGRAPHY IN TENERIFFE.

MR. PIAZZI SMYTH has addressed to the Editor of the *Literary Gazette* the following result of his photographical researches, during the summer of 1856, in Teneriffe:—

"My photographic experiences in Teneriffe were 1 month at the sea level, 1 month at the altitude of 8900 feet, 20 days at the altitude of 10,700 feet, and 1 day at the height of 12,200 feet. This last day was spent on the summit of the Peak, and the success of the photographs was so greatly impeded by the continual jetting out of watery and sulphuric vapours from every portion of the small crater which forms the summit, that I leave it out of the present question.

Taking the other three stations, the average times of getting a good picture of a standard subject, in average illumination, were represented by 7 at the sea level, 5 at the 8900 feet station, and 3 at the 10,700 feet station. These different periods of duration, however, by no means express the whole improvement with altitude; for on looking over the whole collection of about 150 pictures, I find that the intensity and power of those at 10,700 feet is eminently greater than of those at 8900, and these again are far superior to those at the sea level. Further still, I find that there are remarkable facilities in the upper regions of the atmosphere for procuring the detail of distant objects. Thus, over and over again, at 10,700 feet, I have obtained on the collodion plate the bushes, and the stratification, and even the cleavage of the rocks, forming a chain of mountains four miles distant. But at the level of the sea, with a similar range of mountains, and at the same distance, and trying it when to the eye the sun was most vigorously bringing out the marking of the ravines and the clefts of the rocks, I could never get anything but the outline of the mountain, filled up by an even tint. With objects close by, there was, at the same time and place, as much photographic as optical detail; but aërial perspective or dimness seemed to increase so much more rapidly for the actinic than the luminous rays, that four miles of air produced with the former as much scattering effect as forty miles would with the latter. Hence while there was an increase of rapidity on the mountain, and an improvement also in intensity, there was found to be a power with distances of procuring that which is altogether impossible near the level of the sea.

"I have guarded myself as much as possible from giving the results in absolute terms for any station, as that would at once include the special sensitiveness of the particular compound employed, as compared with what other persons employ. Differential determinations for altitude are all that I attempted to obtain; and to this end I used the same chemicals and the same apparatus through the whole period. I have reason to think that the collodion was not so sensitive as it might have been; but that it was respectable, a very fair representation of the surf on the beach at Orotava, taken in about a quarter of a second, sufficiently testifies."

Upon three specimens of photographs—two taken at a vertical height of more than two miles in the air, accompanied by a third, taken at a comparatively low altitude—the Editor of the *Literary Gazette* observes: "Two are of considerable geological interest. One view, taken at the height of 10,700 feet, represents a portion of the Malpays, or broken lava stream of stony augite. This stream of lava, we believe, is the largest on the island, and has been described by geologists as being heaped up in dykes or embankments, over which the traveller is obliged to clamber as one ascends a steep wall. The lava is stated to be porphyritic, with large masses of felspar, not covered with a thick scoria, apparently never having been in a very fluid state, but to have rolled along in large masses. The whole composition of the stream is of felspar embedded in a brown clayey paste, remarkably hard, of a close texture, and heavy. The breadth of the stream is above two miles, and it contains ravines from 60 to 100 feet deep. Of these appearances the photograph before us is a most remarkable illustration. The view is taken across the stream of lava, and, with the help of the stereoscope, a succession of four, at least, of these ridges are distinctly marked, bearing all the traces of the phenomena above described. Each dyke bristles with irregular masses of felspar embedded in its surface, and the whole scene is savage and inhospitable to the last degree. Higher up, at an elevation of 11,000 feet, another view has been taken of the entrance to the ice caverns, a spot called La Cueva, where is a cave filled with snow and most delicious water. The rocks here present an appearance of partial vitrification. Some exhibit an union with the pumice, and the gradation from the stony structure to the vitrified, and thence to pumice. Veins of volcanic matter, formed under different conditions of heat and pressure, run through the mass. This photograph is of beautiful sharpness. Two ridges of rocks vitrified at the upper edges are seen, and then the face of the cliff in which lies the entrance to the caverns. The fact of the colour being not so deep as in the former is accounted for by the circumstance of the day having been cloudy. The third photograph gives a scene in the cultivated part of the island, near Orotava. The dragon-tree (*Dracæna draco*), with its smooth stem, terminated by forked clusters of thick boughs, each tufted at the extremity, is a rare and interesting feature, characteristic at once of a tropical region. It is impossible to witness the effect of these specimens without being struck with the important bearings of this wonderful art upon geological and botanical science." *

PHOTOGRAPHY OF THE MOON.

MR. W. CROOKES having received a grant of money from the Donation Fund of the Royal Society, has devoted considerable time to the difficult process of procuring good Photographs of the Moon. The telescope in which the lunar pictures were taken is the magnificent Equatorial at the Liverpool Observatory. The author conceives that his success in obtaining dense negatives in about four seconds is due to the great purity of the chemical materials which he employed. After describing the *modus operandi* of taking the picture, he states that the glass employed for the original negative of the moon was "extra white colour patent plate," and that for the intermediate positives and large negatives ordinary patent plate. The soluble paper for the collodion was prepared in the following manner :—

Commercial Nitrous acid	Sp. gr.	1·43	4 fluid oz.
,, Nitric acid	,,	1·37	4 ,,
Sulphuric acid	,,	1·82	8 ,,

* Mr. Piazzi Smyth has published the results of his sojourn in a handsome volume, entitled *Teneriffe, an Astronomer's Experiment; or, Specialties of a Residence amongst the Clouds.* Illustrated with twenty Photo-Stereographs. Lovell Reeve, Henrietta-street, Covent Garden.

The collodion was made with—Ether (Sp. gr. 725), previously freed from acid by rectification from dry caustic potassa, 5 fluid ounces; absolute alcohol, 3 fluid ounces; soluble paper (dried at 100 cent.), 50 grains; iodide of cadmium (pure), 30 grains. The alcohol and ether were mixed together, and then the paper and iodide of cadmium were added—they dissolved in a few minutes with a little shaking. As soon as the solution was complete, it was allowed to stand for twenty-four hours, and then half of the clear supernatant fluid was decanted carefully into a clean well-stoppered bottle for use. The author believes that collodion prepared in this manner will keep for many years. The nitrate of silver bath was made by dissolving one ounce of crystallized nitrate of silver, perfectly pure and neutral, in two ounces of water, then, with constant stirring, adding a solution of four grains of iodide of cadmium in one ounce of water, and a quarter of an ounce of the above iodized collodion and water to make up the volume to ten ounces. This was allowed to stand for a few hours at a temperature of about 25° cent., and then filtered from the undissolved iodide of silver and precipitated paper. A glass bath was used in preference to gutta percha. The developing solution consisted of—

Pure pyrogallic acid	8 grains.
Crystallized citric acid	16 ,,
Water	8 fluid oz.
Alcohol	0½ ,,

This developing solution is very slow in its action, fifteen to twenty minutes being frequently required; but it ultimately produces negatives of such vigour and freedom from stains, that Mr. Crookes much prefers it to that made according to the usual formula. The fixing solution employed was the ordinary nearly saturated solution of hyposulphate of soda. After using it, the pictures were well and carefully washed in warm water, dried before a fire, and, after scratching the description or name on a corner, varnished with the usual solution of amber in chloroform. The results obtained by the author are extremely beautiful. He doubts if much better photographs of our satellite can be taken by the process he has pursued. The future of lunar photography lies in another direction; the image must not be received on a sensitive plate, and this copy submitted to an after process of magnifying. Defects quite imperceptible to the naked eye on the small negatives are expanded into great blotches when magnified. In fact, upwards of a dozen seemingly equally good negatives showed spots when enlarged. The magnifying must be conducted simultaneously with the photographing, either by having the eyepiece on the telescope, or, what would be even better, having a proper arrangement of lenses to throw a magnified image of the moon at once on the collodion. The difficulty of want of light could not be any objection, as, supposing the enlarged image to be equal to those which the author has taken, that would be an increase of area of about 20 times, consequently 20×6 seconds, or two minutes, would represent the average time of exposure; a period which, were it even prolonged four or five times, would not be too severe a tax on a steady and skilful hand and eye.

In the Appendix to his paper, Mr. Crookes says :—

Besides the pictures taken in America—which are almost valueless as moon maps, as the sides are reversed in the copying from the daguerreotype plate upon which they were originally taken—the moon has been photographed by Professor Phillips, Father Secchi, MM. Bertsch and Arnauld, several Liverpool photographers, and Mr. Hartnup and myself. It is interesting and instructive to compare among themselves the means employed and the time occupied in taking the impression on these several occasions.

Professor Phillips's telescope has a sidereal focus of 11 feet, and an aperture of 6¼ inches; consequently the brilliancy of the moon's image in its focus is augmented 26 times over what she appears to the naked eye. The average time occupied for the collodion plate to receive the impression was about 3 minutes.

Father Secchi's telescope having a sidereal focus of 18 times its aperture, the moon's image was intensified 37·8 times, and the time required for the impression was an average of 6 minutes.

M. Porro's glass of 49 feet sidereal focus and 20 inches aperture, gave a moon image 12·3 times brighter than she appeared to the naked eye, and the average time of taking the picture was 17 seconds.

Mr. Hartnup's telescope being 12½ feet focus and 8 inches aperture, augments the intensity of the moon's image at its focus 35·1 times. The time which was required for the photograph of our satellite to be taken, on the occasion of the meeting of the British Association at Liverpool in 1854, was about 2 minutes; and under the same circumstances we ourselves succeeded in obtaining perfect and intense negatives in 4 seconds. These, however, were taken under very unfavourable circumstances, the temperature being below the freezing-point, and the moon at a considerable distance from the meridian, which necessarily caused both a diminution of the light and also a diminished sensitiveness of the collodion film.

The rapidity with which the above pictures were taken may be better understood by comparing them with those of terrestrial objects under similar circumstances. According to Herschel*—

"The actual illumination of the lunar surface is not much superior to that of weathered sandstone rock in full sunshine. I have frequently compared the moon setting behind the grey perpendicular façade of the Table Mountain, illuminated by the sun just risen in the opposite quarter of the horizon, when it has been scarcely distinguishable in brightness from the rock in contact with it. The sun and moon being nearly at equal altitudes, and the atmosphere perfectly free from cloud or vapour, its effect is alike on both luminaries."

Thus by comparing the Liverpool object-glass as to power with our ordinary camera lens, its focal length being nearly 19 times the aperture, and the moon's image being copied by its means in 4 seconds, we find that it is equivalent to copying sandstone illuminated by the sun in 4 seconds with a lens 4¼ inches focus, and a little less than ¼ inch diaphragm, or with a compound lens having an aperture of 1 inch, and the same focal length, in a quarter of a second.

Mr. Warren De la Rue has exhibited to the Astronomical Society a great variety of beautiful Photographs of the Moon, several of which he placed at the disposal of Fellows of the Society. He also made some remarks on the application of photography to recording the appearances of the heavens, and more particularly of those presented by the moon and the larger planets. Mr. Bond, of Cambridge, in the United States, was the first, he believed, who obtained a photographic impression by means of the telescope of the lunar surface. At a subsequent period, in the year 1852, Mr. De la Rue applied the collodion, assisted by Mr. Thornthwaite, and obtained an excellent image of the moon; and he had the honour of exhibiting it to the Society, and of describing the apparatus by which he

* Herschel's *Outlines of Astronomy*, p. 249.

obtained it. It is difficult to follow the moon's motion in any telescope without the aid of a clock-work driver; nevertheless, by means of a sliding plate-holder in the place of the ordinary eye-piece, he was able to do so by viewing the image through the collodion film. The particular form of apparatus employed he had the pleasure of describing at that period to the Society. Mr. De la Rue soon relinquished the pursuit of lunar photography, because it required two enthusiasts—one to uncover the mouth of the telescope, and one to follow the moon's apparent motion--and it was not easy to find a friend always disposed to wait up for hours, night after night, probably without obtaining any result. He therefore resolved to discontinue his photographic experiments till he had applied a clock-motion to his telescope. This he has done during the present year, and he has taken the earliest opportunity of resuming his experiments. The first results Mr. De la Rue obtained were similar to those described in 1852, and were produced by employing collodion and obtaining positive images of the moon. He was very successful from the onset, and had been enabled to distribute a few enlarged copies of a photograph obtained on the 7th of September. There were also copies of it on the table for the use of the members then present.

More recently, Mr. De la Rue has been induced to make experiments in the production of negative collodion pictures, for two reasons: first, because they admitted of more easy multiplication; and secondly, because the image is much finer in grain. In the positive pictures the precipitation of the silver is in larger particles than in the negatives. The paper copies before the Society were derived from a positive picture, which in the telescope was obtained in five seconds. When this was procured he was unable to obtain a good negative in less than fourteen seconds. However, his friend, Mr. Howlett, lately put him in the way of making negative collodion very sensitive, and he obtained negative impressions in ten seconds. Since this, by paying particular attention to the state of the bath, he had been very successful in still reducing the time of exposure, and had produced pictures, not only of the lunar surface, but also of Jupiter, in from three to seven seconds. The photographs of Jupiter show his belts remarkably well. The beauty of the photographs exhibited of the moon, he thought it would be admitted, gave great promise that at a future period photography will be considered as the only correct means of mapping down the lunar surface. When we shall be able to obtain collodion finer in grain and still more sensitive, it will supersede hand-drawing altogether; and even now the results obtained are much more accurate than anything hitherto done by mapping or hand-drawing. It is nearly impossible by micrometrical measurement to lay down all the details of the moon, and much, after a sort of triangulation, has to be filled up by eye. The work is too laborious; and the famous map of Beer and Mudler, wonderfully accurate as it is, does not fulfil the conditions of absolute accuracy in all the minute points of detail.

On the same evening was exhibited to the Astronomical Society, Bond's Photograph of ζ and g Ursæ Majoris, and of the Transit of α Lyræ. The Astronomer-Royal expressed his feeling that a step of very great importance had been made, of which, either as regards the self-delineation of clusters of stars, nebulæ, and planets, or as regards the self-registration of observations, it is impossible at present to estimate the value. The most cordial thanks of astronomers are due to Mr. Bond and to the professional amateurs, Messrs. Whipple and Black, by whose perseverance this object had been obtained.—*Athenæum*, No. 1572.

NEW PHOTOGRAPHIC PROCESSES.

New Calotype.—Mr. J. Mercer has described to the Chemical Society a new process, in which the agent employed is the peroxalate of iron, when, by the subsequent application of different reagents, photographic pictures of the most varied and even brilliant colours are produced. This process is an ingenious application of the practice of calico-printing to the purposes of photography.

The Hallotype.—Mr. C. J. Burnett, in the *Athenæum*, No. 1541, as an improvement upon this contrivance, proposes for obtaining an approach to stereoscopic effect, the following:—

1. The printing of one positive from a pair of stereoscopic glass or paper negatives, placed the one above the other; or the printing from a negative which has been in the first instance itself printed from two stereoscopic positives, placed one above the other, all this being done in the pressure frame.

2. The taking in the camera of a single negative from two stereoscopic positives at once by an arrangement which will unite the two into one. This is accomplished by using a lens with the whole of its outer surface covered by a close-fitting cap, with the exception of two eye-holes, which are left at a convenient distance in a horizontal line. The combined picture may be softened down by a pencil, with or without colours; or we might, if wished, combine more than two into one by using more pictures and more eye-holes, or a separate lens with the axes suitably adjusted.

3. We may take our negative from Nature direct in the ordinary way, but with our lens blocked up, as in our last, with the exception of the two circular openings which represent our two eyes, and which give us, in our resulting negative, precisely the two pictures which would be seen by our two eyes combined into one picture. But as, though combined in a certain sense, they are not absolutely connected, except in one point, a little softening down may be desired, which may be effected either in the positive or in the negative, as wished.

4. We may work with a lens having its top and bottom portions blocked up in front, so as to prevent any of the rays from our object falling on them; the light being thus admitted only to a narrow horizontal band across it. By this we get the same two pictures as we do by the last arrangement from the two extremities of our horizontal belt; while the space between these extremities, by an infinite number and variety of intermediate pictures which it yields, serves to shade the two extreme ones imperceptibly into one.

This last process is what I would recommend; and though we may not get by it what I at first expected when I began to devote attention to the subject—namely, that perfect solidity which Sir David Brewster has now most beautifully shown to be produced, and only producible by the successive convergences of the optic axes on different points—we will yet obtain a picture which is a much better compromise with visible nature, as seen by a two-eyed animal, than any which ordinary one-picture photography can produce, and which may be also of no small use to the painter and other artists who profess to represent visibly Nature as on a flat surface, in showing them how much and what part of Nature they ought to aim at giving us.

The Dry Collodion Process.—Sensitive as the Collodion Process is, and charming as are the results when all goes on successfully, it has not hitherto been a process which can be practised out of doors without many extraordinary, expensive, and troublesome appliances. Nearly all the processes which have been published—the "Gelatine," the "Oxymel," the "Glycerine," and others—have much that is excellent in them; but it appears to us that a Dry Collodion Process, devised by Mr. Long, of which he has published a description, is more simple and effective than any other. We have seen beautiful pictures obtained in Belgium, upon plates prepared in England, and which plates were brought to this country again before the pictures were developed. By this means a parcel of highly sensitive plates can be packed in paper and stowed away in a portmanteau, to be drawn out as occasion may require, to be returned again to the same package, and a plate can be kept with its dormant picture until required for development.

Photography and Insanity.—A communication has been read to the Royal Society, "On the Application of Photography to the Physiognomic and Mental Phænomena of Insanity," by Hugh W. Diamond, M.D. The position of the author, as medical superintendent of the Surrey Lunatic Asylum, enabled him to make the peculiar application of photography, of which he gives an account in the present communication. He points out the advantages to be derived from photographic portraits of the insane, as faithfully representing the features of the disease in its different forms, or its successive phases in the same patient, and as affording unerring records for study and comparison by the physician and psychologist.

PHOTOGRAPHY FOR ENGRAVING ON WOOD.

The *Scientific American* says—"A patent was issued, on the 5th of May last, to R. Price, of Worcester, Mass., for a process of Photographing on Wood in lieu of drawing by hand, which has since been so far developed by the proprietors as to be pronounced successful by some of our best engravers. The surface is so prepared as to be sensitive to light like the glass or paper employed in the ordinary photographic processes, and the image of any object is thus impressed upon the block with greater accuracy than it is possible to accomplish by human skill. We have seen a specimen of the above process—a portrait engraved in a hard, black manner, in effect inferior to a portrait drawn by hand, and altogether inartistic. Photography is, unquestionably, an excellent *aid to art*, but is by no means an efficient substitute for it.

Printing from Photographs.—Mr. J. K. Cheetham has patented certain improvements in the application of Photographic Pictures to Metal and other Surfaces, and in rendering the same applicable as Printing Surfaces.

This relates—1. To obtaining designs upon metallic surfaces so as to constitute pictures, which may remain so, or upon which the engraver may work by any of the usual methods. The principle proceeded upon is to obtain a photograph by any ordinary means, and transfer the reduced silver to the metal free from the film which supported it, and in direct contact with the metal. 2. To a method of obtaining surfaces for printing from photographs. For this purpose he proceeds according to the first part of the invention above described, so as to obtain the silver picture upon a surface of copper or other metal, and then treats the plate with nitric acid, which will eat away one portion of the surface and leave the other in relief. 3. To obtaining printing surfaces upon the lithographic principle. To effect this the inventor renders the stone a conductor of electricity by a coating of phosphorus or other suitable substance, and deposits a film of copper or other metal therein. Upon this he transfers the design as before described. The stone which was beneath this is then run over with the inking roller, and the metal picture subsequently removed, leaving a clear surface of stone for the light portions; or this operation may be reversed.

Photographic Paper.—The Industrial Society of Mulhouse has offered a prize of a silver medal for 500 kilogrammes of Paper possessing every quality necessary for Photographic purposes. The conditions are, that the paper should be made of materials perfectly pure and homogeneous, entirely free from metallic spots, small holes, or marks of any kind; its thickness must be exactly equal throughout, with both sides alike, and it must be capable of being saturated with a liquid by floating for not more than ten or fifteen minutes, without its being necessary to warm the fluid; it must also be able, when in large sheets, to bear the necessary handling after soaking in water for several hours. Among existing papers, Turner's (of England) most nearly fulfils these conditions. The Society of Arts has offered a prize for a similar paper.

On Froth.—Dr. Gladstone has made to the British Association some remarks, which gave rise to a long discussion as to the importance of discovering some method of remedying the inconvenience caused by the Froth in certain fluids used for the purpose of photography. It was stated that froth did not depend upon the state of the fluid, for it was found even when it was very viscid. In using collodion there was little inconvenience caused by the presence of froth, whereas it was very great in any substance in which albumen was used.

A NEW GUN COTTON.

A CORRESPONDENT of the *American Journal of Pharmacy* (Mr. Caldwell) describes a new kind of Gun Cotton, which is made as follows:—Newly prepared gun cotton is placed in a saturated solution of chlorate of potash, and allowed to remain for fifteen minutes. It is then gently pressed between folds of clean linen rag, and dried over a heat of 150 degrees. The cotton thus prepared explodes much quicker, and more like fulminating silver, than the ordinary gun cotton. From some experimental shots, the result was as follows:—A pistol loaded with nine grains by weight, of the ordinary cotton, sent a ball about half through a yellow pine door one inch thick, at the distance of twenty feet. It was then fired with two grains of the cotton, treated with chlorate of potash, when the pistol was shattered to pieces. Another pistol was loaded with one grain of the cotton, when the ball passed entirely through the door, making a perfectly smooth perforation.—*Edinburgh New Philosophical Journal,* No. 10.

NIÉPCE DE SAINT VICTOR'S DISCOVERY OF NEW AND REMARKABLE PHOTOGRAPHIC PHENOMENA.

MR. HUNT, in an admirable paper in the *Art-Journal* for January, considers these discoveries of M. Niépce de St. Victor to be certainly the most important which have been made since the discovery of photography itself. They were communicated by M. Chevreul to the French Academy of Sciences, on the 16th of November.

The conditions now determined are—that *any body, after having been exposed to light, retains in darkness some impression of this light.* M. Niépce remarks—"The phosphorescence and the fluorescence of bodies are well known, but I am not aware that any experiments have ever been made on the subject which I am about to describe."

Expose to the direct rays of the sun, during a quarter of an hour at least, an engraving which has been kept many days in obscurity, and of which one-half has been covered by an opaque screen; then apply this engraving upon a very sensitive photographic paper, and, after twenty-four hours' *contact in darkness*, we shall obtain, *in black*, a reproduction of the white parts of the engraving, which, in the process of insulation, has not been sheltered by the screen.

If the engraving has been kept for many days in profound darkness, and we then apply it upon sensitive paper, without having previously exposed it to light, it is not reproduced. Certain engravings which have been exposed to light are reproduced better than others, according to the nature of the paper; but all kinds of paper, even the filtering paper of Berzelius and the *papier de soie*, with or without a photographic design, and others, are reproduced more or less perfectly after exposure to light. Wood, ivory, parchment, and the living skin, are reproduced perfectly under the same circumstances; but metals, glass, and enamels, are not reproduced. If an engraving is exposed to the rays of the sun for a very long time, it is saturated with light; and the intensity of the impressions obtained by contact in darkness is so great, that M. Niépce hopes to arrive at a process by which, operating upon very sensitive papers —as paper prepared with the iodide of silver, for example, or upon the dry collodion or albumen tablets, and developing the image with gallic or the pyrogallic acid—to obtain proofs sufficiently vigorous to form an original, from which impressions may be taken. A new means for reproducing engravings will thus be secured.

It may be satisfactory to our photographic friends to give some of M. Niépce's experiments, as described by M. Chevreul.

If we interpose a plate of glass between the engraving and the sensitive paper, the whites of the engraving are no longer impressed upon it. The same interruption of the radiations takes place if we interpose a plate of mica, or a plate of rock-crystal, or of yellow glass stained with the oxide of uranium. We discover further that these substances arrest equally the impression of the phosphorescent rays when placed directly in front of the sensitive paper.

An engraving covered with a film of collodion or of gelatine, is reproduced; but an engraving covered with a layer of varnish or of gum, is not reproduced. An engraving placed at three millimetres' distance from the sensitive paper, is very well reproduced; and if the design is of a bold character, it will be reproduced at the distance of a centimetre.* The impression is not, then, the result of action of contact, or of chemical action. A coloured engraving of many colours is reproduced very unequally; that is to say, the colours imprint their image with different intensities, varying with their chemical nature—some producing an impression which is very visible, whilst others scarcely tint the sensitive paper.

It is similar with characters printed with different inks. Printers' ink, whether it be such as is used with type or for copper-plate printing, and the ordinary writing ink, formed of a solution of nutgalls and sulphate of iron, do not give images; while certain "English inks give impressions sufficiently strong." Vitrified characters, traced upon a plate of varnished porcelain, or covered with enamel, are imprinted upon the sensitive paper without the porcelain itself leaving any trace of its presence; but a porcelain not covered with varnish or enamel, such as *biscuit china* or "*la pâte de kaolin*," produces a slight impression.

If, after having exposed an engraving to the light during one hour, we apply it upon a white card which has remained in darkness during some days, and if, after having left the engraving in contact with the card during twenty-four hours at least, we put *the card in its turn* in contact with a leaf of sensitive paper, we shall have, after twenty-four hours of this new contact, a reproduction of the engraving, a little less visible, it is true, than if the engraving had been applied directly upon the sensitive paper, but yet distinct.

When a tablet of black marble, lightly strewn with white spots, after having been exposed to the light, is applied at once to a sensitive paper, the white parts of the marble only are imprinted upon the paper. Under the same conditions, a tablet of white chalk will produce a sensible impression, while a tablet of charcoal will produce no such effect. When a black and white feather has been exposed to the sun, and applied in darkness to a sensitive surface, the white parts alone imprint their image. The feather of a parrot—red, green, blue, and black—has given scarcely any impression, acting as if the feather had been black. Certain colours, however, have left traces of a very feeble action.

Experiments have been made with textile fabrics of different natures and of various colours. The following are a few of the results:—

Cotton—*White* impressed the sensitive paper
,, *Brown* (by madder and alumina). Nothing given.
,, *Violet* (by madder, alumina, and iron). Scarcely anything.
,, *Red* (by cochineal). Nothing.
,, *Turkey Red* (by madder and alum). Nothing.
,, *Prussian Blue*, upon white ground, is the blue which produces the best impression.
,, *Blue* (by indigo). Nothing.
,, *Chamois* (by peroxide of iron). No impression.

Linen, silk, and woollen cloths give equally different impressions, according to the chemical nature of the colours.

* The millimetre is 0·03937 of an English inch. The centimetre is 0·39371 of an English inch.

M. Niépce calls particular attention to the following experiment, which is, as he says, curious and important :—

We take a tube of metal—of tin-plate, for example, or of any other opaque substance—closed at one of its extremities, and cover the interior with paper or white card : the open end of the tube is exposed for about an hour to the direct rays of the sun. Then apply this open end to a sheet of sensitive paper, and preserve it in this state for twenty-four hours, when the circumference of the tube will have designed its image. More than this. *If an engraving upon china paper is interposed between the tube and the sensitive paper, we find the same reproduced.* Reproduced, be it remembered, by the radiations which have been absorbed and re-developed from the interior of the tube. "If we close the tube hermetically as soon as we cease to expose it to the light, we shall preserve, during an indefinite time, the faculty of radiation, which the insulation has communicated, and we shall see that this is manifested by the impression produced when we apply the tube upon a sensitive paper, after having removed the cover by which the tube was closed."

Niépce then informs us, that he has repeated upon images formed in the camera-obscura similar experiments to those which he has made with the direct light. A piece of card which had been kept in darkness was placed in the camera-obscura for about three hours, and on it was projected an image brilliantly illuminated by the sun. Then the *card was applied to sensitive paper*, and after twenty-four hours there was obtained a reproduction of the primitive image of the camera-obscura. There must be a long exposure to obtain an appreciable result.

It will be remembered that some few years since Professor Stokes drew attention to some peculiar conditions of light, to which he gave the name of *fluorescence*. M. Niépce has made several experiments with substances which possess this peculiar property. A design was traced upon a sheet of white paper with a solution of sulphate of quinine, one of the most fluorescent bodies : the paper was then exposed to the sun, and subsequently applied to the sensitive paper. The fluorescent parts were reproduced in black, much more intense than that of the paper upon which the design was formed. A plate of glass interposed between the design and the sensitive paper prevented any impression. A plate of glass, coloured yellow by the oxide of uranium, produced the same effect. If the design in sulphate of quinine has not been exposed to light, nothing is produced upon the sensitive paper. M. Niépce then tells us that a design traced with phosphorus upon paper will, without being exposed to light, impress very rapidly the sensitive paper. This impression is, beyond all doubt, due to the formation of phosphide of silver—it is a chemical change quite independent of the luminous effect, and has nothing in common with the other phenomena. He says, however, that the same effects are produced by fluate of lime, rendered phosphorescent by heat.

Such are the principal matters to which M. Niépce now directs attention ; and if his results are confirmed by further experiments, they must materially change our views of luminous variations.

Natural History.

ZOOLOGY.

VIVIPARITY AND

At the American Association (Albany) Meeting, Professor Agassiz has made a communication on Viviparity and Oviparity, on which his researches in embryology have thrown great light. At one time it was believed that those animals which brought forth their young alive had peculiarities which indicated exclusive relationship. The progress of embryology had proved that there was no such relationship, and no radical difference between viviparous and oviparous animals. In the family of snakes there were viviparous and ovi- The vipers brought forth their young alive, but they were not on that account like quadrupeds. Among quadrupeds, too, the marsupials, when first born, were carried about by the mother, attached to the nipple, until they were capable of being again born, and, as it were, standing on their own legs. Placental connexion between mother and young was of not much consequence. Sharks showed that: some being oviparous, others viviparous, with or without placental connexion. Yet the mode of development in all was precisely the same, and was a shark development. There was nothing in it which was allied to that of birds. This had a decided influence on classification. There was no reason for separating the marsupials from other mammals. In each group and different class the relation between the modes of development indicated the real relations of the animals. Animals which were developed in the same manner were sure to be found in the end to belong to the same general division. He maintained that the distinctions founded on complications of structure must be given up for general classification, and confined to the minor distinctions.—*Edinburgh New Philosophical Journal*, No. 10.

NEW FACTS OF TRANSFUSION.

Dr. Brown-Séquard has presented to the French Academy of Sciences a paper, in which he tries to prove the two following propositions:—1st. That arterial or venous blood, from an animal of any one of the four classes vertebrata, containing oxygen in sufficient quantity to be scarlet, may be injected, without danger, into the veins of a vertebrated animal of any one of the four classes, provided that the amount of injected blood be not too considerable. 2nd. Arterial or venous blood of any vertebrated animal, being sufficiently rich in carbonic acid to be almost black (*noirâtre*), cannot be injected in the veins of a warm-blooded animal without producing phenomena of asphyxia, and most frequently death, after violent convulsions, provided that the quantity of injected blood be not below one five-hundredth weight of the animal, and also that the injection be made not too slowly. Dr. Brown-Séquard states that he has transfused into the jugular vein of dogs without any ill effect, blood of rabbits, guinea-pigs, cats, cocks, hens, pigeons, ducks, turtles and tortoises, frogs and eels. In rabbits and birds he has also transfused blood of other animals without any marked bad effect. He attributes chiefly to carbonic acid the phenomena which had been considered as due to differences in the blood of various species. In many communications to the "Société de Biologie," the same physiologist has related facts to prove that in the experiments of Blundell, of Dieffenbach, and of Prevost and Dumas, there were many causes of failure unknown to these experimenters which have prevented them from re-establishing life permanently in dogs bled to death, and transfused with blood from animals of another species. These causes of failure were—1st, that too much blood was transfused at once; 2nd, that the blood was not fresh; 3rd, that it did not contain oxygen enough, and contained too much carbonic acid. Dr. Brown-Séquard has ascertained that even the blood of birds, defibrinated and rich in oxygen, has been able to re-establish full and durable life in dogs, weighing from 15lb. to 20lb., and having lost more than 16oz. of arterial blood, *i.e.*, more blood than the dogs of Blundell had lost. From 30 to 48 grammes of birds' blood (1oz. to $1\frac{5}{8}$oz.) have been sufficient in many cases to restore full life.—*Medical Times.*

BREEDS OF DOMESTIC ANIMALS.

A PAPER has been read to the British Association, "On the Dispersion of Particular Breeds of Domestic Animals as connected with the great Ethnological Divisions of Mankind," by Mr. Ogilby. The author commenced by stating that the power of domesticating animals appeared to exercise a great influence on the civilization of mankind. Where men had no cattle to attend to or breed, there they always exhibited the most degraded forms of their race. The great object of the paper was to show that certain breeds of sheep had always appeared with particular races of men, and that, at the present day, we had no better guide to the original types of mankind than were afforded by certain races of sheep. The paper was illustrated by maps and diagrams, illustrating the breeds of sheep.

THE HORNS OF ANIMALS.

IT is commonly believed that the horns of the ox acquire an additional ring every year after the third, but the addition of annuli is far from being annual in other species. Many rings are gained in one year's growth of the ram's horns, and in those of the ring-horned antelope. The length of the horn forms a distinguishing characteristic in some breeds of cattle; but whatever improvements may have been effected in the form and character of the carcase, by the modification of food and habits, it does not appear that we have been able to superinduce any improvement or alteration in the size or texture of the horns. Indeed, the horns of the wild animals would seem to be more prominent than in the domesticated races.
horns of the African or Cape buffalo, of the Java buffalo, and the Arnee buffalo of India, are the most valuable, and the extent of the trade

in this class of horns may be estimated from the fact that about one million buffalo horns were shipped from the port of Madras last year. As we derive two-thirds of our foreign supply of horns from the East Indies, it is not improbable that the existing disturbances may cause a deficiency in the shipments thence, owing to the interruption of internal communication, and the withdrawal of large masses of the population from their ordinary peaceful occupation of collecting and bringing in the horns to the mercantile houses. South America (chiefly Brazil and the Argentine Republic) furnishes us with a considerable quantity of ox horns, and we also receive several hundred tons a year from the United States. For buffalo and stag horns we are mainly dependent on India; of the former we import fully 1400 tons per annum. Averaging these at 1400 horns to the ton, this would show a mortality of a million buffaloes a year, besides what may be locally used up, or sent to America and the European ports. Of deer horns, the Sheffield cutlers and others work up about 400 tons, chiefly derived from Ceylon and the peninsula of India. The "fall" from at least 300,000 head of deer is required to supply this quantity. Of the aggregate annual quantity of horns entering the market, estimated at 6400 tons, about one-fifth is manufactured into combs, valued at from 300,000*l.* to 400,000*l.*; a large quantity is worked up into knife and cutlass handles; while there are many other miscellaneous uses, in shoe-horns, scoops, drinking-horns, &c. The waste pieces of stag horn are boiled for size in the cloth-making districts; and the pith or slough of other horns and hoofs is crushed for tillage, when light and thus fit. The heavier portion is converted into prussiate of potash and Prussian blue, of which about 10 tons are made weekly in Sheffield from the waste products.—*The Scotsman.*

VISIBLE REPRODUCTION OF THE HUMAN VOICE.

M. LEON SCOTT, of Paris, has devised a method for obtaining the Vibrations of the Human Voice expressed in signs, written, so to say, by the voice itself. If we examine the human ear, we find it chiefly composed of a tube ending in the tympanum, an inclined vibrating membrane. It is well known that sound is transmitted with extraordinary purity and rapidity through tubular conduits, and it would appear that, if there were no disturbing causes, the transmission might be continued to an incredible distance without any diminution of intensity. There is an experiment on record, tried about fifty years ago, by M. M. Biot, who, placing himself at one of the extremities of a tubular aqueduct 950 metres in length, carried on a conversation in a low voice with another person situated at the opposite extremity. These facts have been turned to account by M. Scott in the following manner:—A tubular conduit receives the vibrations of the human voice at one of its extremities, shaped like a funnel; at the other extremity there is a vibrating membrane, to which a very light pencil or stylus is attached. This stylus rests upon a slip of paper, covered with a coating of lampblack, and is made by the aid of clockwork to unroll from a cylinder while the person whose voice is to be experimented upon is speaking. The stylus, in receiving the vibrations of the voice through the tube, marks the paper with undulating lines expressing the different inflexions. These lines are afterwards indelibly fixed by taking photographic impressions of them. A somewhat similar process had been employed some time ago by M. Werthheim, to obtain the graphic representation of the vibrations of a tuning-fork; but M. Scott is the first who has attempted anything of the kind with the human voice. The contrivance, though still in its infancy, has already led to a curious result—viz., that the clearer and purer a sound is, the more regular is the curve described by the stylus; yells and other discordant sounds producing unequal, and therefore not isochronous undulations, while tremulous and indistinct sounds cause secondary undulations, connected with the principal one.—*Galignani's Messenger*.

FUNCTIONS OF THE SPINAL CORD.

Professor Hughes Bennett, in a communication to the Royal Society of Edinburgh, aims at uniting two separate kinds of research, which of late had been directed towards advancing our knowledge of the Structure and Functions of the Spinal Cord. From these it would, he thought, appear, that the views considered to be so firmly established by the genius and labours of Charles Bell required great modification. Dr. Bennett then gave a sketch of these views, and of the present opinions of physiologists regarding the functions of the spinal cord. He indicated certain facts which had long been recognised as difficult of explanation in accordance with them. He then described the results of several experiments by M. Brown-Séquard on the columns of the cord in living animals, which he himself (Dr. B.) had witnessed, and which satisfied him that, on the posterior columns being cut across, increase of sensibility in the inferior extremities was the consequence, instead of paralysis. He also described the discoveries recently made in the structure of the spinal cord, by Budge, Kölliker, Lockhart Clarke, Stilling, Remack, Wagner, Van der Kolk, Schilling, Kupffner, and especially by Owsjannikow. He pointed out how the structural discoveries threw light on the experimental ones, and from the whole inquiry drew the following conclusions:—

1. Although the anterior and posterior roots of the spinal nerves may still be considered motor and sensitive, we can no longer apply these terms to the anterior and posterior columns of the cord.

2. The fibres in these columns do not convey impressions directly and continuously to the brain, as hitherto supposed, but enter the grey matter, and operate through the ganglionic cells of that matter.

3. That all so-called reflex movements are carried on by a definite system of conducting fibres and ganglionic cells, passing through the grey matter; in other words, they are *diastaltic*, and not reflex.

4. That the particular fibres and cells which are necessary to

spinal diastaltic acts have yet to be discovered; so that a new field of inquiry is opened up to the physiological histologist.

FACTS RELATING TO LACTATION.

Dr. Delafond has read a paper to the French Academy of Sciences on the Production of Milk in Animals, independently of those circumstances under which nature usually prepares and provides that important nutriment for the newly-born offspring. History records many singular cases of male animals said to have yielded milk. In the Island of Lemnos, according to Aristotle, there lived a lactiferous ram, from the milk of which small cheeses used to be made; and another ram, claiming descent from the former, was quite as lactiferous as his sire. But, without diving so far into antiquity, we may state that in 1845 Mons. Van Coppenael presented the Garden of Plants with a he-goat, which would furnish per day a litre (1¾ pints) of very good milk, possessing all the chemical qualities and ingredients pertaining to that liquid. This he-goat continued to do so for the long space of five years, during which time M. Geoffroy de St. Hilaire paid particular attention to it. It once suckled a kid that had lost its dam, and displayed great affection for it. Morgagni was the first to discover, upwards of a century ago, that a few drops of milk might be pressed from the nipples of new-born infants, whether male or female. This lactation, which is now a well-authenticated fact, occurs on the second day after birth, and lasts until the thirtieth. Baudelocque relates of a girl eight years of age, who having accidentally, and only in play, offered her breast to an infant, a few months old, the latter began to suck, and, to the surprise of the mother, actually drew from her a sufficient quantity of milk; an experiment which was subsequently repeated several times. At St. Louis, Senegal, young negro virgins have often been seen to give the breast to their infant brothers and sisters. M. de Humboldt mentions the case of a man he had seen in America, who suckled his child for the space of five months during the illness of his wife; and Dr. Auzias Turenne speaks of a young Arab, who studied at Paris in 1845, and from whose nipples milk could be extracted. This Arab is still alive, and is at present a physician in Egypt. M. Delafond's personal observations chiefly relate to the canine species, where this faculty of lactation wholly independent of gestation appears to be general. M. Delafond exhibited a bitch, which had experienced all the various symptoms of lactation just as if it had puppies, and which subsequently suckled one of another breed successfully; the little nursling having increased about a kilogramme in weight in twenty-four days (the same increase as may be expected in a child of that age).

SKULL OF THE MANATUS.

There has been read to the Zoological Society, by the Secretary, Mr. D. W. Mitchell, a paper "On the Skull of a Manatus from Western Africa," by Dr. William Balfort Baikie. It stated that until very recently but two species of the somewhat scarce genus *Manatus* have been acknowledged by naturalists—viz., *M. Australis* and *M. Senegalensis*. Of these, the former inhabits chiefly the mouths of the great rivers of the north-eastern coast of America and the West Indies, while the latter is confined to the tropical portions of the west coast of Africa. Some writers, as Hermandéz, mention a species found along the coast of Peru; but if so, little or nothing is known of it or its habits. Individual specimens of *Manati* have rarely been met with along our own shores, as that recorded by Professor Fleming as having occurred in the Shetland Islands in 1823, and Dr. Baikie is in possession of tolerable evidence that a similar animal had made its appearance from time to time in Orkney, where it is not unknown to the fishermen. The differences between *M. Australis* and *M. Senegalensis* are quite evident. In 1851, while Dr. Barth was journeying towards the country of Adamáwa, in Central Africa, he heard from the natives accounts of an animal, said to frequent the rivers and marshes, named by them Ayú (erroneously written Ajúh). Dr. Vogel having had his attention called to this by Dr. Barth, met with a specimen in September, 1855, in the upper part of the Binue, or Tsádda, an account of which having been sent by him to England, and read at the meeting of the British Association at Cheltenham, Professor Owen thought it presented sufficient peculiarities to distinguish it as a species, which he indicated as *M. Vogelii*. But his remarks partly applied to a *Manatus'* skull, which was exhibited at the time by Dr. Baikie, and which, by some misconception, persons present had been led to consider as belonging to the very individual described by Vogel.

This skull was really obtained by Dr. Baikie on visiting the Kwóra, in July, 1854. He states that on entering the mouth of that river from the sea, he found under some palms and mangroves, a collection of miserable huts, towards which he pulled, and presently landed. The inhabitants in great alarm fled into the bush, and could not be induced to come out, so he walked through their habitations, looking around him, but finding nothing but heaps of nuts of the oil-palm. But just before embarking, his eye caught a heap of dry bones, placed evidently by the negroes as their dju-dju, or sacred heap; he eagerly examined the mass, but found that it was composed mostly of fragments, among which were portions of skulls of goats, of a bullock, and of a crocodile, but on turning these over he saw a more complete relic, one which struck him as being peculiar, and as something he had not previously seen. This he carried off, and it turned out to be the nearly complete skull of the *Manatus*. Dr. Baikie then proceeds to give a table containing the general measurements of the skull, and a comparison with *M. Senegalensis* and *M. Australis*, between which the skull from the Kwóra exhibits characters of an intermediate form. Dr. Baikie proposes to retain for it Professor Owen's name of *M. Vogelii*, and announces his intention of investigating the subject more closely during his next visit to West Africa. The Secretary also read a "Monograph of the Genus *Lasiurus*," by Robert F. Tomes, Esq., the object of which was rather to enumerate and describe all the species at present arranged under the above name, than to enter into the claims of the group to be considered as a distinct genus. He described two new species, under the names of *Lasiurus Grayi* and *L. Caudatus*. Mr. Tegetmeier exhibited a portion of the collection of Asiatic poultry skins, which has been entrusted to him by Mr. C. Darwin, with the view of illustrating the variations which take place in the domestic fowl. The collection contains some curious birds from Persia, India, and Singapore, the peculiarities of which were successively pointed out by the exhibitor.

ANIMALS OF THIBET AND INDIA.

HERR R. SCHLAGINTWEIT has read to the British Association the following "Notes on some of the Animals of Thibet and India:"—

The existence of the Yak, or Tibetan ox, in a wild state, has been repeatedly doubted, but we frequently found wild yaks. The chief localities where we met with them were both sides of the range which separates the Indus from the Sutlej, near the origin of the Indus, and near the environs of Gartok; but the greatest number of them was at the northern foot of the high Karakorum range, as well as to the south of the Kuenluen, in Turkistan. In Western Thibet, particularly in Ladak, there are no more yaks in a wild state at present, though I have no doubt that they have formerly existed there. They seem to have been extirpated here, the population being, though very thin, a little more numerous than in Thibet in general. As Ladak has been occasionally more visited by travellers than any other part of Thibet, the want of the yak here has probably given rise to the idea that they are no more to be found in a wild state at all. Amongst all quadruped animals the yak is found at the greatest height: it stands best the cold of the Snowy Mountains, and is least affected by the rarefied air. But at the same time the range of temperature in which a yak can live is very limited; the real yak can scarcely exist in summer in heights of 8000 feet. We often found large herds of wild yaks—from thirty to forty—in heights of 18,600 to 18,900 English feet; and on one occasion we traced them even as high as 19,300 feet,—a remarkable elevation, as it is very considerably above the limits of vegetation, and even more than 1000 feet above the snow line. The hybrid between the yak and the Indian cow is called Chooboo, and it is very remarkable that the chooboos are fertile. The chooboos, which are most useful domestic animals to the inhabitants of the Himalayas, are brought down to lower places, where yaks do not exist, and where consequently they cannot mix either with yaks or with the Indian cow. We had occasion to see and examine the offspring of chooboos as far as to the seventh generation, and in all these cases we found the later generations neither much altered nor deteriorated; and we were moreover informed that there was never found any limit as to the number of generations. The Kiang, or wild horse, has been often confounded with the Gorkhar, or wild ass, though they differ considerably in appearance, and inhabit countries with very dissimilar climates. The kiang exists in the high cold regions and mountains of Thibet,—the ass in the heated sandy plains of Sindh and Beloochistan. The kiang is found in great numbers nearly in the same localities as the yak; he does not, however, go up the mountains so high as the yak, but the range of his distribution is greater than that of the yak. The greatest elevation where we found kiangs was 18,600 English feet, whilst we traced yaks as high up as 19,300 feet. The regions where the yak and the kiang are found are, in a zoological point of view, altogether one of the most remarkable and interesting of our globe. The highest absolute elevation coincides here, it is true, with the greatest height of the snow line,—or rather it causes the snow line to be higher. But those large, high plateaus and regions, though free from snow and ice in summer, remain a desert throughout the year. The amount of vegetation on them is less than it is in the Desert between Suez and Cairo, in Egypt. Nevertheless, these high, sterile regions are inhabited by numerous herds of large quadrupeds; and besides those already mentioned, numerous species of wild sheep, antelopes, and a few canine animals, chiefly wolves, as well as hares, are abundant. The herbivorous animals find here their food only by travelling daily over vast tracts of land, as there are only a few fertile spots, the greater part being completely barren. The great scarcity of vegetation, particularly the entire absence of mosses and lichens, has a very different effect, though an indirect one, on the occurrence of birds. The small plants are the chief abode of insects, the want of mosses and lichens coinciding with a total absence of humus, limits, therefore, to its minimum the occurrence of insects, the exclusive food of small birds in all extremely elevated parts of the globe, where grains are no more found. We indeed met, travelling twenty consecutive days between heights of 14,000 to 18,200 feet, only with three individuals belonging to a species of Fringilla, but occasionally a few large carnivorous birds, as vultures, were met with. The Gorkhar, or wild ass—an animal which, as I mentioned before, has been often confounded with the Kiang, or wild horse—inhabits chiefly the rather hilly districts of Beloochistan, part of the sandy plains of Sindh, and it is to be found, if I am not mistaken, to the westward of Beloochistan, in Persia, where it is called Koolan. Dr. Barth lately told me, that, according to the description I gave him, he thinks the asses he saw in Africa identical with the Gorkhars, or wild asses, of Sindh and Beloochistan.

I will now try to give an explanation about the fabulous Unicorn, or animal which is said to have one horn only. This animal has been described by Messrs. Huc and Gabet, the famous travellers in Eastern Thibet, according to information they received, as a species of antelope with one horn placed unsymmetrically on his head. When my brother Hermann was in Nepaul he procured specimens of horns of a wild sheep (not of an antelope) of very curious appearance. At first sight it seemed to be but one horn placed on the centre of the head; but, on closer examination, and after having made a horizontal section of the horn, it was found to consist of two distinct parts, which were included in a horny envelope, not unlike two fingers put in one finger of a glove. The animal when young has two separate horns, which are, however, placed so close to each other, that the interior borders begin very soon to touch each other; later, by a slight quent irritation, the horny matter forms one uninterrupted mass, and the two horns are surrounded by this horny substance, so that they appear at first sight to be but one. In conclusion, allow me to say a few words about migratory birds.

There are no migratory birds in the Himalayas; we nowhere and at no season found flocks crossing the Himalayas, as many birds of Europe cross the Alps, between Italy and Germany. The Himalayan birds do not change their abodes on a large scale; the different various heights themselves afford them the opportunity to select the climate they require in different seasons. In the plains of India, however, chiefly in Bengal, a large number of birds disappear during the breeding time; they do not, however, leave India altogether, but select their abodes in the lower, impenetrable jungles of the delta of the Ganges and Brahmapootra, called the Sundabunds, where they were found by my brother Hermann in large quantities, whilst at the same time they had entirely disappeared in Bengal Proper.

The Hon. Mr. Gough inquired at what height the Brothers Schlagintweit had observed grouse in the Himalayas? Herr Hermann Schlagintweit replied, that he had observed them at a height of 11,000 feet above the level of the sea.—

SHANGHAI SHEEP WOOL.

ALDERMAN WAUD has reported to the Bradford Chamber of Commerce on the quality of a fleece of Shanghai Sheep Wool, which had been received by the Chamber from the Zoological Gardens, London, for the purpose of being examined. Mr. Waud said the wool produced from the fleece weighed 2¼ lb., and he had produced from it 12½ oz. in top, 15¾ oz. in noil, and 2½ oz. in shorts, the waste being 5 oz. The wool had a good lustre, something like alpaca, and was very soft, with a great deal of kemp about it. It might be used as a substitute for the bright-haired wool of the Leicester sheep; and the Shanghai sheep, of which there are two flocks in this country, were as prolific as reported—producing young three times a year, one of them 18 sheep in that period—manufacturers would derive great advantage from this new raw material. At the present time the wool would be worth 10d. per lb.

NEW ZEALAND BATS.

MR. R. F. TOMES has communicated to the Zoological Society a paper on two species of Bats inhabiting New Zealand. The first notice of the occurrence of *Chinoptera* in New Zealand was given by Forster in 1772-74, who recorded the occurrence of a bat flying over the seashore near the margin of a wood in the estuary of Queen Charlotte. It was shot, but being struck only in the wing lived for two days. To this species Forster gave the name of *Vespertilio tuberculatus.* Having some time since had occasion to examine some species of bats in the museum of the College of Surgeons, Professor Quekett showed Mr. Tomes one which had been recently received from New Zealand. It was not until he had been assured that he came directly from that country, that he could be persuaded that no mistake as to locality had been made, the example being so entirely unlike the only New Zealand species he had seen. Mr. Tomes shortly after inspected three of this supposed new species in the Leyden Museum; and finally he detected five other examples in the British Museum. Being thus satisfied of the existence of two species of bats in New Zealand, he was anxious, if possible, to determine to which of these Forster had given the name of *V. tuberculatus.* The kindness of Dr. Gray speedily placed in his hands all the necessary materials. There could be no hesitation; the supposed new species was undoubtedly that from which Forster's drawing had been made, whilst the description indicating the number of incisors, and other peculiarities, pointed unequivocally to the same conclusion.

NEW RODENTS FROM AUSTRALIA.

MR. GOULD has called the attention of the Zoological Society to four new species of Rodents from Australia, which he described under the names of *Mus assimilis, M. nanus, M. sordidus,* and *M. manicatus.* To these interesting species of the mammals of that country, a fifth was contributed by Dr. Gray from the collection made during the expedition under A. C. Gregory, Esq., which he has named *Hapalotis hemileucurus.* The Chairman exhibited an unique Australian bat (*Molossus Australis*) from the museum of the United Service Institution, to which it had been presented in 1832 by Major McArthur.

AIR IN THE BONES OF BIRDS.

DR. CRISP has read to the Zoological Society a paper "On the Presence or Absence of Air in the Bones of Birds," for the purpose of showing the prevailing error upon the subject—viz., "that the bones of a bird are filled with air." Of fifty-two British birds recently dissected by him, only one, the sparrow-hawk (*F. nesus*), had the bones generally perforated for the admission of air. In thirteen others, the humeri only were hollow, and among these were several birds of short flight. In the remaining thirty-eight, neither *humeri* nor *femora* contained air, although in this list were several birds of passage and of rapid flight—Dr. Crisp's conclusion being that the majority of British birds have no air in their bones, and that with the exception of the Falconidæ, but very few British birds had hollow femora.

NEW BIRDS.

MR. GOULD, who is entitled to rank as one of the most distinguished and indefatigable naturalists of his day, has exhibited and described to the Zoological Society several New Species of Birds from various parts of the world. He commenced by calling attention to three species of Australian birds, collected by Mr. Elsey during the recent expedition under A. C. Gregory, Esq., from the Victoria River, on the north-west coast, to Moreton Bay. Two of these birds were of especial beauty and interest, viz., a Psephotus and a Malurus. The former is allied both to the *P. pulcherrimus* and *P. multicolor*, but differs from either among other characters by the rich yellow mark on the shoulder; and the Malurus is distinguished from all other members of its genus by its larger size, and by the beautiful lilac circlet which adorns its crown. The third bird alluded to is a species of Petroica, allied to *Petroica superciliosa*, a bird discovered by the late Mr. Gilbert in the neighbourhood of the Beiderken Lakes, and which with the present would admit of separation from the other species of the genus. For these birds Mr. Gould proposed the following names—*Psephotus chrysopterygius*, *Malurus coronatus*, *Petroica cerviniventer*. The next species to which he directed attention was a new hawk belonging to the genus Spilornis, and which differs remarkably from the *S. undulatus*, or Bacha of the continent of India, and the *S. holosphilus* of Manilla. For this bird Mr. Gould proposed the appellation of *Spilornis rufipectus*. It was obtained in Macassar, by Mr. Wallace. A new bullfinch of typical form was described under the name of *Pyrrhula aurantia*. For his knowledge of this pretty species Mr. Gould was indebted to the researches of Dr. A. L. Adams, of the 22nd Regiment, who killed it in the Western Himalayas. For a new Momot, Mr. Gould proposed the name of *Momotus æquatorialis*. This is a large and robust species, and differs from all others in the broad spatulate feathers of the breast tuft. It was obtained at Ardudona, near the equatorial line, in the Andes. A very fine Odontophorus, remarkable for the rich chesnut red colouring of its under surface, received the appellation of *Odontophorus hyperythrus*. For this bird Mr. Gould is indebted to the Messrs. Verreaux, of Paris, who obtained it in a collection from Santa Fé de Bogotà. Mr. Gould has also exhibited and described three new and very beautiful species of birds, which he characterized under the following names—*Cotinga amabilis*, from Guatemala; *Halcyon fulgidus*, and *Pitta concinna*, from the Island of Lombock.

BIRDS' NESTS IN LAPLAND.

THE Secretary has read to the Zoological Society a paper "On the Nidification of the Wax-wing, the Lapland Owl, and Tengmalin's Owl," by Mr. J. Wolley, jun., dated Muoniovara, February 2, 1857. The wax-wing, as observed in Lapland, makes a good-sized and substantial nest, but without much indication of advanced art. It is built on the branch of a tree, not near the boll, and rather, as one of the observers has said, standing up from the branches, like a fieldfare's or other thrush's nest, than supported by twigs touching it at the sides, as the nests of many birds are supported. Of six nests, four were in small spruces, one in a good-sized Scotch fir, and one in a birch, all placed at a height of from six to twelve feet above the ground. Five seems to be the ordinary number of eggs; in one nest only there were as many as six. They have a pale salmon-coloured ground, upon which are distributed pretty equally good-sized purple spots, some with more and some with less deep colour, but nearly all of them having a shade or penumbra, such as is common in eggs of the chaffinch. The eggs are about an inch in length, but hardly enough have been obtained to determine the average dimensions. In the backward and cold spring of 1856, the wax-wings had their full complement of eggs about the 12th of June. Two nests of the Lapland owl were found in Finnish Lapland in 1856—one near Sodankyla, in which were two eggs, and the other near the Aunasjoki. Tengmalin's owl lays its eggs in holes of trees, and occasionally in egg boxes. When once established, it cannot easily be made to leave its quarters, and it can, it is said, keep possession against a much larger bird. From the only nest Mr. Wolley had had the good fortune to meet with, the mother, after having laid four eggs, was ejected by a golden-eye.

NEW CASSOWARY.

THE Secretary has read to the Zoological Society a paper by Mr. Gould, on a new species of Cassowary lately discovered in the island of New Britain, an example of which, apparently fully adult, is either now living at Sydney or on its way to Europe. The following letter, addressed to Mr. Gould by Dr. Bennett, contains the details respecting this new species:—

"Sydney, September 10th, 1857.

"My dear Gould,—I send you an account of a new species of Cassowary, recently brought to Sydney by Captain Devlin, in the cutter *Oberon*. It was procured from the natives of New Britain, an island in the South Pacific Ocean, near to New Guinea, where it is known by the name of 'Mooruk.' The height of the bird is three feet to the top of the back, and five feet when standing erect. Its colour is rufous mixed with black on the back and hinder portions of the body, and raven black about the neck and breast; the loose wavy skin of the neck is beautifully coloured with iridescent tints of bluish purple, pink, and an occasional shade of green, quite different from the red and purple caruncles of the *Casuarius galeatus;* the feet and legs, which are very large and strong, are of a pale ash colour. This bird also differs from the *C. galeatus* in having a horny plate instead of a helmet-like protuberance on the top of the head; which callous plate has the character of, and resembles, mother-of-pearl darkened with black lead. The form of the bill differs considerably from that of the emu (*Dromaius Novæ-Hollandiæ*), being narrower, longer, and more curved, and in having a black and leathery cere at the base. Behind the plate of the head is a small tuft of black hair-like feathers, which are continued in greater or lesser abundance over most parts of the neck. The egg is about the same size as that of the emu, and is of a dirty pale yellowish green colour. I give this description from an egg obtained from the natives by Captain Devlin. The bird appears to me to approximate more nearly to the emu than to the Cassowary, and to form the link between those species. In its bearing and style of walking it resembles the former, throwing the head forward, and only becoming perfectly erect when running; it also very much resembles the apteryx in the carriage of its body, in the style of its motion, and in its attitudes. The accurate drawing which accompanies this letter was taken from life by Mr. G. F. Angus, whose correct delineation of objects of natural history is so well known. Before closing my letter, I have again examined the bird, and have to add that its bill presents a good deal of the character of that of a rail, and that it utters a peculiar whistling chirping sound, and I am informed that it also emits a loud one, resembling the word 'mooruk,' whence, no doubt, is derived its native name. The existence of the species in New Britain, or some of the neighbouring islands, has been suspected for the last three years, and some time since a young specimen was procured, but unfortunately lost overboard during the voyage.—Ever, my dear Gould, your sincere friend, GEORGE BENNETT."

From the varied interest which Dr. Bennett has always manifested in the welfare of the Society, and the various contributions he has made to natural science, Mr. Gould considered it would be but a just tribute of respect to name the new bird in his honour, *Casuarius Bennetti*. Of this particular section of the Struthionidæ there are now three species:—1. *C. galeatus*, a native of New Guinea; 2. *C. Australis*, inhabiting the Cape York district of Australia; 3. *C. Bennetti*, whose domicile is the island of New Britain.

BIRDS OF NEW GRANADA.

MR. P. L. SCLATER has read to the Zoological Society a paper, entitled, "Further Additions to the List of Birds received from Bogotà," which was supplementary to former communications on the same subject, and contained the names of fifty-two species of birds which the author had lately ascertained to be inhabitants of the interior of New Granada. These, added to the species enumerated in Mr. Sclater's previous papers, raise the total number of birds now known to belong to this peculiar ornithology to upwards of five hundred and ten in number. Two of these birds, apparently hitherto undescribed, were characterized under the names *Anabates striaticollis*, and *Sclerurus brunneus*.

BIRDS FROM THE AMAZON.

Mr. Sclater has read to the Zoological Society a paper on a collection of Birds, transmitted by Mr. W. H. Bates, from the Upper Amazon. Although many travellers and collectors have passed through this country, we are still without any detailed information concerning the general character of its ornithology. Those into whose hands collections from new localities come, are in general too prone to pick out single objects and describe them as new, instead of, what is much more important in a scientific point of view, giving an accurately determined catalogue of the whole of the species, such accounts being always useful as tending to increase our knowledge of the geographical distribution, and giving great assistance to future investigators studying collections from the same quarter. The species transmitted by Mr. Bates are mostly from Ega, or from the Rio Javarri, the frontier stream of Peru and Brazil. He next laid before the meeting a review of the species of the Fissirostral family, *Momotidæ*, with a table giving their geographical distribution.

HABITS OF THE TROCHILUS CERIORNIS.

Mr. Gould having returned from a visit to North America, whither he had proceeded for the purpose of studying the habits and manners of the species of Trochilus frequenting that portion of America, has detailed to the Zoological Society some of the results of his observations. Having remarked that he arrived just prior to the period of the bird's immigration from Mexico to the north, and had ample opportunities for observing it in a state of nature, he noticed that its actions were very peculiar, and quite different from those of all other birds; the flight is performed by a motion of the wings so rapid as to be almost imperceptible—indeed, the muscular power of this little creature appears to be very great in every respect, as independently of its rapid and sustained flight it grasps the small twigs, flowers, &c., upon which it alights with the utmost tenacity; it appears to be most active in the morning and evening, and to pass the middle of the day in a state of sleepy torpor. Occasionally it occurs in such numbers, that fifty or sixty may be seen in a single tree. When captured, it so speedily becomes tame that it will feed from the hand or mouth within half an hour. Mr. Gould having been successful in keeping one alive in a gauze bag attached to his breast button for three days, during which it readily fed from a small bottle filled with a syrup of brown sugar and water, he determined to make an attempt to bring some living examples to England, in which he succeeded, but unfortunately they did not long survive their arrival; had they lived, it was his intention to have sent them to the Society's Gardens, where they would doubtless have been objects of great attraction. Mr. Gould exhibited a highly interesting species of Ceriornis, which he had found in the collection of Dr. Cabot, of Boston, who with the greatest liberality permitted him to bring it to England for the purpose of comparison and description. For this new bird, forming the fourth species of the genus, Mr. Gould proposed the name of *Ceriornis Caboti*.

CAPTURE OF AN EAGLE IN SCOTLAND.

A SHEPHERD, named Ferguson, in the employment of Mr. Macarthur, of Admeanach, has captured an Eagle "tunnelling" the body of a sheep. Watching the motion of the eagle, he was enabled, by a sudden spring, to disable it so far as to effect (though not without the aid of his dogs, and after suffering a good deal in the encounter himself) the capture of the bird alive. It measures seven feet six inches from point to point of its wings, and is one of the largest that has been seen in the part of the country where it was taken for years. A pair (of which it is one) have, for more than fifty years, been known to frequent and build in the crags above Inchkenneth, but without bringing eaglets to maturity, so far as is known; and the shepherds in the district hail, with no small degree of satisfaction, the capture of the depredator such as this one is known to have been.—*Glasgow Herald.*

WILD PIGEONS.

THERE was shot, lately, in the neighbourhood of Inverness, a Wild Pigeon, in which was found the enormous number of 1100 grains of wheat, barley, and oats, together with 40 grains of peas—the barley grains predominating. This seems to be no unusual case. There was some time before that another killed on a neighbouring farm, in which were found 70 grains of peas, along with a very large quantity of the different grains already mentioned, but the precaution of counting was not taken. It is stated, however, that the bird was full to the very bill. Such quantities by a flock of 100 or 200 of these destructive birds must be very considerable indeed in the course of a whole harvest season, particularly since some ornithologists maintain that such are the digestive organs of pigeons, that they are capable of partaking daily three times their own weight of food—a most extraordinary fact, if true. It is needless to add, that the extermination of such creatures must be highly desirable on the part of the farmer.—*Inverness Courier.*

PELVIS OF THE CHLAMYPHORUS TRUNCATUS.

DR. GRAY has read to the Zoological Society a paper "On the Structure of the Pelvis of *Chlamyphorus Truncatus*," which he had recently had an opportunity of investigating in a specimen of this rare animal which had been transmitted to the British Museum by Sir Woodbine Parish. The truncated posterior disk or shield is firmly attached to the pelvis by four posterior processes, and in the central line by the elongated ridge of the posterior sacral vertebræ.

EXHIBITION OF LIVING GAR-PIKES.

MR. J. E. GAVIT, in a paper read to the American Association, has observed:—Professor Agassiz said that the apparition of the oldest-fashioned fish alive was hardly less striking than if one of the old Egyptians were suddenly to present himself in the hall. There were very few types of this kind to be found among living fishes, but there were many among fossils. They had what other fishes had not, a ball-and-socket joint in the neck, so that they could bow; this was common to them with reptiles. Their pectoral fins were small, and continually in a vibratory motion like the cilia of animalcules. The same motion was also observed in the upper lobe of the caudal fin, which was the actual prolongation of the back-bone, and analogous to the tails of reptiles. In the Old Red Sandstone he had found a fish which he called Glypticus, with the same sort of tail. This went, with so many other things, to show that the order of succession in past times was exemplified now in the development of individuals. Here were also two features observed in genuine reptiles—the power of moving the head on the back-bone, and the *quasi* tail. He had noticed also that these fishes would rise to the surface of the water, draw in air at the nostrils, and then emit bubbles from the gills. This was singular, and was a character only known to exist among reptiles.

In a paper subsequently read to the Association, "On Carboniferous Reptiles," Professor Agassiz referred to a portion of the details as very welcome evidence of reptile life, and the difficulty of identifying animals from mere portions of them. He said that in the dissection of turtles he had discovered the bones in the turtle's neck which were supposed to be peculiar to birds; so that had a skeleton been found, the upper portion of it would have been referred to a bird, and the lower to a reptile. These discoveries forced upon science the necessity of reconsidering many cases which were now relied upon as furnishing good evidence of the existence of peculiar animals in past ages. He believed that the batrachians did not belong to the class of reptiles, but that they formed a class of amphibians intermediate between reptiles and fishes, and comprising a large portion of what were called the large reptiles of the old ages.

THE MUD FISH.

We have to record the death of the interesting specimen of Mud Fish (*lepidosiren annectens*) which had for upwards of two years enjoyed the climate of the tropics at the north end of the Crystal Palace. Many of our readers will probably remember the interest excited among the naturalists when it was announced that several of these animals, embedded in mud, had been sent to Sydenham by the Governor of Gambia; and Professor Owen and other gentlemen attended to witness the opening of the case. Of all the specimens only three showed signs of life, and these were committed to the charge of Mr. Bartlett, under whose constant care they increased in size, notwithstanding their confinement.

SCIENCE AND THE HERRING FISHERY.

During the fishing season, shoals of herrings enter the fiords of Norway at most unexpected intervals, and at places where often not more than one or two fishing-boats are to be found. Before the boats from the surrounding bays and fiords can be summoned to the spoil, the herrings are generally spawned and are away to sea again.

To prevent these repeated disappointments and losses to the fishermen, the Norwegian Government is about to lay a submarine cable along some fifty miles of the coast most frequented by the shoals, with land stations at short distances communicating with fishing villages. The instant the shoal is seen in the offing, therefore (and it can always be known at a distance by the whales which surround it), a message will be sent along the coast telling each village the fiord or bay which it has entered.—*Isle of Man Journal.*

THE OYSTER-BEDS OF FRANCE.

M. COSTE, Professor at the College de France, has visited the bays of St. Malo and Cancale, in order to ascertain to what extent new Oyster-beds might be formed, and what measures would be best calculated to re-people the old ones. The matter having engaged the attention of the authorities at St. Malo during the last four years, he found several new oyster-beds already established in the bay, and on causing them to be dredged in his presence, pronounced them to be in an excellent state. He was informed that in one year St. Malo had exported four millions of oysters, which produced 37,000fr. It is now fully proved that oysters transported to points where there never were any before, will thrive well and multiply just as in the old beds. This fact has confirmed M. Coste in the opinion that, in accordance with the desire of the Emperor of the French, profitable oyster-beds might be formed along the whole seaboard between Dunkirk and Bayonne.—*Galignani's Messenger.*

OSTRACIDES.

M. DUMERIL has communicated to the French Academy of Sciences a paper by Mr. Hollard, on a genus of fish called Ostracides, remarkable for their strange form and for having the body clothed in an inflexible armour of hard plates, the tail fins passing through a hole in their coat of mail. They are only met with in tropical regions, and are mentioned by Strabo, who calls them *Ostra-* [illegible] a name lately re-adopted. Mr. Hollard has specially devoted his attention to the structure of the plates of this fish, which are all polyhedral, and he has obtained results calculated to cast a new light on the fossil remains of many fish hitherto but imperfectly known.

ARTIFICIAL PROPAGATION OF FISH IN FRANCE.

MONSIEUR COSTE states that the first proceeding was to form piscicultural establishments in the various provinces of France, the principal one being at Hunaingue, where they produced the eggs and sent them to be hatched at various smaller establishments all over France, as well as to nine other countries out of France—to Naples, Bavaria, Germany, &c. From these remote places they had received fish eggs back again in return for those sent to them. In the succeeding year they sent two persons to inspect every establishment: they found them successful, and particularly that of the Duke of Noailles, who had introduced vast quantities of trout into a river where none had been seen before. Within the College of France, in a space of about four yards square, he had constructed an apparatus of Roman cement, by means of which he had hatched 150,000 fish, and he found that of the number of eggs so deposited one-half only produced fish ; but this he considered was a great gain over the natural mode practised by the fish of depositing their ova in the bed of a river, where the produce of only one egg out of 1000, so naturally deposited, ever became human food. Several commissioners are now engaged in propagating both salmon and trout artificially, to stock two great rivers, the Seine and Rhone, about 1000 miles in length. Salmon are not known to exist in the rivers flowing into the Mediterranean; but he is of opinion that they would live there, and the French are intending to introduce them this year into the Rhone, which flows into that sea. Monsieur Coste is now engaged in inspecting the marine fisheries along the coasts of France and of other countries, as well as in extending the oyster fisheries, &c. The rivers in France belong to the Government, and the public having exercised the right of fishing in them indiscriminately, at all seasons, have in consequence caught all they could without protecting the parent fish. The produce of the fisheries had thereby become very much reduced, but within the last three years the Government has introduced better laws, and has artificially propagated millions of fish ; and as a proof of the beneficial results, an increased supply of fish has been brought into the Paris market, thereby proving, this year, that fish can be artificially produced and successfully also, the only obstacles being their numerous natural enemies—insects, and other large fish, which eat up the eggs so deposited in the rivers—and the want of protection from poachers to the parent fish in the rivers in the breeding season ; the poachers catching the fish in the breeding season, and the young fry also, he considered the greater evil of the two. During the ensuing two years the Emperor has prohibited all persons from catching any fish in those rivers intended to be stocked, and especially the river Seine. The surveyors of the forests, canals, and roads in France are authorized to protect the fisheries. Monsieur Coste considers the Danube salmon a distinct species of fish, not migrating to the sea, but very similar in form to the trout, and he would only recommend its being introduced into lakes in England which are not connected with salmon rivers. It is a very large, voracious fish, and might devour our more valuable salmon.—*Dundee Courier.*

ARTIFICIAL PRODUCTION OF SALMON.

THIS interesting pursuit has been illustrated by aid of the scope, at a *soirée* held at St. Bartholomew's Hospital. Thus was shown the ova preserved in gelatine, which, after being placed in a river, produces in a few weeks the most minute of the fish tribe, from whence it takes the form of what is called parr, a fish not exceeding three or four inches in length, at which it continues for twelve or fifteen months, when it changes its scales so as to protect it from the action of the salt water, when it makes to sea, returning to its native waters in about six weeks a noble fish of 15 lb. or 20 lb. weight; and, should it remain unmolested, again, in the following year, it goes to sea, returning once more as noble a fish as ever graced a royal board, the largest fish exhibited that night being about three feet long and ten or twelve inches broad. The inspection of these specimens could not fail to produce speculations as to how much may be done by a judicious regulation with regard to fishing in certain waters at fixed periods of the year, to produce for the public an immense supply of a dainty and wholesome food at moderate prices. So successful, indeed, is the artificial breeding of salmon become in France that, whereas a few years ago it was difficult to procure this fish in Paris for less than 3s. or 4s. per lb., it has this season been selling as low as 6d. per lb.

SEA FISHERIES OF IRELAND.

MR. W. ANDREWS has communicated to the British Association, a paper "On the Sea Fisheries of Ireland, with reference to their Investigation Practically and Scientifically," In the course of his paper, he drew attention to the great want of knowledge exhibited by fishermen of the products of the sea. He introduced specimens of a substance which he stated was regarded by the fishermen on the west coast of Ireland as the spawn of the turbot; and wherever this substance was found, trawling had been forbidden. All the regulations for fishing were founded upon the evidence and opinions of fishermen; and where these were incorrect, the regulations acted just the opposite to what they were intended to effect.

Mr. J. S. Bowerbank stated that the specimen just exhibited was not the spawn of a fish, but a not uncommon form of sponge. It had no other relation to fish than this—that where these sponges were found, there would Mollusca be found, and where Mollusca abounded fish would be plentiful, so that exclusion from the ground on which this sponge lived, would probably be exclusion from a good fishing ground. Mr. Blomfield stated that he was interested in the fisheries of the coast, and that the local authorities had the greatest difficulty in knowing what rules to enforce upon fishermen, arising out of their prejudices, the trawling fishers and long line fishers always holding diametrically opposite opinions. Professor Allman expressed his pleasure at having heard Mr. Andrews's paper. To naturalists, navigators, and fishermen, it was alike interesting and instructive. The register of accurate soundings was of great importance, as depth regulated the distribution of marine life in the same way that height regulated terrestrial life. Mr. M'Andrew stated his conviction that cod and ling fed more upon the Mollusca than the Crustacea; that where Mollusca abounded, there these fish might be expected. "Fishing Banks" were not banks, but very variable districts where fish abounded, led there chiefly for the sake of food. From his own dredgings around the coast of Ireland, he believed there were many districts where fish abounded which had not yet been worked at all. Mr. Patterson stated that the subject of establishing schools in fishing villages had often been discussed by the late Edward Forbes and Robert Ball. If the children could be taught to observe for themselves, and grow up free from prejudices, the resources of our coasts might be greatly increased. One great evil of all the laws and regulations hitherto issued was, that no one cared to see them put into execution, and the fishermen were, after all, left to their selfishness and ignorance. Dr. Lankester stated that the committee had that morning called for a report on the habits of those marine animals which were used as food, in order to enable persons interested in the capture and sale of these animals to carry on their business with the greatest possible advantage.

Dr. Redfern pointed out numerous inaccuracies in the existing descriptions of *Flustrella hispida*, under the names of *Flustra hispida* and *Flustra carnosa*,—referring especially to the facts that no spines are ever to be found on that side of the aperture of the cell next its base; and that whilst in specimens gathered in Kincardineshire the spines are placed on the septa all round the cells, in those gathered in Dublin Bay the spines for the most part form a semicircle over the aperture, two or three only being found on the sides of the cell in rare instances. The Doctor then described the structure of the polypide after its removal from the cell, and its development by germination, describing its various stages from day to day, as it grew from a mere projection on the wall of the original cell, up to a complete cell with its spines and fully protruded polypide. The various characters of the perfectly formed zoophyte, with its cells set with spines; the most prominent features of its anatomical structure, and the growth of the new being from day to day by germination, were illustrated by a series of coloured drawings made by the author with the camera lucida; and microscopical preparations exhibited to the members showed the characters of the cell, and of the polypide after its removal.

THE MECISTOPS.

The Secretary has read to the Zoological Society a paper by Dr. Baikie, "On the Skull of a species of *Mecistops*, inhabiting the river Binuë, or Tsádda, in Central Africa." In August, 1854, while at the town of Ojogo, on the river Binuë, Dr. Baikie's assistant procured from a native the skull of a *Mecistops;* and as this was the only occasion on which he met with its remains, and as he never saw one in the river, he concluded that it is there a comparatively scarce species. He subsequently described the animal to Dr. Barth, who informed him that he had never met with it. The skull seems from its appearance to be that of an adult animal. Its extreme length is 22¼ inches, the greatest breadth being 9¼, or nearly in the proportion of 2¼ to 1. From this it may be inferred to be most probably *M. cataphractus*, the proportion of the length to the breadth being the same in that species.

FURCELLA.

The Secretary has read to the Zoological Society a paper, by Dr. Gray, on the genus *Furcella* of Oken. On making an aperture in a perfect specimen of *Furcella* which recently reached his hands, Dr. Gray found that, although the animal had two of the characteristics of the family *Teredinidæ*, it wanted the third. The plates within were only the pallets, which are simple, and somewhat like those of the more common *Teredo norvegica;* there were no proper shelly valves, nor even any rudiments of them, and the animal forms a genus in that family which has the abnormal character of wanting the true shelly valves, which are so universal in the *Conchifera.* The reason of this absence seems to be explained by the fact that the animal does not require them to protect its head and nervous centre, living as it does in a soft sandy mud, while they are required in *Teredo* and the allied genera, which have to bore their way into hard wood or stone to form the hole that is to be lined with the shelly tube. Sir Everard Home, in his Lectures, when describing the animal of *Teredo navalis,* refers this shelly tube to the genus *Teredo,* and gives a very good figure of the pallets, or, as he called them, "operculum;" but he was not aware of the absence of the shelly valve, for he figures what he considers the "boring shell of the same *Teredo.*" What he has here taken for the "boring shell," or true valves of the animal, is evidently a fragment of the plate which closes the end of the tube.

HOW TO MANAGE AN AQUARIUM.

THE following instructions for the management of an Aquarium have been given in a lecture upon the subject by Mr. Warrington, at the Royal Institution :—

Water, fresh and marine.—The water used for the aquarium should be clean, and taken direct from a river, or from a soft spring, and should not have been purified by means of lime. As regards sea water, it should, if possible, be taken at a distance from shore, and at the period of high water. If artificial sea water is employed, it should be made either from the saline matter obtained by the evaporation of sea water, or by the following formula :—Sulphate of magnesia, 7¼ oz.; sulphate of lime, 2¾ oz.; chloride of sodium, 43¾ oz.; chloride of magnesium, 6 oz.; chloride of potassium, 1¼ oz.; bromide of magnesium, 21 grains; carbonate of lime, 21 grains. These quantities will make ten gallons. The specific gravity of sea water averages about 1·025; and when from evaporation it reaches above this, a little rain or distilled should be added, to restore it to the original density.

Vegetation.—The plants best fitted for fresh water are the vallisneria spiralis, the myriophyllum, ceratophyllum, and the anacharis, all of them submersed plants, and fulfilling the purposes required most admirably. From the great supply of food in the aquarium, the growth of the vallisneria is very rapid, and it requires, therefore, to be thinned by weeding; this should never be done until late in the spring, and on no account in the autumn, as it leaves the tank with a weakened vegetation at the very time that its healthy functions are most required. The vegetation of the ocean is of a totally different character and composition, being very rich in nitrogenous constituents. There are three distinct coloured growths,—the brown or olive, the green, and the red. For the purposes of the aquarium, where shallow water subjects are to be kept, the best variety is the green, as the ulvæ, the enteromorpha, vaucheriæ, cladophora, &c. These should be in a healthy state, and attached to rock or shingle when introduced. We shall have occasion to notice the rhodosperms under the head of Light.

Scavengers.—A most important element in establishing and maintaining the permanent balance between the animal and vegetable life; without which no healthy functions can be secured, and the aquarium must become a continued source of trouble, annoyance, and expense. The mollusc which was first employed, the limnea stagnalis, was found to be so voracious, as it increased in size, that it had to be replaced by smaller varieties of limnea, by planorbis, and other species of fresh water snail. The number of these should be adjusted to the quantity of work they are required to perform. In the marine aquarium, the common perriwinkle fulfils the required duties most efficiently, and is generally pretty active in his movements. The varieties of trochus are also most admirable scavengers; but it must be borne in mind that they are accustomed to mild temperatures, and will not live long in a tank liable to much exposure to cold. The nassa reticulata not only feeds on the decaying matters exposed on the surface of the rockwork and shingle, but burrows below the sand and pebbles with the long proboscis erected in a vertical position, like the trunk of the elephant, when crossing a river. But in the ocean there are innumerable scavengers of a totally differing class, as the annelids, chitons, starfish, nudibranch molluscs, &c.; thus affording a most beautiful provision for the removal of decaying animal matter, and converting it into food for both fish and man.

Light.—It is most probable that the greater amount of failures with the aquarium have arisen from the want of a proper adjustment of this most important agent; the tendency being generally to afford as much sun's light as possible; but, on consideration, it will be found that this is an erroneous impression. When the rays of light strike the glassy surface of the water, the greater part of them are reflected, and those which permeate are refracted and twisted in various directions by the currents of the water; and where the depth is considerable it would be few rays which would penetrate to the bottom; but let the surface become ruffled by the passing wind, and it is little light that can be transmitted; and when this same disturbing cause lashes into waves and foam, not a ray can pass, and all below must be dark as night. Too much light should therefore be avoided; and the direct action of the sun prevented by means of blinds, stipling, or the like. It is a great desideratum to preserve the growth of the lovely red algæ in all their natural beauty, and prevent their being covered with a parasitic growth of green or brown coloured plants; this can be effected by modifying the light which illuminates the aquarium by the intervention of a blue medium, either of stained glass, of tinted varnish, coloured blinds, &c. The tint should be that of the deep sea, a blue free from pink, and having a tendency rather to a green hue. This modified light affects also the health of those creatures which are confined to shallow waters, so that a selection of the inhabitants must be made.

Heat.—The proper control of this agent is also most material to the well-being of these tanks, for experience has proved that an increase or diminution of temperature beyond certain limits acts most fatally on many of the creatures usually kept. These limits appear to be from 45° to 75° Fahrenheit. The mean temperature of the ocean is estimated to be about 56°; and this does not vary more than 12° throughout the varying seasons of the year, showing the extreme limits to be from 44° to 68°. Great care should therefore be taken to afford as much protection as possible, by the arrangement of the rockwork, both from the sun's rays by day, and the effects of radiation at night, as from the small volume of water contained in the aquarium these effects are rapidly produced.

Food.—As many persons, to whom those interested in these matters have naturally looked for instruction have decried the idea of feeding, it will be necessary to offer a few remarks on that point. How creatures, so voracious as most of the denizens of the water are, both fresh and marine, are to thrive without food, is a question it would be difficult to solve; common sense would say they must gradually decrease in size, and ultimately die from starvation. The food employed should be in accordance with the habits of the fish, &c. For the vegetable and mud feeders, vermicelli, crushed small, with now and then a little animal food, as worms, small shreds of meat, rasped boiled liver, and the like. For the marine creatures, raw meat dried in the sun and moistened when used, answers very well. Oyster, mussel, cockle, raw fish, shrimps, and the like matters may be employed; these should be cut or pulled into very small pieces, and never more given than they can at once appropriate; and if rejected by one it should be transferred to another, or removed from the tank. In the case of actinia, they require, from their fixed position, that the food should be guided to their tentacles; and if the animal food, of whatever kind, is soaked in a little water, and the water thus impregnated with animal fluids be dropped in moderate quantity into the tank, it will afford food for the small entomostracha and smaller creatures with which the water abounds, and which constitute the food for many of them.

MICROSCOPIC EXAMINATION OF SHELLS.

MR. CHITTY has expressed to the Zoological Society his thanks to Dr. Livesay for the great assistance his Microscope and ingenious contrivances had afforded him in the Examination and Measurement of Shells, enabling him to measure to the thousandth part of an inch with the nicest accuracy.

MEDUSÆ.

A PAPER has been read to the British Association, "On British Naked-eyed Medusæ, with notices of seven undescribed forms," by Mr. Joseph R. Green. The author commenced by alluding to the progress which had been made in the study of the Naked-eyed Medusæ since the publication of Professor E. Forbes's monograph; the researches of Agassiz, Leuckhardt, and Gegenbaur being more especially dwelt on. He next gave a list of the Acalephæ which he had hitherto observed on the Dublin coast, in all amounting to twenty-five species. The Physograda were represented by the beautiful Agalmopsis of Sars. The Ciliograda by two species of Cydippe—one of Beroe and the *Eucmia norvegica*. The Steganophthalmata by all the British species, except Pelagia; and the Gymnophthalmata by thirteen species, six of which were new to science. In addition to the above, two other species of Thaumantias had been taken in Belfast Bay—one, the *T. lineata*; the other, a new species, which he proposed to name *T. Pattersonii*. The author then proceeded to describe the seven new species which he had discovered. Three of these were referred to the genus Thaumantias, one to Bougainvillea, one to Equorea, one to Steenstrupia, and one was deemed sufficiently remarkable to induce him to establish a new genus for its reception. This last animal was particularly interesting, since it was, in all probability, identical with the medusoids produced from Coryne, as observed in Iceland by Professor Steenstrup. The author also noticed that in this medusa reproduction took place by germination from the tentacles themselves, as also from the tentacular bulbs. He had observed the latter mode to occur in his new species of Steenstrupia. The development of medusoids from *Laomedea geniculata* was next alluded to: in all the cases which the author had himself observed, the medusoids were free and detached, nor in any instance was he able to corroborate the statement of Loven, "that the medusoids merely expanded at the summit of the 'ovigerous vesicle,' discharged ova, and then perished." He did not, however, wish to deny the correctness of Loven's description.

Mr. Patterson congratulated the Association on having obtained so good an observer as Mr. Green in this field of inquiry. Professor Wyville Thompson stated it as his conviction, that the Naked-eyed Medusæ were truly species, and not medusoid forms of Sertularian zoophytes. The only families of zoophytes producing medusoids with which he was acquainted were the Tubulariadæ and the Campanulariadæ. The Rev. Thomas Hincks thought that the true nature of the Gymnophthalmatous Medusæ had not yet been demonstrated, and that there was still great reason to believe them medusoid forms of unknown species of zoophytes.

THE CROCODILE IN CENTRAL AFRICA.

THE Secretary has read to the Zoological Society a paper "On the species of Crocodilus inhabiting the rivers Kwóra and Binuë (Niger and Tsádda), in Central Africa," by Dr. W. Balfour Baikie. Among the zoological collection which Dr. Baikie made during his visit to the rivers Kwóra and Binuë, in 1854, were several skulls of crocodiles, varying in length from 14 to 26 inches. A careful comparative examination of these showed them all to be possessed of similar characters. In various prominent points they resembled *C. marginatus*, yet in proportional measurements they approach more nearly to, while not altogether agreeing with, *C. vulgaris*, showing that in many characters they are intermediate, and thus either lowering these two into mere varieties, or, as Dr. Baikie believed more probable, establishing for themselves specific characters. They showed the crocodile from the Binuë to be proportionally longer than *C. vulgaris*, and much more so than *C. marginatus*. Dr. Baikie added a few other general characters derived from these skulls, and stated he had compared them with twelve others of Indian and American species, from all of which they were quite distinct.

THE NAUTILUS.

MR. CUMING has communicated to the Zoological Society a paper "On the *Nautilus umbilicatus* of Lister," by Dr. A. A. Gould, of Boston, U. S. He states that, in looking over the shells of a dealer in Boston, he observed three specimens of an umbilicated Nautilus, which struck him as differing essentially from the shell commonly known as *Nautilus umbilicatus*. A more careful examination satisfied him that they were quite distinct, and he made out a comparative description of them, intending to designate the newly-observed one by the name *texturatus*, on account of its finely reticulated surface. On the supposition, then, that these are two distinct species, Dr. Gould thinks it proper to restrict the term applied by Lister to the shell represented by him, and to substitute another for the shell ordinarily named *umbilicatus*. The term "scrobiculatus" indicated in manuscript by Solander, adopted by Dillwyn, and placed by others as a synonym, Dr. Gould considered might be appropriately restored to this species.

PERRIWINKLES.

MR. R. PATTERSON has read to the British Association the following note of the quantity of perriwinkles (*Litorina litorea*) shipped at Belfast during the years 1853, 4, 5, and 6, furnished by Mr. Edmund Getty, Secretary to the Harbour Commissioners of that port.

Years.	Bags.	Tons.	Bushels.
1853	1034	181	3102
1854	2626	459½	7878
1855	2286	400	6858
1856	786	137	2358

Such of these as are not got in the Bay of Belfast, are principally collected on the coasts of the County Down; but the "banks" from which they have been derived are becoming exhausted, and no longer capable of supplying the demand. The quantity of perriwinkles deficient is now imported from Stranraer to Belfast, and thence re-shipped for London. The local term in the north of Ireland for the perriwinkle is "whelk." The "whelk" (*Buccinum undatum*) is known as the "buckie."

The reading of this paper led to a general conversation on the subject of the habits of marine animals used as food, and the methods of their conservation. Mr. Patterson, of Belfast, stated that fishermen are generally ignorant of the simplest fact connected with the habits of the animals they catch, and stated as an illustration, that at Belfast one party of fishermen swore before a court of law that flat-fish deposited their spawn on the shore, whilst another party swore equally hard that they went out to sea to deposit their spawn. Professor Kinahan added that a frequent cause of the destruction of the crustacea on our coasts is the occurrence of either great heat or cold at the period of the hatching of the spawn. The young are hatched in holes and shallow pools on the shore, and either heat or cold kills them. Professor Wyville Thompson stated that the laws which regulate the development of animal life are little understood, and that the naturalist must be careful not to promise the fisherman too much.

LEECHES.

M. DE QUATREFAGES has recently communicated to the French Academy of Sciences a series of important experiments concerning the Preservation of Leeches. From these experiments it appears that the Algerian leech, which has been considered greatly inferior to those of Bordeaux, is quite equal to it in quality, provided proper caution is used in exporting it. M. de Quatrefages, however, recommends that measures be taken to regulate the trade in Algeria, to prevent its marshes, which are very rich, from being too soon exhausted, like those of Hungary and Wallachia. He further recommends an apparatus for preserving leeches, invented by M. Vayson, whom the War Department had sent over last year to Algeria to explore the marshes. This apparatus consists in a kind of large earthen pot, in the shape of a cone with its base downwards, pierced with small holes; it is filled with earth taken from the swamps; the pot is placed in an earthen dish containing water to the height of about three inches; this suffices to keep the earth within sufficiently moist. The mouth of the vessel is covered with gauze. In this apparatus leeches have been kept without nourishment for a whole year without any mortality.

THE TOAD.

EVIDENCE of the oft-asserted fact in natural history, that a Toad continues to live, although deprived of food, light, and air, has been witnessed at Kinnahaird, in Ross-shire, last week. One of Mr.

Ross's sons, on the 12th of August, 1856, placed a live toad in a box about four inches square, and buried it a foot and a half under ground. On the 12th of August, 1857, the box was dug up, and on removing the lid, the toad was found to be alive, and apparently in excellent health, and walked off as if nothing unusual had happened.—*Inverness Courier.*

PHOSPHORESCENCE OF INSECTS.

MR. THORNTON T. HERAPATH has taken advantage of a recent trip to South America, to collect and examine the fire-flies, in order to get at the secret of their luminosity. The commonly received opinion in regard to the source of the light emitted by insects is, that it is due to the slow combustion of phosphorus, resembling that produced by gently rubbing a wafer match with the fingers. Mr. Herapath denies this, however, as he was unable, on the application of the most delicate tests, to detect the smallest trace of phosphorus in the bodies of these curious little creatures. His opinion is, that the light is caused by the burning of a peculiar compound of carbon and hydrogen, formed in a special gland.

BEE-KEEPING.

CHLOROFORM has been applied instead of sulphur to Bees. A correspondent in the *Edinburgh Evening Courant* has adopted this plan successfully. The quantity of chloroform required for an ordinary hive is the sixth part of an ounce ; a very large hive may take nearly a quarter of an ounce. His mode of operation he describes as follows :—I place a table opposite to, and about four feet distant from the hive ; on the table I spread a thick linen cloth ; in the centre of the table I place a small shallow breakfast plate, which I cover with a piece of wire gauze, to prevent the bees from coming in immediate contact with the chloroform ; and into this plate I pour the chloroform. I now quickly and cautiously lift the hive from the board on which it is standing, set it down on the top of the table, keeping the plate in the centre ; cover the hive closely up with cloths, and, in twenty minutes or so, the bees are not only sound asleep, but, contrary to what I have seen when they are suffocated with sulphur, not one is left among the combs ; the whole of them are lying helpless on the table. You now remove what honey you think fit, replace the hive in its old stance, and the bees, as they recover, will return to their home. A bright, calm, sunny day is the best ; and you should commence your operations in the morning, before many of the bees be abroad.

A NEW FOOD FOR BEES.

TWO agriculturists of the Department of the Var observed in the month of May last, that all the bees had left their hives, although the latter were well filled and exceedingly heavy. Towards evening, the bees returned heavily laden, but on the following morning set out again in a direction which was this time carefully noted by the farmers. They immediately followed them, and soon arrived at a farm where cakes of tilseed, which had been previously subjected to the oil press, were being beaten up into a paste with water, to be used as manure for potatoes. There they saw their bees clustering round the tubs containing the paste. The agriculturists immediately procured their bees abundance of this food, and have been rewarded with nearly ten times the usual quantity of produce, besides an immense increase in the reproduction of the insect.

A NEW KIND OF WAX.

M. STANISLAS JULIEN, professor of Chinese at the Collége de France, has published an interesting article in the *Revue de l'Ouest* on an animal substance used by the Chinese instead of Wax. The subject is of some importance, since it is in contemplation to introduce the insect which produces this substance into Algeria. M. Julien has found a complete account of the manner of rearing the insect, and cultivating the plant on which it lives, in some of the Chinese works existing in the Imperial library. There are three kinds of plants which afford nourishment to the insect, viz., the rhus succedaneum, the ligustrum glabrum, and a kind of hibiscus, akin to hibiscus syriacus. The wax insect is white and very small. About the beginning of June it climbs up the plant, and feeds upon it, gradually depositing upon its branches a kind of slime, which is condensed into a sort of white wax, giving the tree the appearance of being covered with hoarfrost. This is scraped off towards the end of August; it would be too late to do so after the first week of September, since it would adhere too firmly to the bark. After it is collected, it is melted in boiling water, and strained through a cloth. The wax thus obtained is incorporated with one-hundredth part of its weight of oil, and then used for candles, which are much superior to common wax tapers. When the insects grow old, they turn from white to red and brown; they then congregate and hang from the branches in clusters. In the first stage of its existence, the insect is no bigger than a grain of millet, but it grows in time to the size of a hen's egg; so at least the Chinese author says. When it is about to lay its eggs, it forms a kind of shell, which it fills with very minute white eggs. These are collected in the beginning of May, wrapped up in ginger leaves, and suspended to the branches of the tree. Care must be taken to prevent the ants from destroying the eggs.

SPONGES.

MR. BOWERBANK has read to the Royal Society a paper "On the Anatomy and Physiology of the Spongiadæ." The author rejects the arrangement of Spongiadæ by Lamarck, which is based entirely on external form, and is wholly inadequate for the discrimination of species. The classification adopted by Drs. Fleming, Grant, and

Johnston, dependent more especially on the chemical constituents of those bodies, is far too limited to be applied to generic characters. The author has, therefore, for this purpose rejected both systems, and has retained the latter one for forming primary divisions only; and he purposes founding the generic characters principally on the organic structure and mode of arrangement of the skeleton, in accordance with the practice so generally adopted by naturalists with regard to many of the higher classes of animals. *Tethea*, *Geodia*, *Dysidea*, and a few others, are the only well-defined genera that have yet been established; while others, such as *Halichondria*, even in the narrow circle of the list of British species, contain at least ten distinct modes of arrangement of the skeleton, each of which is constant and well-defined in its character.

It is not intended to propose the rejection of any of the well-established genera of preceding authorities, but to confine each genus strictly within the bounds indicated by the peculiar mode of structure of the skeleton which exists in that species of sponge which is the oldest-established and best-known type of the genus, and to refer all others that may distinctly differ from that type to the new genera founded on structural principles.

It is proposed to characterize the elementary tissues in the following order:—1. Spicula. 2. Keratode or horny substance. 3. Membranous tissues. 4. Fibrous tissues. 5. Cellular tissues. 6. Sarcode.

And, in the second place, to treat of the organization and physiology in the following order:—1. The skeleton. 2. The sarcadous system. 3. The interstitial canals. 4. The intermarginal cavities. 5. The dermal membrane. 6. The pores. 7. The oscula. 8. Inhalation and exhalation. 9. Nutrition. 10. Cilia and ciliary action. 11. Reproduction, gemmules, &c.

And to conclude with observations on the generic characters.

The author then proceeds to describe the specula, which he states are essentially different in character from the fibres of the sponge, although the latter may be equally siliceous with the former. However closely the spicula may be brought into contact with each other, or with siliceous fibre, they appear never to unite or anastomose; while the fibre, whether siliceous or keratose, always anastomoses when it comes in contact with other parts of its own body or with those of its own species. A detailed description is given of the origin and progressive development of these organs, from which it is inferred that they are the homologues of the bones in the higher classes of animals, and that the forms they assume are always of an organic type, never crystalline or angular: and the same forms of spicula are found composed of either silex or carbonate of lime, demonstrating the fact that the deposits of earthy matter are influenced by the laws of animal organization only, and never by those of inorganic or crystalline arrangement.

Each species of sponge has, not one form of spiculum only, equally dispersed throughout its whole substance, but, on the contrary, separate parts have their appropriate forms; and thus we find that there are often three, four, or even more forms of spicula in the same individual. The author, therefore, in describing them, proposes to treat of these organs in the following order:—1. Spicula of the skeleton. 2. Connecting spicula. 3. Defensive spicula. 4. Spicula of the membranes. 5. Spicula of the sarcode. 6. Spicula of the gemmules.—For the entire paper, see the Proceedings of the Royal Society.

MOLLUSCA, THEIR NUMBER.

COLONEL PORTLOCK, in his late address to the Geological Society, states, on the excellent authority of Deshayes, that the known species of living mollusca have increased fourfold within the last thirty years—from 5000 to 20,000. The list of fossil mollusca has probably been enlarged in a still greater proportion within the same period.

BOTANY.

ALTERNATION OF PLANTS AND ANIMALS.

A PAPER has been read to the British Association "On the Alternation of Generations and Parthenogenesis in Plants and Animals," by Dr. Lankester. After alluding to the phenomena of "Alternation" as described by Steenstrup in the Entozoa, Medusæ, and Sertularian polyps, and to the phenomena of Parthenogenesis, described by Owen and Von Siebold, the author concludes his paper as follows:—"If we turn now to the vegetable kingdom, we find perfectly analogous phenomena presenting themselves. In fact, the modifications of the reproductive function, which have recently excited so much surprise in the animal kingdom, are the normal forms of the function among plants. In the roots and branches of a tree we have a gigantic 'nurse,' and the buds are its progeny. Just as we find the same secondary products called 'gemmæ,' in animals either remaining adherent to their parent-stocks, as in the Sertularian and other zoophytes, or floating off, as in Hydra and many others, so we find the buds of plants remaining attached to the tree, or becoming separated from it. Just, too, as we find a different form assumed by the secondary offspring of the 'nurse,' as in the scolex-head of the cystic-worm, so we find in such cases as those presented by the 'bulbillus,' the 'bulb,' and the 'sporule,' different forms assumed by parts having the same relations in the plant as in the animal. So likewise in the plant we find a greater change of the secondary offspring taking place, when sexes are developed and flowers are produced, and the hermaphrodite flower, with its stamens and pistils, is the representative of the segments (proglottides) of the tape-worm, with its male and female apparatus in a common envelope. We may go yet further with our analogies in the vegetable kingdom. Here also we have numerous cases in which the germ-cell, the ovule, is produced, and developes within itself an embryo quite independent of the influence of the sperm-cell, the pollen." The paper was illustrated by the following diagram:—

GENESIS.

HOMOGENESIS.

(Reproductive force acting through similar cells.)

It is represented in—

A. Plants by Phytoids.
1. Isophytoids.
Buds.
2. Allophytoids.
Bulbilli.
Bulbs.
Sporules, &c.

B. Animals by Zooids.
1. Isozooids.
Gems, or buds.
2. Allozooids.
Nurses (Steenstrup).
Agamozooids (Huxley).
Virgin Aphides (Owen).
Agamic eggs (Lubbock).
Drone Bees (Siebold).

HETEROGENESIS.

(Reproductive force acting through dissimilar cells, sperm-cells and germ-cells.)

It is represented in—

A. Plants by
1. Gynophytoids.
Female flowers.
Pistillidia, &c.
2. Androphytoids.
Male flowers.
Antheridia, &c.
3. Androgynophytoids.
Hermaphrodite flowers.

B. In animals—
1. Gynozooids.
Females.
2. Androzooids.
Males.
3. Androgynozooids.
Hermaphrodites.

Professor Allman thought Dr. Lankester's nomenclature very clear and intelligible; and he believed by its aid inquiries into the curious and difficult subject he had brought before the Section would be facilitated. Dr. Baird could confirm the statements made by Dr. Lankester with regard to the Entomostrecous Crustacea. In the case of the ordinary *Daphina pulex*, he had observed seven generations of young without the existence of males amongst them.

VEGETABLE PARTHENOGENESIS.

THE production of perfect germinating seeds in plants without the contact of pollen was noticed long ago by various vegetable physiologists; but the occurrence of this vegetable parthenogenesis was considered doubtful by subsequent authors, and the statements were attributed to imperfect observations. Of late, however, these statements of old authors have been confirmed by very careful examination of plants of *Cœlebogyne, Cannabis, and Mercurialis;* and Dr. Radlkofer has recently published a paper, in which he states, from very accurate experiments and dissections, that he is satisfied that true parthenogenesis does take place in plants. To Mr. Smith, at Kew, the botanical world is indebted for the first observation on the plants of Cœlebogyne, and these plants have been made the subject of experiment by Radlkofer.—*Edinburgh New Philosophical Journal*, No. 10.

Naudin has lately confirmed the views of Bernhardi and others relative to Vegetable Parthenogenesis, or the production of fertile seeds without the contact of pollen. He performed experiments on the pistilliferous plants of Hemp and Bryony, as well as on plants of *Ecbalium Elaterium* and *Ricinus communis.—Comptes Rendus.*

VITALITY OF SEEDS.

Dr. Daubeny has read to the British Association a final Report on the Vitality of Seeds. He stated that about sixteen years since, Mr. Strickland and others, and himself, suggested the advisability of instituting experiments for the purpose of ascertaining, as far as possible, the terms to which different seeds would retain their vitality. They were all well aware of the statements as to the germination of mummy seeds, and it was with the view of determining the various questions which arose that a committee was formed in 1840 to make experiments, which were made in the following manner:—A considerable number of seeds of as many kinds as could be procured were placed in porous stone jars, covered so as to exclude insects and rapid circulation of air, and so as to secure a slow circulation. The experiment had been carried on for seventeen years, and each year a Report was given, stating the number of seeds which had germinated, which were resown until their vitality ceased. As the seeds which had originally been procured had, with the exception of four, lost vitality, the inquiries were considered to have come to a close, and the final Report was brought forward. He submitted a paper to the meeting containing a general summary of the experiments from 1841 to 1857, and a tabular statement, showing the relative vitality of different kinds of seeds, from which it would be seen that the greater number of seeds lost their vitality at eight years, and that forty-three years was the longest period to which they retained it. The experiments made by the Association did not confirm the common belief regarding the indefinite vitality of certain seeds—for instance, the mummy seed. If any naturalist would suggest a better mode of preserving the plants, it would be well to institute a new set of experiments; but as far as was at present known, the plan that was adopted was the most likely to preserve their vitality.

Dr. Lankester observed that the Report was very valuable, but that the result was not in accordance with what vegetable physiologists would expect. The question, however, was, whether the Report settled the mooted point of the duration of vitality in seeds. As to the mummy seeds, too much care could not be taken in relating such cases. It was not sufficient to get a parcel of seeds from a mummy and put them in the ground; the mummy should be got out of the tomb, because no one could say what might not occur during the transfer of the mummy-case; so that unless some person quite capable of making the experiment should unrol the mummy with his own hands, plant the seeds, and keep them constantly under his own supervision, the experiment should not be considered satisfactory.

Dr. Steele, in confirmation of Dr. Daubeny's observation, said, that in the course of last year Mr. John Ball sent through his brother to him (Dr. Steele) a packet of wheat which had been taken out of a mummy case. He sent the wheat, which was in a vase in the case, to Mr. Moore, the curator of the Royal Dublin Society's Gardens at Glasnevin, who had tried them with all the knowledge and skill which he possessed, but not one of them vegetated.

Dr. Daubeny observed, that he should have mentioned that they had tried seeds taken from mummies, and in no instance did they vegetate.

The following interesting statement upon this much-vexed question has appeared in *Galignani's Messenger* :—

"It has long been a disputed question among botanists, whether the uniformity existing in the vegetation of different islands and continents having no other communication with each other but a wide expanse of ocean, is owing to a special creation in each instance, or to an interchange of seeds transported from one shore to another by the waters of the sea. M. Ch. Martens, professor at Montpellier, in a letter to M. Flourens, recently communicated to the Academy of Sciences, gives an account of certain experiments he has instituted for the purpose of ascertaining—First, whether many kinds of seeds are specifically lighter than sea-water, so as to swim on the surface; and, secondly, whether, after having undergone the action of sea-water for a certain length of time, they are still in a condition to germinate. With regard to the first question, M. Martens has found that out of a certain number of different kinds of fresh seeds, chiefly of a large size, taken at random, two-thirds will swim on the waters of the Mediterranean, the density of which is 1·0258. To ascertain the second question, M. Martens caused a large box of sheet-iron to be made, divided into 100 compartments. Ninety-eight of these compartments received a certain number of seeds of different kinds, and the apparatus thus prepared was fastened to a buoy. A large number of minute holes pierced in the sides of the box allowed the water free ingress and egress, without any danger of the seeds being washed away. After a lapse of six weeks, the box was taken out of the sea and opened, when out of the 98 kinds of seeds, 41 were found completely rotten. The remaining 57 kinds were immediately sown in pots filled with earth taken from a heath. Of these 35 kinds only germinated, including 17 of those which are specifically heavier than sea-water, and could not therefore be transported to any distance; so that, out of 98 species, 18 only might germinate after a six weeks' voyage, under the most favourable circumstances. Repeating the experiment with the 35 kinds which had resisted the action of sea-water for this space of time, M. Martens left them for three months exposed to its action, and then found 11 in a rotten state; of the other 23, only nine germinated, two of which were specifically heavier than sea-water; so that after a three months' sojourn in the sea, a period most likely to be the usual one, seven kinds only out of 98 might have some chance of germinating. The Ricinus communis and Cucurbita pepo are among the number. Now, if all the dangers be taken into consideration to which a seed must be exposed during a long voyage, as well as the difficulties it must meet with to find a congenial soil on landing, with other circumstances calculated to promote its germination and subsequent preservation from destruction, M. Martens concludes, with M. Alph. De Candolle, that the transportation of seeds by sea must have had a very small share in the propagation of plants to other shores, and that the hypothesis of simultaneous creations in different parts of the globe acquires much probability."

EGYPTIAN WHEAT.

SOME stalks of wheat have been laid before the French Academy of Sciences: they had been derived from five grains found in an Egyptian tomb by a Monsieur Drouilard (since deceased); they were sown in 1849, and yielded a return of 1200 for 1. Since 1853, grains of this wheat have been pretty widely disseminated, and the results of various experiments upon it, made under the direction of the local authorities, and of certain members of the Agricultural Society of Morlaix, nominated by the Sub-Prefect to inquire into the subject, were submitted to the Academy. They are in substance as follow:—Sown broadcast on one-half of a piece of land, of which the other half was sown with the common wheat of the country, the return was 60 for 1, while that of the latter was 15 for 1; and the mean return in France is 7 or 8 for 1. The same Egyptian wheat, sown grain by grain in a line, gave a return of 556 for 1. The wheat, since its fecundity became known, has been much in request, and is sold at four or five times the price of common wheat. The stalks submitted to the Academy were more than two metres (6½ feet) in length, and each carried from 20 to 40 fine ears.

METHOD OF PRESERVING PLANTS OF THEIR NATURAL FORM AND COLOUR.

THE plant to be operated on should be placed in a box, in such a manner as to preserve the natural disposition of its parts. The fine sawdust (perfectly dry) of box, or other hard wood, is then to be carefully sprinkled over it, taking care not to shift the position of the leaves. Every part of the plant must be completely covered with the dust. Several plants may be dried in one box—avoiding contact, however. The plants to be preserved ought to be quite fresh when put into the box; if they be lax, place the stems in water till the vessels again distend and recover their natural firmness. About a fortnight in the dust is sufficient to dry the plants in summer (in a natural heat); succulent plants require longer. To assist in freeing the plants from the sawdust, the box may be made with a wire grating and sliding bottom; slightly shake the plant to free it from the dust; what still adheres may be brushed off with a soft hair pencil.—*T. R. Marshall, in the Proceedings of the Botanical Society of Edinburgh.*

MODE OF DRYING SUCCULENT PLANTS.

M. MOTLEY, in writing from Borneo, states, that he believes he has found out the right way of drying succulent plants, and such as are apt to come to pieces. He had previously tried hot water, but that made the specimens mould; then a hot iron, but that was tedious, and it spoiled the flower; pricking the leaves with a penknife or fork was of use, but the specimens looked unsightly after it; and chloride of calcium was too troublesome. He now puts the plants into a large bottle of weak spirit for one night. This kills them, and an endosmose goes on in the tissues, which breaks them up, and makes them dry as quickly as other plants.—*Hooker's Kew Journal.*

A NEW VEGETABLE PRINCIPLE.

M. DE LUCA has communicated to the French Academy of Sciences his discovery of the poisonous principle of the *cyclamen Europæum*, or common sowbread. This tuberculous plant has long been used in medicine as a violent purgative, and externally as a resolvent and a remedy for the earache; but it was not known that it contained a powerful poison producing effects not unlike those of the curara, which the Indians of the Rio Negro use to poison their arrows with. M. de Luca obtains it by digesting the root for 45 days in alcohol, then pounding the root, digesting it again in a fresh quantity of alcohol, and repeating this process until the pulp had lost its acrid taste. All the tinctures thus obtained are then left to spontaneous evaporation in a cellar. At the end of about 40 days a whitish substance is deposited, which, after being repeatedly washed in boiling alcohol, is left to dry in the dark. The *cyclamine*, or vegetable base of the cyclamen thus produced, is white, opaque, and brittle, and emits no particular smell; it absorbs the humidity of the air, becomes transparent and gelatinous in water, and assumes a dark colour when exposed to the action of light. It is a curious fact that, while pigs can eat any quantity of the root with impunity, not only the active principle itself, but even the natural juice of the root, acts as a poison on small fish, if mixed with the water in which they are in the proportion of 1 to 3000. Four grammes of the juice injected into the trachea of a rabbit caused it to die in convulsions in the course of ten minutes. Bromine appears to be an antidote to this poison, or at least to mitigate its effects considerably; it has the same neutralizing power over the curara poison.—*Galignani's Messenger.*

A NEW VEGETABLE GREEN.

THE attention of silk dyers has of late been turned to a new kind of bluish-green imported from China, and which produces a beautiful effect by candle-light. The composition of this green has tried the ingenuity of chemists, many of whom are now engaged in seeking a substitute equal in quality to this Chinese produce, and offering the advantage of a lower price, since the original article is sold at the enormous rate of 500f. per kilogramme. M. de Montigny, French Consul in China, having received instructions from the Minister of Commerce to obtain information on the subject, at length succeeded in obtaining, in 1854, the seeds of the plant which produces this green, and sent them to Paris. This year, the Chamber of Commerce, at Lyons, has received a valuable communication from Father Helot, a Missionary in China, on the cultivation of this plant, which he calls the Rhamnus Sinensis (*ham-bilo-za* in Chinese). It is a species of alder tree, rising to the height of from 8 feet to 9 feet, and there is every reason to believe that the colour in question may be obtained from some plant of the same family indigenous in France. With this view, the Chamber of Commerce at Lyons has offered a prize of 6000f. for the discovery of a process by which the China green may be produced at a cost not exceeding 100f. per kilogramme.—*Galignani's Messenger.*

THE FLORA OF INDIA.

DR. HOOKER has read to the Linnæan Society a paper, contributed by himself, Mr. Thomson, and Mr. Bentham, on the Flora of India, in the course of which regret was expressed that so little attention had been paid to the subject, and some remarks were made on the extension of genera without sufficiently marked distinctions. Mr. Westwood coincided in the want of limitation being made to divisions of genera and species, which were become so numerous that it was impossible to recollect them. In entomology this was more apparent than in botany, for the number of species in a single genus sometimes exceeded 10,000. He suggested that it would be desirable to have an authenticated, popular botanical work, in which the broader distinctions only should be marked, so that the study of botany might be more attractive to officers in the East Indies. The notion of a popular work on botany received no encouragement from Dr. Hooker, who expressed himself opposed to popularizing the study in the way proposed.

FOOD AND GRAIN OF INDIA.

A PAPER has been read to the Society of Arts, "On the Composition and Relative Value of the Food Grains of India," by Dr. Forbes Watson. The author began by stating that the researches on which his paper was chiefly founded had been conducted under orders received from the directors of the East India Company. In the plains of Upper India to the west, in Guzerat and Scinde, wheat is extensively cultivated, and in the north, along with barley, constitutes the common food of the people; whereas in the south, wheat, for the most part, is a luxury which the poor man cannot reach. Thus, also, rice at the deltas, and by the sides of large rivers, is the chief food of the million; but pass inland some distance, and millet, which experience and science have shown to be in some respects superior to rice, is found to be the ordinary diet. Rice contains but a small portion of nitrogenous matter; and although it is the popular notion that it forms the diet of almost all the inhabitants of the East, it is found that nature has prompted them in many instances to add one or other of the numerous pulses produced there, in quantity sufficient to supply to the starchy rice the requisite amount of nitrogen, containing, as many of these do, nearly twice as much of that essential element as wheat. These pulses accordingly occupy a most important position in the food catalogue of the country, and are, in fact, to the Brahmin what beef and other meats are to us. In the Indian pulses, the proportion of non-nitrogenous and nitrogenous compounds varies from a little more than two up to about three of the former to one of the latter, and there is one bean in which the proportion of nitrogenous matter is greater than in flesh itself. With regard to the value and pre-eminent importance to India of its agricultural products, it appears that, according to returns, the total value of the agricultural products exported from India in 1853 amounted to 17,484,183*l.*, representing more than four-fifths of the then entire value (21,519,861*l.*) of Indian commerce. Of this sum 889,040*l.* is laid down as that received for the grain products of the soil. It has therefore with reason been said, that the greatness of India in the world's estimation depends on her agriculture, and that for her future prosperity and progress reliance can only be placed on the improved cultivation of her soil, and on the facilities that may be afforded to enable her to bring her products to the best markets at the lowest possible expense. The paper was extensively illustrated by tables, showing the nutritive value of the various grains.

THE SACRED BEAN OF INDIA.

A PAPER has been read to the British Association, "On the Lotus or Sacred Bean of India," by Dr. Buist, communicated by Dr. Norton Shaw. This plant belongs to the natural order Nelumbiaceæ, and is allied to the water lilies, and is the *Nelumbium speciosum* of botanists. Dr. Buist states that there are three species of this genus at least. The only variety he has observed in India is one with pale rose-coloured flowers, which when full blown, but not open, forms a globe of from 6 to 7 inches in diameter. The leaf is from 14 to 16 inches long, the leaf and flower-stalks together from 6 to 8 feet in length. The leaf and flower-stalks abound in spiral vessels, which Dr. Wright says are extracted and burnt by the Hindús in the lamps placed before the shrines of their gods. Dr. Buist, however, states his conviction that all the spirals of all the lotuses of India, from the Himalayas to the Line, would not make a lamp-wick a yard long the thickness of the finger. The stalks are full of air, the leaves buoyant and floating, the flowers small, like the Tonquin bean. After describing the external appearance and uses of the plant, the author proceeded to describe—1. *The internal structure of the root, flower, and leaf stems.* The stalks are filled with air, and in their construction care is taken to prevent the percolation or introduction of water. 2. *Repulsion of water from the leaves.* This depends upon the surface of the leaves being covered with a fine fur of silvery hair, like papillæ, which, when magnified, show themselves in the form of a succession of beads, diminishing in size towards the apex. It is this structure which entangles and retains the air, and thus obtains a high degree of buoyancy. It is the same structure which enables the rose, clover, and young cabbage-leaves, young shoots of grain and grass, to exhibit the pearly forms of dew-drops, and to repel water from their surface. The same structure performs the same function in the wings of diving birds. 3. *Respiration of the lotus.* The lotus leaves constantly give out air from their surface, which Dr. Buist has not examined. He found that one plant gave out from a cut stem

38 cubic inches of air in an hour. The greatest quantity of this air was given off two hours after sunrise.

CULTIVATION OF THE CINCHONA TREE IN JAVA.

An official Report on the Cultivation of the Cinchona Tree in Java has reached Calcutta. The success of this important experiment is stated to have been complete, and Java may in a few years furnish a large supply of quinine to India as well as to Europe. A local journal observes upon this subject:—"It may be as well to remind the Government, if really in earnest as to obtaining a supply of this invaluable medicine in their own territories, that two indigenous species of cinchona have been described by Indian botanists. Whatever exertions may be made—and they are not likely to be very great—it must take many years before the South American tree, should it succeed in India, can be large enough for use. In the meantime, why are not experiments made with the bark of the indigenous species? A short time would determine whether its properties are similar to those of the Peruvian tree or not, and the expense of ascertaining this important fact would be a mere trifle."—*The Homeward Mail*.

THE AGRICULTURAL GARDEN AT CIRENCESTER.

Dr. Lankester has read to the British Association a Report from Professor Buckman, "On the Growth of Plants in the Agricultural Garden at Cirencester." The Report contained an account of the continuation of the experiments laid before the Association at the Cheltenham Meeting. In the present series of experiments, the reporter believed he had successfully proved that many species of plants regarded as species by botanists were only varieties or hybrid forms. Thus, he had produced *Avena sativa* from *Avena fatua*, *Symphytum officinale* from *Symphytum asperrimum*, and many others. He had not succeeded in producing wheat from any species of Ægilops. He also recorded some experiments on the growth of the potato and other edible plants, as scorzonera, yams, &c.

Mr. Babington stated, that although Professor Buckman's experiments had been very laboriously performed, he had the conviction that he had not been sufficiently careful in excluding all sources of error as to render his experiments conclusive. No precaution had been taken to prevent the travelling of the plants from one bed to another by seeds or buds, or to prevent hybridization by insects and wind conveying the pollen of one plant to another. Professor Buckman was more anxious to establish identities than differences, and in his anxiety to do so had actually referred to species which botanists generally did not think existed. His experiments on the conversion of the wild into the common parsnip, and the wild into the cultivated oat, were very interesting.

THE GRAPE BLIGHT.

An important Report on this subject has been communicated to the Société d'Encouragement pour l'Industrie Nationale, by M. Barral, in the name of the committee appointed by the Society to decide whether the prizes offered by it for the discovery of a remedy against the potato blight should be awarded or not. From this Report it appears that sulphur is at length proved to be the only efficacious and infallible remedy against the ravages of the *oidium Tuckeri*, and that the prize of 10,000fr. offered by the French Government in conjunction with the Society is jointly due—1st. to Mr. Kyle, an English horticulturist, who first applied sulphur to this purpose in 1848; 2nd. to M. Duchartre, Professor of Agronomy at Versailles, who first introduced the method in France; 3rd. to M. Gontier, a horticulturist at Montrouge, near Paris, who was the first to apply it on a large scale; and 4th. to M. Henry Marès, Secretary to the Society of Agriculture of the Department of the Hérault, who by numerous experiments has proved the superiority of sulphur over all other agents previously tried, and pointed out the surest and most economical way of applying it.

SUPPOSED REMEDY FOR HYDROPHOBIA.

THE following appears in the *Opinione* of Turin:—"A missionary who has just returned from China states that, in that country, a kind of polygala is successfully used as a cure for hydrophobia. This plant has thick leaves, and its stem contains a milky juice; it grows to the height of two feet, with a thickness like that of a goose-quill. The flowers are small, and of nearly the same colour as the leaves. Its root is perennial, and annually produces new shoots and stems. There are several kinds of polygala in Europe, two of which are used in medicine against the bite of reptiles. In order to apply this plant as a remedy, the Chinese gather a handful of the stalks, crush them, and cook them in water in which about two pounds of raw rice have been washed. The decoction is effected by means of a water bath. The juice is then strained, and half a quart of it is administered to the patient, if he be an adult, and this draught is continued for several days, gradually diminishing the dose. Sometimes a single dose suffices for a radical cure. It is also administered to animals with their food, large cattle requiring a much larger quantity.

BOG-PLANTS OF IRELAND.

MR. D. MOORE, Curator of the Royal Dublin Society's Garden, Glasnevin, has read to the British Association a paper entitled *Observations on Plants which, by their Growth and Decomposition, form the Turf in Ireland*. He observed that, although much has been written and reported on the bogs of Ireland, singularly enough no person had yet given any intelligible account of the plants which form them. He divided the varieties of bog into red bog, brown, black, and mountain bog, carefully stating the plants which formed each. He considers the red bog to have been formed on the sites of ancient lochs or deep morasses, of which upwards of one million of acres exist in Ireland, more than two-thirds of which are situated west of the River Shannon, according to the reports of the commissioners. The black bog he considered to have been formed on the sites of ancient forests, as was evident from the number of roots and stems he has found therein. He did not consider the idea correct, of species having once flourished on those bogs which have since died out and been replaced by others. His opinion was, that the Irish bogs were of too recent a date, and that we had all the plants existing yet in Ireland which have formed them, with the exception, probably, of Lough Neagh, which may have been anterior to the glacial epoch of geologists; but he thought it must be exceedingly hazardous to state what the species were which formed the fossilized wood found there. Mr. Moore, in allusion to this portion of his paper, stated that there still exist a few trees of the ancient Scotch fir on the Earl of Arran's property in the County Mayo, which once formed such extensive forests in Ireland.

ECONOMICAL USES OF TIMBER.

M. Kreuter, in reporting on the Timber shown at the late Paris Exhibition, states that France requires annually for the Imperial navy 1,200,000 cubic feet of oak timber, and for the commercial navy 1,400,000 cubic feet. Britain requires five times as much, and America still more. There was at the Exhibition the model of a ship at present being built in Britain under the direction of M. Brunel, and intended for the Australian trade, which requires 644,000 cubic feet of solid timber for its construction. The timber consumed for railway sleepers is now enormous. A sleeper measures 3 cubic feet, and one mile of single rails requires about 8000 sleepers, which last on an average five years. Hence 1600 of these sleepers require changing annually. For 100 miles this will amount to 160,000.

VINES AND WINES.

When Chaptal was Minister of the Interior in France, he planted 1200 different species of vines, from the French provinces alone, in the garden of the Luxembourg. Thus, every species is capable of yielding several different grapes, according to the varieties of soil and cultivation. One cluster covered with a bell of dark glass is totally unlike another from the same branch exposed to the light. The sunny side of the Johannisberg affords a produce far richer and more fragrant than that from the opposite side of the mountain. In all cases, however, the juice is colourless. But what, in a chemical sense, are grapes? The juice is a combination of sugar, gelatine, gum, fat, wax, vegetable albumen and gluten, tartaric acid, cream of tartar, and lime; racemic, silicic and malic acid, oxide of manganese and iron, sulphate of potash, ordinary salt, phosphate of lime, and magnesia may also exist. No other ingredients have been discovered, but some must exist in small quantities—producing the vinous smell common to all wine, and the aroma and flavour peculiar to each quality in almost unlimited variety. These essentials have hitherto eluded analysis. They may be derived, in some instances, from the skins, when they are allowed, as in red wine, to ferment with the juice; but even this point is undecided. The varieties of wine depend not only on the constituents of the original plant, but on the composition of the soil, and 100 processes which follow the juice until it is decanted upon the dinner-table. The soil whence the Burgundy comes is a clayey lime, that of champagne a more thorough lime; Hermitage is yielded by a granitic, Medoc by a sandy, and Vin de la Gaude by a slaty soil. The additional influence of artificial appliances is important. Fetid manures, such as the mud and refuse of great towns, destroy the perfume of the wine; wool, hair, and bone-black, which are inodorous and decompose slowly, improve it. In the preparation of some wines, the skins and stones, and in many cases the stalks, are allowed to ferment with the juice, the purple and white skins yielding tannic acid, while only in the former does any colouring matter exist. A considerable quantity of white wax may be obtained from grape skins, by means of boiling alcohol. The stones are remarkable as containing a considerable quantity both of tannic acid and of a fatty oil, the amount of which Ray reckons at more than ten millions of pounds weight annually for France alone. He considers it as well suited for food as for burning. Bender, of Coblentz, convinced himself that it was not worth the expense of pressing. Zeimer found it disagreeable to smell and taste; but it has been suggested by others to roast grape stones, and use them instead of coffee. The stalks have a sharp, astringent flavour, and if treated with water and salt of oxide of iron, yield tannic acid.

NEW METHOD OF OBTAINING SILK.

It appears from the Indian journals that some slight notice has been taken of an Italian discovery, already practically and extensively carried out in France and in Syria, for obtaining Silk, at a most moderate cost, direct from the bark of the mulberry-tree, and for converting the bulky residue, after the silk has been extracted, into a pulp suited, better than most materials, for the manufacture of paper. The process has been secured by patent in England and in France, and by an Imperial firman in Turkey; and steps are about to be adopted for taking advantage of an extension of the patent laws into India, to secure the right of the process to the discoverers, and to work it in that country. In Bengal alone millions of mulberry plants, which would yield tons of silk and of pulp, are now next to thrown away—that is, employed as fire-wood, because no other use has hitherto been found for them. In some parts of Bombay, in Mysore, where the raising of silk has steadily progressed for several years; in the Punjaub, especially in the northern portions; and in the north-western provinces of Hindostan, the mulberry-tree abounds, so that the field of operation is a most extensive one. It is believed, moreover, that this new manufacture would interfere in a very trifling, if any, degree with the present silk operations in India. It ought, in fact, to advance them, as it should have the effect of increasing the mulberry cultivation to a considerable extent.—*Smith, Elder, and Co.'s Homeward Mail.* [There is nothing peculiar in the bark of the mulberry-tree. It is the chemical process in the stomach of the silkworm, and the subsequent fine spinning, that makes the silk. Given these, silk may be produced from any fibre that can be got of sufficient length. Some fibres are better than others, but of these the best is not that obtained from the bark of the mulberry-tree. At present the silkworm is the most experienced chemist, and (the cotton-spinner will understand what we mean) the cheapest dresser and spinner of "fine numbers" yet occupied in the manufacture and spinning of silk from fibre which it finds readiest of the right quality in the leaf of the mulberry-tree.—*Manchester Guardian.*]

CHINESE PASTILES AND TORCHES.

MR. FORTUNE has exhibited to the Zoological Society two Chinese Pastiles, half a yard long, made of the sawings of juniper and pine wood, used for the purpose of driving mosquitoes from apartments; also some rolls of the same material used for the same purpose: likewise some torches formed of the stems and leaves of *Artemisia indica*, used by the Chinese when taking honey from hives; one of these torches being lighted, and waved about by an attendant, the smoke stupefies the bees, which fly around without stinging the operators, although they are naked to the waist.

THE MOON AND VEGETATION.

DR. SMITH has communicated to the Edinburgh Botanical Society a paper "On the Supposed Influence of the Moon on Vegetation in Peru." The author alluded to the prevailing belief in Peru of the moon's influence on vegetation, and gave a *resumé* of the results arrived at by various scientific observers who had had opportunities of noticing the lunar influence in the tropics. He thought it not unreasonable that the lunar ray might have a peculiar chemical agency on the functions of plants and animals, as it appears to have on dead animal matter. While the moon was not regarded in Peru as influencing so much the changes of weather as in directly effecting increased growth, it must be borne in mind that the light afforded both by the sun and moon in Peru is much greater than in the British Islands,—so that, although we may reasonably repudiate any marked effect from the moonlight in these islands, the more intense lunar light of Peru may exercise a sensible power in plants. In noticing special instances in which this might be supposed to be shown, the author alluded particularly to the surprisingly rapid growth of lucerne, which is extensively cultivated in Peru, and is evidently much favoured by light, whether of sun or sun and moon together. During the prevailing misty season on the coast (which is the time when the low and maritime sandhills are garnished in grass and flowers to their summits), the growth of lucerne in the plains and valleys is greatly stinted. In these wet months, as they are called, though the rain very rarely forms into a light shower, or exceeds the limits of a dripping mist, the clover or lucerne does not attain to a flowering maturity; but no sooner do the vapours of the coast begin to break up, and the sun show itself in a brightening sky, than this useful plant, on which the horses and other cattle thrive admirably, receives a fresh impulse, yielding two or three luxuriant crops in succession. This remarkable vigour of vegetation, under the influence of a returning sun, argues on behalf of light, more than heat, as the vivifying power, because the requisite degree of heat does not appear to be deficient at any season, where the thermometer of Fahrenheit seldom sinks under 60° on the coast. Besides, in the temperate valleys of the Sierra or Andine heights, where the summer temperature of the air does not exceed the winter temperature of the coast, the lucerne grows luxuriantly under a bright clear sky during the dry season, though there also its growth is checked in the cloudy and rainy months; and yet the sunny season of the mountains is subject to night chills, or even frost at certain elevations, whereas the wet months are not so.

Light, therefore, seems the essential condition to the occurrence of the more luxuriant vegetation, as observed in the successive climates of the Andes from the headlands of the coast to the temperate agricultural elevations of 10,000 feet, where the lucerne still attains a perfect growth in a clear but cool atmosphere of about 60° Fahrenheit. And then, as we descend into yet deeper valleys, at only 6000 or 7000 feet elevation, where the rains of the so-called wet season are only slight and transitory, and not to be compared to those that fall at twice this height, the sun is seen throughout the year, and, in the dry months, actually dazzles in reflected brilliancy from every stone and rock. In these favoured inland valleys there is a predominating sun all the year over; and in the dry season especially, a profusion of sun by day, followed by a most luminous moonlight, with a calm clear sky. Here, then, so liberal a supply of light from sun, moon, and stars, appears to be singularly favourable to vegetation; and the lucerne yields inland two crops to one on the coast, though the temperature of the air on the coast be in the shade 10° to 12° higher during the dry season than in the inland valleys under consideration, and this, too, on soil generally inferior to that of the coast now compared with it in strength of vegetation. The author concluded by some observations on the effect of light in promoting the discharge of oxygen from the leaf tissues of plants, showing that light, independently of heat, increased their vital actions.

Professor Piazzi Smyth, in remarking upon Dr. Smith's paper, made some observations on the amount of heat given by the moon, and shortly traced the history of this inquiry, detailing many experiments by himself and others, and alluding particularly to the researches of Sir John Herschel, Professor J. D. Forbes, &c.

HOW TO IMPART ODOURS TO FLOWERS.

A FLORIST of Africa, as we are informed by the *Emperio Italiano*, has made successful experiments in heaping over the roots of flowers an odoriferous compost, and thus producing the required scent. By means, for instance, of a decoction of roses, he has given to the rhododendron the perfect odour of the rose. "To ensure success, however, the seeds themselves of the plant to which it is desired to impart fragrance should be acted upon. This operation is to give scent to those plants which have none whatever. But if it is required to substitute one scent for another natural to the plant, it is necessary to double or triple the quantity of essence; and besides preparing the seed, it will be well to modify the nutritive substance. In order to retain the perfume, it will be necessary to repeat the moistening with the odorous substance several days during the spring season, for two or three consecutive years. Fragrance may be given at the will of the horticulturalist to any plant or tree, by boring a hole from one side of the stem to the other, or through the roots, and introducing the odoriferous ingredients into the hole."

THE SORGHO FORAGE.

THE Sorgho or Sorghum is a genus of grassy plants, various species of which are largely cultivated in tropical Asia. The plant known under the name of Indian millet belongs to this genus; but the species called sorghum saccharatum, because an inferior kind of sugar may be extracted from it, has but lately been introduced in France, and tried with great success as forage on a small farm of about 16 hectares (39 acres English), called Peysieux, near Belley (Ain). M. Nivière, the proprietor of this farm, has learnt from experience that this sorghum will yield about 40,000 kilogrammes of dry forage per hectare, and that its nutritive power, compared to that of hay, is as 3 to 1. Another advantage is, that it will afford green forage to cattle during the months of October, November, and December, when every other green forage is exhausted. For this purpose, when the frosty season sets in, the sorghum is reaped and tied into sheaves, which are set upright under shelter; it may also be stacked in the open air. Some sheaves having accidentally been left in the field in November last, they remained buried under snow for nearly a month, when, a thaw coming on, they were found to be as fresh as ever, and even preferable to those which had been kept under cover.

A NEW SUGAR PLANT.

IT has long been known that a Sugar-producing Plant, a species of millet (*holcus sorghum*), was cultivated in the northern provinces of China, and the expressed juice used, like that of the sugar-cane and the beet-root, both for producing sugar and for purposes of distillation. It has lately been introduced into the United States, and the following account of its cultivation and produce is given in a letter to the *New York Times*:—

"This plant is the 'sweet reed,' mentioned by several of the ancient writers, but for the last 500 years known only to the Chinese of the interior, and the Kaffirs of Southern Africa, for its saccharine properties.

"The Imphee, or African variety, has not as yet been grown in any quantity north of 'Mason and Dixon;' but the accounts received of it are very favourable from South Carolina and Georgia, where 150 acres are being cut and turned into syrup and sugar. The Chinese variety, or 'Sorgho,' however, has been planted pretty extensively throughout the northern states; and in New Jersey, in the vicinity of New Brunswick, there are three patches, of about an acre each, on separate farms, which, although planted as late as

June, have nearly matured, standing from 12 feet to 14 feet high, and proving exceedingly rich in saccharine juice. They have passed uninjured through two pretty sharp frosts, which killed the Indian corn on either side of them, and are fresh and green as ever, thus proving the Sorgho to be a hardy plant, well suited to our northern latitudes. The fields in appearance closely resemble the cane fields of Cuba and Louisiana, and the plant is jointed like the common cane, resembling it in all respects, with the exception of bearing a heavy bunch of seed at the top, from which it may be propagated."

Mr. R. A. S. Johnson, the New Jersey agriculturist, has found the syrup made from his canes equal to some obtained from Georgia. When put into the vinous fermentation, for the purpose of ascertaining the yield of alcohol, it worked without violence, and attenuated to zero in 48 hours, just as the southern syrup had done. On distillation, it yielded nearly a gallon of proof spirit, resembling brandy, for each gallon of syrup in the wash, which has been appraised by dealers at 2 dollars per gallon. After being kept a year or so, till the newness passes off, no doubt 4 dollars or 5 dollars could be easily obtained for it.

CULTIVATION OF THE MUSHROOM.

Mr. James Cuthill, of Camberwell, in a pamphlet with the above title,* details his experience in the cultivation of this wholesome esculent, by any one having a stony cellar:—

Mushroom spawn (says Mr. Cuthill) is formed in horses' stomachs, for it is certain that the more oats a horse eats the more spawn will be produced, the finer the mushroom will be, and the longer the crop will last. We have proof of this when we make up a bed with no artificial spawn in it; a bed made up, however, without spawning, will take four months instead of two to come into bearing; but such a bed could be much helped by saving all the dry parts of the bed containing spawn, and inserting them near the surface, amongst the droppings of another new bed, before moulding. This plan is only recommended where you cannot get, nor depend upon artificial spawn; a bed made up like the above must not have any water for four months, until the spawn has run thoroughly through it and well established itself. The mould, unsifted, should be put on in a moderately dry state, more for the convenience of handling than for any other reason, because it must be well trodden and watered to make it solid—not watered to pass through the mould, however, or you will ruin the spawn. Tepid water should be employed in winter. When the bed is made up it will always ferment a little, but the less the better; holes made every square foot apart will let out the heat quickly; therefore do not spawn the bed until the interior falls to about 80 degrees, or even lower at this time of the year. Then spawn and mould at once, cover over with a mat to keep the mould from drying and cracking, and when you find that your trial-stick does not indicate more than a gentle milk-heat, then gradually put on coarse hay. The whole is then finished for six or eight weeks; during that time do not forget to uncover; and if there should be wood-lice, slaters, pea-bugs, cheese-bugs, or whatever other name they may be called, boiling water poured round the seams or crevices (not on the bed) will destroy them. This plan is worth something, not only to mushroom growers, but also to cultivators of cucumbers and melons. A bushel of spawn will be enough for a bed of 100 feet square; if the brick is well run with it, each brick will make into nine pieces, giving two inches square to a foot apart each way.

Mushrooms, Mr. Cuthill maintains, are, as food, second only to beef and mutton; and the great cause of their disagreement with certain stomachs is their not being cooked when perfectly fresh.

* Sold by Hamilton and Adams, Paternoster-row.

Geology and Mineralogy.

RECENT PROGRESS OF GEOLOGY.

THE President of the British Association, in his inaugural Address, at their recent Annual Meeting, observed :—The science of *Geology* appears, of late years, to have entered upon a new phase of its development,—one characterized by a stricter reference of its speculative views to the principles of those sciences with which it is connected, and upon which it ought to be based. We have an example of this in the able Memoirs of Mr. Hopkins, on what may be called *Dynamical Geology*, including the changes which have taken place in the earth's crust by the operation of internal forces. Another instance of the application of sound physical principles to this science is found in the explanations which have been recently offered of the phenomena of *slaty cleavage*. A Report on this interesting subject was presented to the Association by Professor Phillips at its last Meeting, and will be found in the volume just published. These sounder views originate, I believe, with himself and with Mr. Sharpe; but they have been enlarged and confirmed by Mr. Sorby, Dr. Tyndall, and Professor Haughton.

We have another interesting proof of the readiness of geologists of the present day to submit their views to the test of exact observation, in the measurements undertaken by Mr. Horner for the purpose of approximating to the age of sedimentary deposits. Of the geological changes still in operation, none is more remarkable than the formation of deltas at the mouths of great rivers, and of alluvial land by their overflow. Of changes of the latter kind, perhaps the most remarkable is the great alluvial deposit formed in the valley of the Nile by the annual inundations of that river; and here it fortunately happens that history comes to the aid of the geologist. These sedimentary deposits have accumulated round the bases of monuments of *known age;* and we are, therefore, at once furnished with a *chronometric scale* by which the rate of their formation may be measured.

The first of the series of measurements undertaken by Mr. Horner was made with the co-operation of the Egyptian Government, around the obelisk of Heliopolis, a monument built, according to Lepsius, 2300 years B.C. A more extensive series of researches has been since undertaken in the district of Memphis; but Mr. Horner has not yet, I believe, published the results. The problems now to be solved in *Palæontology* are clearly defined in the enunciation of the problem recently proposed by the French Academy of Sciences as one of its prize questions—viz., "to study the laws of distribution of organic beings in the different sedimentary rocks, according to the order of their superposition; to discuss the question of their appearance or disappearance, whether simultaneous or successive; and to determine the nature of the relations which subsist between the existing organic kingdom and its anterior states." The prize was obtained by Professor Bronn, of Heidelberg; and his

Memoir, of which I have only seen an outline, appears to be characterized by views at once sound and comprehensive. The leading result seems to be, that the genera and species of plants and animals, which geology proves to have existed successively on our globe, were *created in succession*, in adaptation to the existing state of their abode, and *not transmuted*, or *modified*, as the theory of Lamarck supposes, by the physical influences which surrounded them.

THE SEA LEVEL AND GEOLOGICAL EPOCHS.

A PAPER has been read to the British Association "On the Existence of Forces capable of changing the Sea-level during different Geological Epochs," by Professor Hennessy. If, in assuming its present state from an anterior condition of entire fluidity, the matter composing the crust of the earth underwent no change of volume, the direction of gravity at the earth's surface would remain unchanged, and consequently the general figure of the liquid coating of our planet. If, on the contrary, as we have reason to believe, a change of volume should accompany the change of state of the materials of the earth from fluidity to solidity, the mean depth of the ocean would undergo gradual, though small, changes over its entire extent at successive geological epochs. This result is easily deduced from the general views contained in other writings of the author, whence it appears, that if the surface stratum of the internal fluid nucleus of the earth should contract when passing to the solid state, a tendency would exist to increase the ellipticity of the liquid covering of the outward surface of the crust. A very small change of ellipticity would suffice to lay bare or submerge extensive tracts of the globe. If, for example, the mean ellipticity of the ocean increased from $\frac{1}{300}$ to $\frac{1}{290}$, the level of the sea would be raised at the equator by about 228 feet, while under the parallel of 52° it would be depressed by 196 feet. Shallow seas and banks in the latitudes of the British isles, and between them and the pole, would thus be converted into dry land, while low-lying plains and islands near the equator would be submerged. If similar phenomena occurred during early periods of geological history, they would manifestly influence the distribution of land and water during these periods, and with such a direction of the forces as that referred to, they would tend to increase the proportion of land in the polar and temperate regions of the earth, as compared with the equatorial regions during successive geological epochs. Such maps as those published by Sir Charles Lyell on the distribution of land and water in Europe during the tertiary period, and those of M. Elie de Beaumont, contained in Beaudant's *Geology*, would, if sufficiently extended, assist in verifying or disproving these views.

GRANITITE AND GRANITE.

GUSTAV ROSE has made to the German Association some observations on the gneiss which forms the north-western limit of the Granitite of the Riesengebirge, and of the Granite which occurs in it; he also spoke of the relation of granite to gneiss in general. The boundaries betwixt the two could, he said, be very distinctly drawn in the Riesengebirge. In 1856, at Vienna, the learned Professor gave an account of some recent investigations which he had made in the Riesengebirge and Isergebirge, with a view to determine the exact limits betwixt granitite and granite; and assigned the reasons which had induced him to regard the former as a separate species of rock from the latter. These reasons were—first, the distinct mineral composition—the white mica of the granite being entirely wanting; secondly, the accurate limits which can be drawn betwixt it and the granite of the Isergebirge; and, thirdly, the circumstance that mixtures of similar composition to the granitite of the Riesengebirge and Isergebirge occurred in the most diverse localities. From the relations of the granitite to the granite, the Professor considered that the former must have penetrated to the surface more recently than the latter. [See also a contribution by Rose, "Uber die zur granitgruppe gehörigen Gebirgsarten," in the first volume of the *Zeitschrift der Deutsch-geologischen Gesellschaft.*]

FORMATION OF ROCK BASINS.

MR. J. CLEGHORN, in a paper communicated to the Geological Society by Sir R. I. Murchison, refers to the existence of Pot-holes on the shores of Caithness, which he has reason to believe were formed in the first place by the grinding action of a loose mass of rock rotated on one spot by the action of the waves, and in the second place by the wearing action of pebbles and boulders washed about within the pots or basins by the sea. Mr. Cleghorn referred also to the rock basins of Dartmoor, and the Giants' Pots of Sweden, and stated his belief that these also had originated in some modifications of a similar agency, in opposition to the opinions of other observers, who had referred the formation of some to the decomposing action of the atmosphere on granite (aided in some instances by human agency), of others to the effect of glaciers, &c.

CONDUCTING POWER OF ROCKS—MOUNTAINS NOT IMMOVABLE.

MR. HOPKINS, of Cambridge, has lately made some interesting experiments on the *conductivity* or conducting power of different substances for heat, of which an account was laid before the Royal Society of London in June last. Without attempting to describe his processes, we give his more important conclusions. These results are in decimals, the conductivity of "igneous rock" (trap or granite, we presume) saturated with moisture being taken for unity:—

Chalk, in the state of dry powder			·056
Clay,	ditto	ditto	·07
Sand,	ditto	ditto	·15
Sand and clay,		ditto	·11

The conductivity of the following rocks is given in two states—*dry*, and *saturated* with water:—

	Dry.	Saturated.
Chalk, in block	·17	·30
Oolite rock	·30	·40
Hard compact limestones	·50	·55
Siliceous New Red Sandstone	·25	·60
Freestone	·33	·45
Hard compact sandstones (Millstone Grit)	·51	·76
Hard compact old sedimentary	·50	·61
Igneous rocks	·53	1·00

The effect of *pressure* on the conducting power of substances was also tried, and proved to be almost nothing. A pressure of 7500 lb. on a square inch of beeswax, spermaceti, and chalk, had no appreciable effect. Uncompressed clay, which had a conducting power of ·26, had the same raised to ·33 by a pressure of 7500 lb.

Sandstone, with conducting power of ·5, divided into strata each 1 foot thick, when compared with a similar mass in one block, had its conducting power diminished 1-20th. When the strata were only 6 inches thick, the diminution was 1-10th. The effect of discontinuity of substance is therefore small. Saturation with moisture, on the other hand, produces generally a great effect, as will be seen on comparing the dry and saturated blocks of chalk, the dry and saturated New Red Sandstone, and again the dry and saturated "igneous rocks."

These facts have a certain bearing on a geological question—namely, the transmission of heat from the interior of the earth to the crust. The oolite, for instance, conducts heat much better than the chalk, the sandstone better than the oolite, the igneous rock better than the sandstone, and, in all cases, the rock charged with moisture better than the dry rock. But Mr. Hopkins would have added to the value of his paper if he had ascertained by experiment the quantity of water absorbed by each rock at given temperatures, and whether the conductivity is exactly in proportion to the absorption.

In illustration of the use that may be made of the tables, we would refer to certain remarks made by Dr. Robinson on a paper read by Professor Hennessy at the recent meeting of the British Association. The subject was "the direction of gravity at the earth's surface." In alluding to certain supposed local and temporary changes of level, he mentioned the following curious fact:—"He found *the entire mass of rock and hill on which the Armagh Observatory is erected to be slightly, but to an astronomer quite perceptibly, tilted or canted at one season to the east, at another to the west.* This he at first attributed to the varying power of the sun's radiation to heat and expand the rock throughout the year; but he subsequently had reason to attribute it rather to the infiltration of water to the parts where the clay-slate and limestone rocks met. The varying quantity of this (water) through the year he now believed exerted a powerful hydrostatic energy by which the position of the rock is slightly varied." With the light furnished by Mr. Hopkins's experiments, we may pronounce the explanation satisfactory. Armagh and its Observatory stand at the junction of the mountain limestone with the clay-slate, having, as it were, one leg on the former, and the other on the latter, and both rocks probably reach downwards one or two thousand feet. When rain falls, the one will absorb more water than the other; both will gain an increase of conductive power, but the one which has absorbed most water will have the greatest increase; and being thus the better conductor, will *draw a greater portion of heat from the hot nucleus below to the surface*—will become, in fact, temporarily hotter, and, as a consequence, *expand more than the other*. In a word, *both rocks will expand at the wet season; but the best conductor, or most absorbent rock, will expand most, and seem to tilt the hill to one side; at the dry season it will subside most, and the hill will seem to be tilted in the opposite direction.*

The fact is curious, and not less so are the results deducible from it. First, hills are higher at one season than another, a fact we might have supposed, but never could have ascertained by measurement. Secondly, they are highest, not, as we would have supposed, at the hottest season, but at the wettest. Thirdly, it is from the *different rates* of expansion of different rocks that this has been discovered; had the limestone and clay-slate expanded equably, or had Armagh Observatory stood on a hill of homogeneous rock, it would have remained unknown. Fourthly, though the phenomenon is in the strictest sense *earthly*, it is by converse with the *heavens* that it has been made known to us. A variation of probably half a second, or less, in the right ascension of three or four stars, observed at different seasons, no doubt revealed the fact to the sagacious astronomer of Armagh, and even enabled him to divine its cause; which has been confirmed as the true cause, and placed in a clearer light, by the experiments of Mr. Hopkins. One useful lesson may be learned from the discovery—to be careful to erect Observatories on a homogenous foundation.—*Mr. Maclaren, in the Scotsman*, Oct. 10, 1857.

CRAG SHELLS AND THE CLIMATE OF ENGLAND.

Sir Charles Lyell, in the Supplement to the fifth edition of his *Manual of Elementary Geology*, deduces an important conclusion from Mr. Searles Wood's newly completed Monograph on the Crag Shells, which affords "clear evidence of a gradual refrigeration in the climate of England from the time of the older to that of the most modern Pliocene strata." On the shores of Norfolk and Suffolk there are three sandy deposits called "Crags," abounding in shells. On comparing these three Crags, the *northern* species of mollusca (still living in the Arctic seas) are found to increase as we ascend from the older deposits to the newer; on the other hand, the *southern* species yet living in the Mediterranean are found to increase as we descend from the newer deposits to the older. Contemporary with these deposits, or perhaps later, are the Hippopotamus Major, a monkey, and remains of Rhinoceros Leptorinus, found on the north bank of the Thames, in Essex; and above the whole is a sheet of ochreous gravel spread over the valley of the Thames from

Maidenhead eastward to the sea, containing the bones of Arctic quadrupeds, witnesses of the intense cold of the glacial period.

MITCHELSTOWN CAVES.

THERE have been read to the British Association some "Notes of a Visit to Mitchelstown Caves," by Mr. E. P. Wright, Director of the Dublin University Museum. He stated that, in company with Mr. Halliday, he, in the early part of August, 1857, explored the extensive limestone caverns situated in the valley of Mitchelstown, between the Galtee and the Knockmildown ranges of mountains; the object of the visit being to examine whether any of the curious blind animals, so well known as inhabiting the Carniola and other caves, would be found in Ireland. Mr. E. Percival Wright gave a brief sketch of the geology of the district, of the various blind insects found on the continent and described by Schiodte, and of the Mitchelstown cave, of which a ground-plan was exhibited; and then stated that in the interior of the cave, and near some small pools of water formed by the dropping from the roof, specimens of a small white Lipura were discovered. This insect comes very near to the species figured by Schiodte, found in Adelsburg Cave; but on a very careful examination by Mr. Halliday many differences were detected, more particularly the total absence of ocelli, fourteen of which are figured by Schiodte on each side of the head of his Lipura; but not a trace of ocelli were found in the Mitchelstown Cave specimens. Mr. Halliday observed that there were some other points to which Schiodte's observations, or at least his interpretation of them, were at variance with what is known of the common structure of this family. Hence he was led to hesitate as to the importance to be attached to the differences noted. His Lipura, as well as another species of the family (certainly blind), *Tritomurus scutillatus*, had both been ascertained to have an extensive range in the caves of the Austrian territory, and it did not seem so improbable that they should occur in similar situations even in these islands. The other species found in the Mitchelstown caves having distinct eyes, and the structure of the anal fork agreeing with Macrotoma, could not be confounded with the last-named insect. The list of the proper subterranean Fauna of the European caves (independent of the immigrant animals which occur on the outer world also) had been largely added to since Mr. A. Murray's paper "On Blind Insects and Blind Vision" was written.

Mr. Halliday submitted a list which, in its turn, would doubtless soon be antiquated by the fresh investigations so diligently pursued by the Austrian naturalists. The present list comprises—Vertebrata, 1; Insecta, 31; Arachnida, 7; Myriapoda, 1; Crustacea, 5; Annelida, 1; Mollusca, 17.

The Rev. Mr. Higgins inquired if it were Mr. Halliday's conviction that the blind insects found in these caves were truly species, or not rather insects which had strayed from the light, and, being confined in these caves, lost an organ which was no longer of any use to them.

Mr. Halliday replied, that these animals possessed other organs besides eyes which distinguished them as species; and there could be no doubt they had been created for the special circumstances in which they were found.

Dr. Harvey remarked on the curious fact of many of these caves containing species peculiar to themselves. The same limited distribution of species was found in many other forms of animals. Thus many of the Unios (Mollusca) of the rivers of America were peculiar to the one river in which they were found.

GOLD IN BRITISH GUIANA.

A NEW Gold Field has been discovered about ninety miles from Upata, where about three or four years ago a large quantity of gold was taken from the river. The average find is two ounces per day for each man; but there have been instances where much larger quantities have been taken; as much as twenty-four ounces having been found in between seven and eight hours; and two men who were working at the same time obtained forty-four ounces.

This gold field is said to be within the British territory of British Guiana, according to the line ran some years since by Sir Robert Schomburgh, by order of the British Government. The gold lies at a depth of between five and six feet from the surface. Large orders have been received here for pickaxes, shovels, and other implements for digging.—*Port of Spain Gazette*, May 9, 1857.

COAL IN THE ROCKY MOUNTAINS.

MR. W. P. BLAKE, of the United States, in his recent tour through Texas and New Mexico, spent a few weeks in Santa Fé and the vicinity, observing the geology, and paying special attention to the gold region, of the Placer Mountains and to the carboniferous rocks. One of his most interesting results is the determination *by fossils* of the existence of the veritable coal-measures on the *west* slope of the first range of the great Rocky Mountain chain. They contain beds of bituminous coal; and about 25 miles south of Santa Fé *anthracite* is found in a bed thick enough to be profitably worked. Hitherto there has been much doubt about the age of the coal-beds found in these mountains, and beyond. They have been regarded as more recent than the carboniferous. Mr. Blake's observations settle the fact that the true coal occurs there. The fossils are identical, specifically with those in the coal-measures of Missouri. The coal-fields are thus shown to extend 1090 miles west of the Mississippi, and to crop out at an altitude of from 6000 to 7000 feet above the sea,—the limestones being much higher, up to 12,000 feet, as before observed by Marcou.

These coal-seams are accompanied by thin layers of gypsum in dark shales, which, in some places, bear the impress of ferns. The strata are coarse grits and limestones, the latter in thin beds, and usually highly charged with *Producti*, *Spiriferes*, *Althyris*, and stems of crinoids and corals.—*Edinburgh New Philosophical Journal*, No. 9.

FOSSILIFEROUS IRONSTONE.—PERMIAN FOSSILS.

THERE have been read to the Geological Society the following papers :—1. "On some Fossiliferous Ironstone occurring on the North Downs." By Mr. Joseph Prestwich, F.R.S. Besides a drift of red loam with flints, and the few local outliers of lower tertiary sands and pebble-beds, there are scattered on the summit of the North Downs from Folkestone to Dorking a few masses of sand, gravel, and ironstone, which present a certain regularity of structure and uniformity among themselves, and are clearly different from and of a later age than the outliers of eocene tertiaries on the same hills. This fossiliferous ironsand on close examination yielded casts of bivalve and univalve shells belonging to nearly thirty genera, besides indications of *Lunulites*, *Diadema*, &c. The presence of a *Terebratula* very like *T. grandis*, with several species of *Astarte*, and afterwards his finding a large Mya-shaped shell, led Mr. Prestwich to conclude that these sandy beds belonged to the Lower Crag. Mr. Searles Wood, to whom the fossils have been submitted, states that, as far as the evidence goes, he thinks they may with some probability be referred to the Lower Crag period ; the occurrence of a *Pyrula* more especially strengthening this view. Mr. Prestwich assigns without any doubt this shelly ironstone to the ferruginous sands above referred to, and points to the peculiar concentric arrangement of the contents of the sandpipes of the locality in question, as definitely indicating (in accordance with the observations he formerly published in the Society's Journal) the former existence of horizontal strata of—1, (lowermost) loam with flints ; 2, greenish sands with ironstone nodules ; 3, yellow and reddish sands, superposed on the bare chalk, after the eocene beds were for the most part denuded, and before the sandpipes were formed, into which these overlying beds were here and there let down, and thereby preserved when further denuding agencies removed the later tertiary beds.

2. "Notice of the Occurrence of a Malacostracous Crustacean, and of a new Chiton in the Magnesian Limestone of Durham ; with Remarks on some other Permian Fossils." By Mr. J. W. Kirkby. The author has in the course of the last three years met with six imperfect specimens of a minute Crustacean, characterized by two large caudal rings, about nine or ten narrow body rings, and a large cephalic carapace with two prominent hemispherical eyespots, placed far forwards. This animal appears to be the same as that named *Trilobites problematicus* by Schlotheim, and *Palæocrangon problematicus* by Schauroth. It is not, however, related either to the Trilobites or the Crangons ; but is pronounced by Mr. C. S. Bates to be probably Isopodous in its relations ; and more nearly representing the immature than the mature form of recent Isopods. The other fossils described or noticed in this paper are the *Chemnitzia Roessleri*, *Chiton Howsianus*, *Lima Permiana*, and *Hippothoa Voigtiana*.

CAMBRIAN FOSSILS.

A PAPER has been read to the Geological Society, "On some additional Cambrian Fossils from the Longmynd," by Mr. J. W. Salter, F.G.S. In March, 1856, Mr. Salter communicated the discovery of traces of annelides and probable fragments of a trilobite, accompanied by ripple marks, in the sandstone-beds of the eastern part of the Longmynd. During the last summer he collected many more materials for the elucidation of the palæontology of the Longmynd rocks; and in the present paper described the occurrence of abundant annelide markings referable to two species (one of them new), throughout a mile of thickness in the lower portion of the nearly vertical shales, sandstones, and flagstones of the Longmynd, from Church Stretton to the Portway. Wave, or surf-marks, ripples, sun-cracks, and rain-prints were also described as occurring at several localities on the surfaces of these laminated rocks of the Longmynd. *Arenicolites sparsus* was proposed as the name for the new species of double worm-hole above alluded to. Mr. Salter also adverted to the discovery of numerous vertical worm-tubes in the quartz rock of the Stiper Stones. These he believes to be the same as the *Scolithus linearis* of Hall, found in the Potsdam sandstone of North America. He proposes the term *Arenicolites* for all fossil worm-holes with double openings, and *Helminthites* for the superficial trails.

PARADOXIDES IN NEW ENGLAND.

A PAPER has been communicated to the British Association "On the Discovery of Paradoxides in New England," by Professor W. B. Rogers. The fossil was discovered in a quarry near Boston, which had been open for thirty years without its being suspected by men of science that the rock was fossiliferous. A specimen which Professor Rogers had succeeded in tracing to that quarry, had been lying in a museum for many years. It had been named *P. Harlami*, and was supposed to be a foreign specimen. These rocks lie between great ridges of igneous rocks, running along the eastern margin of the State of Massachusetts, and although greatly metamorphosed, they exhibit very good specimens of Trilobites. The Paradoxides is a fossil found in several localities in Europe, and always in the lowest fossiliferous beds. Some specimens from Boston appear to be very similar to *P. spinosus* of Barrande, which species is abundantly found in all the lower beds of Bohemia. It is, therefore, important as determining the age of these new rocks. Up to the present time the oldest fossiliferous beds in the district in which these fossils had been found were beds containing coal plants. These, however, are separated from the beds at Boston by a large mass of igneous and metamorphic rocks. Professor Rogers remarked that the discovery of these fossils confirmed the idea that during the earlier geological epoch there was a more general uniformity in the distribution of organic life than is at present the case. A series of photographs of the specimens was exhibited.

THE MASTODON IN CHILE.

There has been read to the Geological Society, a paper "On the occurrence of Mastodon Bones in Chile," by Mr. W. Bollaert. The author observed, that hitherto there have been few if any fossil bones of large quadrupeds found on the western side of the Andes. During his travels in South America, he had diligently searched for information on the subject; and he had learnt from Mr. G. Smith, H.B.M. Consul at Santiago de Chile, that some elephantine bones had been met with in digging a trench to drain the Lake Taguatagua, in the province of Colchagua, about forty-five leagues due south of the capital, and at an elevation of 2300 feet above the level of the Pacific Ocean. This lake occupied a circular and crater-like depression among the third range of hills running north and south through Chile. The skeletons of two animals were found at the depth of about thirty feet below the margin of the lake. Some of the teeth (referred to *Mastodon* by Don V. Bustilos) are in the Museum at Santiago, and fragments of the femur and tibia brought home by Mr. Bollaert have been also referred to *Mastodon* by Professor Owen.

GEOLOGICAL POSITION OF THE FOSSIL ELEPHANT OF NORTH AMERICA.

An elaborate paper, comprising a variety of local details, has been read to the American Association by Mr. J. W. Foster. The following is the author's summary:—From all the facts, I am disposed to believe that the Fossil Elephant commenced his existence before the drift agencies had entirely ceased—when the water stood at a higher level—when the contour of the continent was different—when a different climate prevailed, and when a sub-arctic vegetation stretched far towards the tropics—at a time when the valleys were excavated by the returning waters, and the streams assumed nearly their present direction. It was a period of erosion, which ought to be marked by distinct geological monuments. I would designate it as the Fluviatile Period. Although, in rare instances, the remains of the elephant and the mastodon are found side by side, there are deposits apparently newer, which contain the mastodon, and in which those of the elephant have never been found. The inference, therefore, might be drawn that, although at one time contemporary, the one was introduced earlier, while the other survived later. Contemporary with these fossil pachyderms was the fossil beaver (*Castor oides*). In bulk he was twice the size of the existing species, and was adapted to a wide geographical range. Contemporary, too, with these pachyderms was the mastodon (*M. giganteus*) of a more ponderous frame, but of an inferior weight. The fossil beaver tenanted the streams and lakes. Herds of cattle (*Bos bombifrons* and *Bison latifrons*) roamed over the plains, while the tapir wallowed in the swamps. In the milder regions of the south, visited by the elephant and the mastodon in their migrations, lived the great leaf-eating megatherium, the mylodon, megalonyx, the hippopotamus, the horse, the elk, and the deer, all belonging to extinct species, while at the head of the carnivora stood the colossal lion (*Felis atrox*), which then, as now, was the monarch of the forest.

KIDDERMINSTER DEPOSITS.

We have received information from the President of the Malvern Natural History Field Club (Rev. W. S. Symonds), that the equivalents of the Caithness, Lesmahagow, Kington, and Ludlow tile stones, or transition beds between the Ludlow and Old Red Sandstone deposits, have been lately discovered by Mr. G. E. Roberts, of Kidderminster, three miles north of that town. The organic remains are most abundant. The Pterygotus and Eurypterus are found in the same bed with *Cephalaspis Lyellii*, and are associated with beautiful specimens of molluscan or crustacean spawn, probably the latter. Terrestrial plants, apparently allied to Equisetum, are imbedded with the fossil seed-vessels of Lycopodiaceæ, determined by Dr. Hooker from the bone bed of Ludlow, with many other fossils yet to be described. The persistence of this bed throughout so large an area is very extraordinary.—*Edinburgh New Philosophical Journal*, No. 10.

GRAPTOLITES.

Mr. James Hall, of Albany, states, in a letter to M. Konink, the Belgian palæontologist, that what have been hitherto termed Graptolites, are but fragments of a more complex animal. He has discovered this from specimens sent him by Mr. Logan, Director of the Canadian Geological Survey.

REMAINS OF THE MOA IN NEW ZEALAND.

On January 4, 1856, Mr. G. H. Moore, of Glenmark, in the northern portion of the province, discovered three of the finest specimens of the great Moa bird remains which have yet been found in this colony. His men, in tracing up a drain through a peat swamp to the spring at the foot of the hill in the rear of his woolshed, came across a number of huge bones in a very high state of preservation. Upon carefully excavating them, and removing a depth of about four feet of peat, in which partly they were found, and below which was a blue clay, they discovered in one place the frames of two birds, and a few yards farther back the entire bones of another. The two former are of a great size; the shank bones are upwards of 2 feet in length and 9 inches across the knuckle joints. The lower joints of these two birds appear to be imbedded perpendicularly in the blue clay, as if they had sunk beyond their powers of extrication, and the upper parts of their frames were found in the peat, which covered them entirely over. The position of the remains leads to the idea that these birds had all sought shelter from fire under the steep hill at the spring there, and were overtaken by the fire before recovering from their state of exhaustion. The peat and vegetable matter which appears to have been washed down upon them has maintained these remains in a very high state of preservation. The greatest care is being taken by Mr. Moore to collect all the parts, and it is probable that the entire skeletons of all three birds will be obtained.—*New Zealand Paper.*

FOSSIL REMAINS OF A GIGANTIC BIRD.

THE French Academy of Sciences has been presented by M. Lartet, Professor at Auch, with three fragments of the shoulder of an unknown bird, dug up in the department of the Gers. The three fragments placed end to end measured 58 centimetres, or nearly 23 inches, which is alone about a third more than that of the albatross, which of all known birds has the largest humerus; so that the entire length must have been considerably more. From the form of the bone it would appear that the bird belonged to the same genus as the albatross. M. Lartet, however, proposes to consider it as belonging to a distinct genus, under the name of *Pelagornis miöcaenus.* The discovery is the more interesting as the fossil remains of birds are comparatively rare.

MAMMALIA IN SECONDARY ROCKS.

THE Rev. C. Kingsley has communicated to the *Illustrated London News,* No. 895, an account of some important discoveries at Swanage, in Dorsetshire, a locality remarkable for the number and value of its fossil remains. These discoveries were made by Mr. S. H. Beckles, F.G.S., who began them in December last, with the view of ascertaining if Mammalia, or other air-breathing animals of a high order, existed in any number during the age in which the Secondary Rocks were deposited.

A mammal jaw had been already discovered by Mr. Brodie on the shore at the back of Swanage Point Mr. Beckles's business was to trace the vein from which this jaw had been procured, through its course along the cliff above, and to search it as thoroughly as he could. With that practical sagacity and zeal which distinguishes so many of our scientific men, he found the precious vein (a stratum about five inches thick, at the base of the Middle Purbeck beds), and set to work. Before he could lay it bare he had to remove a superincumbent load of fifty-two feet thick, forty feet of which was solid rock; and again and again, after losing the vein, where it was shifted and snapt by earthquake "faults," to try fresh cuttings at fresh points of the cliff. In nine months he removed many thousand tons of rock, and laid bare an area of nearly 7000 square feet (the largest cutting ever made for purely scientific purposes), and, even more difficult, he educated the more intelligent of his Swanage workmen into trusty and observant fossil hunters.

Reptiles (tortoises and lizards) he found in hundreds; but the most important discovery was that of the jaws of at least fourteen different species of mammalia. Some of these were herbivorous, some carnivorous, connected (we understand) with our modern shrews, moles, hedgehogs, &c., but all of them perfectly developed and highly-organized quadrupeds. The detailed results of Mr. Beckles's labour will be published in the Transactions of the Geological Society.

The Rector of Eversley then proceeds to illustrate, in his own clear and eloquent manner, the interest and value of these discoveries :—

"To all which our readers may answer, *Cui bono?* All this may be amusing, curious ; but what is its use? Its use is this. It was supposed till very lately that few if any mammalia were to be found below the tertiary rock, *i. e.*, those above the chalk ; and this supposed fact was very comfortable to those who support the doctrine of 'progressive development,' and hold with the notorious 'Vestiges of Creation,' that a fish by mere length of time became a reptile, a lemur, an ape, and finally an ape a man. But here, as in a hundred other cases, facts, when duly investigated, are against their theory. A very ancient bed of the Secondary rocks is found full of mammalia, as perfect as most which now walk this earth ; and Mr. Beckles's discoveries give fresh strength to the theory of our best scientific men, that not merely species, but whole orders, were created from time to time by some absolute act of the Almighty mind, as perfect at the first moment of their existence as at any subsequent one. Thus are the conclusions of sound science shown more and more to coincide with those of sound religion ; and every man who, like Mr. Beckles, by discovering physical truth, helps the cause of spiritual truth, deserves well of his country, even though all he visibly brings them be a few jaws of unmarketable vermin."

Mr. Kingsley's paper is illustrated by an engraving from a photograph of the scene of the discoveries at Swanage.

Ten years ago no remains of quadrupeds were believed to exist in the Secondary strata. "Even in 1854," says Sir Charles Lyell (in a Supplement to the fifth edition of his *Manual of Elementary Geology*), "only six species of mammals from rocks older than the Tertiary were known in the whole world." We now possess evidence of the existence of fourteen species belonging to eight or nine genera from the fresh water strata of the Middle Purbeck Oolite. They are all small, none of them much exceeding the dimensions of the common hedgehog or squirrel—some of them herbivorous, some predaceous ; some of the predaceous marsupial (pouched) ; others probably placental. It would be rash now to fix a limit in past time to the existence of quadrupeds.

SO-CALLED HUMAN PETRIFACTIONS.

DESCRIPTIONS of Petrifactions of Human Bodies which occur in the newspapers appear to refer to the conversion of bodies into adipocere, and not into stone. All the supposed cases of petrifaction are probably of this nature. The change occurs only when the coffin becomes filled with water. The body, converted into adipocere, floats on the water. The supposed cases of changes of position in the grave, bursting open the coffin lids, turning over, crossing of limbs, &c., formerly attributed to the coming to life of persons buried who were not dead, is now ascertained to be due to the same cause. The chemical change into adipocere, and the evolution of gases, produce these movements of dead bodies.—*Mr. Trail Green.*

FOSSIL MAMMALIAN FOOTMARKS.

M. DAUBRÉE has laid before the French Academy of Sciences casts of certain impressions found in sandstones of the *Grès Bigarré* (Trias or New Red Sandstone), in the department of Haute Saone. They are compared to some impressions found in Thuringia—namely, those of the Labyrinthodon, a reptile noticed by Sir C. Lyell (*Manual*, p. 342). "They have some resemblance to the paw of a dog, and seem to afford a new proof that mammifers existed when the last beds of the Trias were deposited." That the footmarks may be those of a quadruped is credible, since the *Microlestes antiquus* belongs to this formation, but the Labyrinthodon was also supposed to be a quadruped till Owen pronounced it a reptile. At all events, the fact must remain doubtful till some competent authority pronounce an opinion.—*C. Maclaren.*

NEW FOSSIL IN HEREFORDSHIRE.

THE Rev. W. S. Symonds has read to the British Association a paper on a New Species of Eurypterus from the Old Red Sandstone of Herefordshire. This fossil was discovered by the parish clerk of Rowlstone, Herefordshire, and presented to the Rev. W. Wenman. Mr. Symonds examined the correlation of the rocks in which the fossil was found, and stated that they were gray sandstones of the upper cornstones, and pass upwards into red and chocolate coloured sandstones and the old red conglomerate.

Professor Phillips noticed the interesting nature of the problem connected with the discovery of this new fossil in a rock immediately succeeding the Upper Silurian rock containing peroxide of iron. The author had proved the continuance of organic life in a series of rocks probably two thousand feet higher than had hitherto been found in the particular geological period to which his paper referred.

NEW FOSSIL FERN.

MR. W. H. BAILY has read to the British Association a paper "On a New Fossil Fern, from the Coal Measures near Glin, County Limerick." This fern was discovered by Mr. G. H. Kinahan in the black shale above the coal in the townland of Ballygilternan Lower, County Limerick, together with ordinary coal plants. It appears to be the central portion of a frond, with about 20 alternate pinnules, which are apparently covered by thecæ or cases of the reproductive germs, presenting an appearance somewhat resembling rows of small flowers. This plant is unlike any present or fossil fern, and has organs of fructification—an occurrence rare among carboniferous ferns. It is exceedingly interesting, and may possibly be a new generic form.

FOSSILS IN ESSEX.

IN March last, some workmen, in digging earth for bricks in a field at Ilford, in Essex, came upon some bones of a mammoth, of an enormous rhinoceros, and the head of an extinct *bos*, allied to the bison of America; bones of the horse, deer, &c., were also found.

They were in the brick-earth of the Pliocene beds, a little above the sand, the underlying stratum, and about 14 feet below the general level, which is that of the valley of the Thames. The mammoth's tusk is extremely massive and unusually curved, being 4 feet 8 inches across the bow made by the bend, and 9 feet 2 inches in length at present, though both ends are considerably decayed. The animal was probably the *Elephas primigenius*, or else *E. meridionalis*, both American; and the ivory of the former is of great Siberian export. The lower jaw of the bos was destroyed, by time first, and the pick-axe on discovery, but the skull is otherwise perfect, and the splendid horns are entire. In excavating for sewers on the new London-road from central Essex and the Lea Bridge-road to the metropolis, the workmen have, at a depth of about 20 feet, dug into a bed of sea-sand, containing numerous shells, both univalves and bivalves of supposed extinct species, commingled with what appears to be drift wood in large pieces, now quite black, thus evidencing that at some period of our world's history the seashore reached to Upper Clapton.

VOLCANIC ERUPTIONS IN THE SPICE ISLANDS.

An official Report, sent to the Dutch Government from one of its settlements in the Spice Islands, describes two destructive Eruptions in the island of Sangir, north of Celebes, on the 2nd and 17th March, 1856. Several villages, and a great part of the crops, were destroyed by the lava, or the fragmentary matter ejected, or by the torrents of water which escaped from the sides of the volcano, and 2806 human beings fell victims. No change was observed on the summit of the mountain, but some portions of its sides on the coast had sunk in the sea and disappeared, and in consequence thereof a precipice 70 metres (230 feet) in height had replaced what was formerly a gentle declivity.—*Edinburgh New Philosophical Journal*, No. 13.

VOLCANIC ISLANDS—EARTHQUAKES IN CALIFORNIA.

An Academy of Sciences has been established in San Francisco; and among the first-fruits of its labours are the following important investigations:—

Dr. Trask has for some years kept a record of earthquakes in California and the adjacent countries, the frequency of which has created an absurd impression among the people that a volcano exists under California, and may one day swallow up the inhabitants. There were sixteen earthquakes in 1856, of which only three caused some alarm—in one case rending the ceilings of some houses, and in the others making people leap out of beds. One shock, of 15th February, was felt over an area of 63 miles by 153. But if the commotions of the ground were small in California, they were formidable further north. According to a report received by the Russian frigate *Dwina*, a volcano broke out on 22nd June, apparently in the Aleutian Isles, and the frigate, on the 25th, sailed through a sea covered with pumice. The latitude given is 50° 50′, and the longitude 158° 32′ east—we presume from St.

Petersburg—which indicates a position among or near the Aleutian Isles. The barque *Alice Fraser*, Captain Newell, brought accounts of a submarine volcano which appeared in latitude 54° 36′, and longitude 135° east. He stated that several whalers, in traversing the Strait of Ourinack on 26th July, saw the outbreak of the volcano, which threw up a column of water some hundred feet in height. Immediately afterwards, immense masses of lava were projected, and the sea, to an extent of some miles, was covered with floating masses of pumice. The ships *Enterprise*, *Scotland*, and *William Thompson*, which were nearer the eruption than the *Alice Fraser*, received some of the masses of lava and pumice, as well as ashes, upon their decks. The eruption was accompanied with earthquake shocks, and Captain Newell thinks that an immense bank or shoal arose in consequence of the submarine action. This is evidently a different volcano from that seen by the captain of the *Dwina*, but there is an error either in the latitude or longitude. The position alluded to is probably about the north end of the Kurile Isles or the south end of Kamtschatka, a region abounding in active and extinct volcanoes. The Aleutian Islands are of a similar constitution; and Sir C. Lyell informs us that a new island arose there in 1796, which still exists, and is some thousand feet in height, and two or three miles in circumference.—*Scotsman.*

ERUPTION OF VESUVIUS.

VESUVIUS has been an object of the greatest interest in the past year; and the establishment of an Observatory on the mountain enables the scientific authorities of Naples to watch and record its phenomena. The following details are from the Reports of Professor Palmieri:—

October 5.

I announced in my Report of the 14th of June of this year, the approaching appearance of lava on the N.N.E. side of the cone of Vesuvius, and it did not fail to show itself in reality on the 16th—that is to say, two days after I had predicted it. It continued to flow until the 24th, accumulating continually mass upon mass, without going beyond the base of the cone. After some time the fire began to decrease much, but the cone risen upon the mouth, formed on the 19th of December, 1855, continued to explode, throwing out the ordinary pieces of lava in a perfect state of fusion. From time to time, from the base of this little cone flowed a rivulet of fire, which cooled upon the summit of the mountain. From the 20th of this month the explosions were heard more loudly at the Observatory, in spite of the smoke not having at all augmented. On the 21st, the little cone, risen after the re-opening of the crater N.E. of that of 1850, bursting open on the side, gave out lava rather more copiously, and it began to pour itself over the slopes of the mountain towards the S.E., where it collected, hardening upon the scoria of the preceding lava. A second much more copious stream flowed from the base of the other little cone, and took the road of that of the 16th of June, and by the morning of the 22nd descended, smoking, in the same direction, and petrified on the 23rd, without having as yet arrived at the base of the great cone of Vesuvius. It did not happen thus with another branch of the same lava, which, melting in the great cavity, produced on the east side of the cone by clefts occasioned by the great eruption of 1850, arrived very soon at the lower plain of the Atrio del Cavallo, investing and surrounding in part one of the two cones always existing after the above-mentioned eruption. From this side it again descended this morning at eight o'clock, when I visited it. It appears that there is nothing to fear, at least whilst the eruption confines itself within the limits which have bounded it from the first. In the smoke-holes dispersed over the summits of Vesuvius, all the gradations of volcanic activity may be often observed, and are distinguishable not only by the temperature, but also by the nature and character of the solid and aeriform matter to which they owe their origin. Therefore, the old mouth of which I speak is a kind of solfatara; by excavating there at a little depth we find sulphur in small bright crystals sublimated upon the old scoria, more or less changed by the action of the acids. The lava of the 16th of June covered all this space, but when it hardened and somewhat cooled the sulphur re-appeared more copiously, and splendidly adorning and beautifying the new scoria; both were crystallized and were fused. In the night of the 21st and 22nd fresh lava destroyed these magnificent sublimations, which would have figured well in collections of Vesuvian productions; but perhaps they will re-appear. The apertures for the smoke towards the southern side of the cone have acquired greater activity during this month. Those of the recent lava are still rich in alkaline chlorures, amongst which marine salt predominates, and these chlorures are very often seen mixed with oxidized copper; the usual colourings proceed from chloride of iron, copper, &c., and are only seen inside the little cones and in the interior of the craters. In my last Report I said that the lava of the 16th of June might have covered the gulf of the 14th of December, 1854, which was the signal of the great eruption of 1855; but in the beginning of this month it opened afresh, in so singular a manner as to merit all the attention of the geologist. It remained thus on the 9th of this month, on which day I visited the mountain in the company of our distinguished young naturalist, Guilielmo Guiscardi. On the morning of the 22nd, I found it covered anew by the recent lava, freshly issuing from the crater of 1855. I sought the carbonic acid which, according to the illustrious French geologist, Charles de Ville, is found at the lowest degree of volcanic activity, and I did not find it on the summits of the mountain, but I found it in many smoke-holes of the lava of 1855, and in the fosse of Vetrana, where I found in some places a temperature of 360°.

October 16.

Vesuvius continues with unusual determination to throw up lava upon the cone and on the Atrio del Cavallo—repeating in a manner still more worthy of consideration the phases which preceded the memorable eruption of 1850. From the 25th to the 27th of the past month the lava descended the same precipice as in 1850. On the 28th it seemed as if about to cease, but the louder detonations from the mountains announced fresh torrents of lava, which, during the evening of the 1st of this month (October), appeared to be approaching the Observatory, menacing the new road which had just been opened under my direction by the guides of Vesuvius. The first torrent has ceased, however, without reaching the foot of the cone, but immediately after another copious stream of lava appeared, and, dividing into three or four branches, descended with such velocity that in twenty minutes it had already reached the Atrio, and there met the old lava of 1855. This lava sparkled with such unusual brightness that the rugged masses at the summit of the mountain seemed to be on fire. Towards ten o'clock the same evening all this brightness disappeared. Before dawn next day I went up to this lava, which I still found burning under the crust, but it was not of the same kind which had been thrown up before, viz., of the rugged contorted surface, of the colour of ebony, but of the sort which hardens in larger or smaller reddish fragments. It had numerous smoke-holes, which, in the preceding stream, had been very few. All these I found over the lower part of the stream, especially on the banks which the fiery torrent had itself formed. All the surface of the lava was sprinkled with a kind of delicate white flower. The smoke-holes had already in a few hours produced several sublimates, some of which were perfectly white, others ash-coloured, and others yellow, inclining to a dirty reddish tinge. The first experiments made on these sublimates present several peculiarities worthy of notice, which may be the objects of *special publication.* I ought to mention that all these smoke-holes produced through distillation an acid liquid; which facts do not confirm the doctrine of an illustrious living geologist. Up to the present time it is believed by several observers of Vesuvius, that salts of ammonia are never produced on the cone, but upon the lava which has run over cultivated ground,—but the first experiments I made on the lava of the 16th of July, gathered from the smoke-holes of several sublimates, prove the existence of ammoniacal mixtures. The Observatory renders the study and investigation of many facts possible, which might escape the notice of the most diligent observer. To return to the lava :—On the 3rd of this month it towards the eastern side of the cone, where it is still incessantly flowing but now without danger to the cultivated ground. The continued detonations of the mountain have at last enabled me to determine the distance existing in a direct line between the Observatory and the aperture of the 10th of December, which is almost in the centre of the lofty plain of the Vesuvian cone—this distance is 2720 metres. I have been able to determine the greatest velocity at which the smoke ascends, and find it is about 15 metres a minute: its issue is by an orifice a metre and a half in diameter, with the temperature of 1200°. With these facts any one may calculate how many pipes of water the larger of the two small cones s each day in steam, and what mechanical force that steam represents.—um, No. 1567.

EARTHQUAKE IN THE UNITED STATES.

FROM the *St. Louis Democrat* of Oct. 9th, we learn that the city of St. Louis and its neighbourhood, and the adjoining regions of Illinois, have been visited by a severe Earthquake. "In Illinois," says the account, "it was accompanied by a tempestuous sky and electrical phenomena of an unusual character: while with us it was preceded by freaks of electricity, variously described as vivid flashes of lightning, and as the descent of a blinding meteoric ball from the heavens. The interval between the two shocks, the first of which occurred at about a quarter past four o'clock, was one of a painful suspense to such as had aroused themselves to a full consciousness of the nature of the danger, and who adverted to the fact that ordinarily, at least in the earthquakes of the tropics, the violence of the convulsions succeeding the first, of which there are commonly two, was that of a progress nearly equalling geometrical ratio. The stanchest houses swayed to and fro with an undulatory motion very much resembling that of a ship labouring under an angry sea, now seeming to stop still and bid defiance to the towering waves, and anon bounding forward quivering in every plank, and imparting to the voyager that ineffable sensation which is to the mind what sea-sickness is to the body. The rattling of windows, the displacement of furniture, the gleaming of lights from bedrooms which suddenly illuminated the pitchy darkness which prevailed; the wild terror of some, and the bewilderment of others whom the threatening phenomena had startled from their dreams, formed a scene more easily imagined than described. The second shock took place about five minutes after the first, but was of brief duration and inferior violence."

GREAT EARTHQUAKE AT NAPLES.

THE greater portion of the kingdom of Naples has been visited by one of the most destructive Earthquakes recorded for many years past. There was a slight shock on December 7, which had the effect of throwing down the cone of Vesuvius. Another phenomenon observed was the extraordinarily fine weather, approaching that of summer, which had prevailed for two or three months.

A Correspondent of the *Athenæum* writes from the city of Naples, that on December 16, at 10·10 P.M., while writing, his table seemed to be grasped by a powerful hand, and dragged violently backwards and forwards. The timbers of the room creaked like a ship in a heavy sea, and the very walls moved perceptibly. Two minutes had scarcely elapsed, when the "replica," or repetition, came, and the stones were shaken from the roof, and a bell in the house was rung continuously. In the streets of Naples, crowds of people rushed into the open squares—some of the persons in their night-dresses. The poor people rushed forth screaming and calling on the Madonna and Saints to protect them. At three and five o'clock, after midnight, two other shocks were repeated, and the panic was increased. As daylight came, it was evident that comparatively little damage had been done. A staircase here and there had fallen; very many houses had fissures opened in them; but no house had fallen, and no life had been lost. The Director of the Royal Astronomical Observatory reported that the base of the tower in which is fixed the equatorial machinery was cracked, and that two pendulum clocks in the direction of the shock, which was from S. to N., had stopped.

Naples had a great escape. The first shock lasted 5 sec., the second 25 sec. The Official Journal announced the news of the disaster in the provinces. In Campagna a house had fallen; in Castellamare some staircases gave way; in Sorrento, too, damage of the same kind was sustained; and in Capri a portion of the mountain had fallen. During the following night again a considerable number of persons slept in the open air, and the same scenes were to be witnessed as during the preceding night. One or two slight shocks of earthquake occurred, but the alarm was not great. The Journal of the 18th reported that at Sala three persons had been killed, and that the prison and the barracks had received considerable damage; that in Padua 100 houses had given way, and how many were killed was unknown; in Polla the disasters were immense; in Auletta, Petrosa, and Caggiona, many houses ruined, and many persons killed; in Salerno many houses were opened, amongst which two churches, the palace of the Préfet, and the barracks of the gendarmerie, had suffered the most; the belfry and the church of Saldina, close to Salerno, had given way, and two women had been killed. At Bari the people had been much alarmed, and had spent the night in the open air. In Ricigliano ten houses had fallen, two persons had been killed, whilst five or six had been dug out of the ruins. On the 19th two other shocks were felt in Salerno, and one in Naples. News came from Potenza, a city of 14,000 or 15,000 inhabitants, where not a house remained in a habitable state. Tito (a suburb of Potenza, possessing nearly 10,000 souls), Marsiconuovo, Haut-cuzana, and Brienza, were almost entirely destroyed; two-thirds of Vignola had perished. The ruin in Viggiano, Calvello, Anzi, and Abriola was awful. In Naples, at five and half-past six o'clock, P.M., on the 19th, we felt two other shocks. At midnight, another slight shock was felt, and on the 20th, at ten o'clock in the morning, we felt our tables heaving again beneath us. The greatest violence was confined to the provinces of Principato Citeriore and Basilicata. Up to the 18th, nineteen bodies had been dug out in Potenza, and the work was still going on. In Polla 300 had been dug out. Lagonegro felt three shocks, on the night of the 16th, in the course of seven hours; and the shocks continued there up to the 19th, and the whole population were in temporary barracks. In the commune of Carbone, twenty-one were killed and nineteen wounded. Castelsano was levelled nearly with the ground, and 400 persons killed. A similar disaster befel Sarconi, where thirty persons had perished. In Chiria Rapalo equal damage was inflicted on the houses, and four persons perished. Naratra was partly destroyed. In other communes of Lagonegro, as Maratea, Lauria, Castelluccia, Rotonda, Vigianello, Sant' Arcangelo Calvera, San Martino, Castronuovo and Senise, most of the houses and especially the churches suffered.

The same correspondent's next letter, December 29th, describes Vesuvius, on the night of the 16th, to have sent forth only a small lambent flame, instead of the gorgeous body of fire which had shot up for the previous three months. On the 16th, at the base of the cone in the new crater, a round hole was opened in the direction of Torre del Greca, and from this were discharged red-hot stones, and next day an immense volume of smoke. On the 22nd there were a cannonade of stones and smoke, and constant rumblings; and by the 29th the above hole was closed, and two apertures were opened in the summit, one sending forth stones, and the other smoke.

From the observations of many persons, the earthquake seems to have been undulatory, vertical and gyratory, thus combining all the worst features of this tremendous phenomenon. The Journal of December 28th states 3656 persons to have been dug out; and 100 towns and villages, from first to last, suffered.

From a subsequent letter, dated January 4th, we gather that on December 16th, in the territory of Beda, the earthquake levelled the neighbouring hills, rolled the earth over and over, and formed deep valleys; half an hour before the shock, a light like that of the moon, and a fetid exhalation like that of sulphur, were perceived. The township of Polla (7000 souls) was half laid in ruins. On the 26th, the little town of Sasso had its main street separated asunder, and so it remains with a fissure through its entire length. On the 28th and 29th, both in Sala and Potenza, strong shocks were felt; and in Naples, from December 16th to January 4th, there are stated to have been 84 shocks. Four places have been almost entirely swallowed up. Of Pertosa only six houses remained, and 1000 persons fell victims; and between Pertosa and Polla, the road had been carried off 200 feet distant, and the mountain above it cleft in two. On January 1st, three shocks of earthquake were also felt; and on January 4th, the official documents returned upwards of 30,000 persons as dead, and 250,000 living in the open air. Three photographic views of the destruction of Polla and its neighbourhood were engraved in the *Illustrated London News*, January 16, 1858.

Astronomical and Meteorological Phenomena.

THE ROYAL OBSERVATORY.

On Saturday, June 6, 1857, the Annual Visitation of this great national establishment took place, on which occasion the Astronomer-Royal presented his Report to the Board of Visitors on the condition of the Observatory, and its history during the past year. This document contains, as usual, several interesting features in connexion with the progress of Astronomy.

The Instruments, with a few trifling exceptions, are in the same condition as they were last year. The new S.E. Equatorial, which promises to be one of the finest instruments ever made, is now nearly completed. Messrs. Merz, of Munich, have not, however, yet succeeded in making an object-glass to their satisfaction.

The Meridional system of Astronomical Observations, for which the Greenwich Observatory is so deservedly celebrated, is rigidly preserved. Each star of a large clock-star catalogue is observed, if possible, twenty times in three years; some stars are observed for refraction; some as having been compared with the Moon; some on suspicion of proper motion, &c. The Moon is observed at every opportunity without exception. The Sun and Planets are observed at every opportunity, except on Sundays, and when they pass later than 15^{h} in the morning, in which state the large planets only are observed, and only when the moon also is to be observed. The transits have been observed almost entirely by the chronographic method, except for the close circumpolar stars.

The whole number of Meridional Observations from 1856, May 19, to 1857, May 23, is as follows:—In the Department of Transits: Observations of Transits (reckoning two limbs, or two methods of observation by ear and by touch, as two observations), 4169; Observations of Collimator, by the Telescope of the Transit-Circle, 311 pairs; Observations of Transit-wires by Reflexion, 310; Observations of one Collimator by the other, 52. In the Department of Zenith Distances (reckoning two limbs, or a combination of Direct Observation with Reflexion Observation, as two observations, and including the observations of the wire by Reflexion), Circle Observations of all kinds, 3663.

A curious fact has been noticed with respect the Azimuth of the Transit-Circle and the Azimuth of its Collimator. Mr. Airy observes:—"There is a well-marked annual periodical change in the position of the Transit-Circle, the southerly movement of the eastern pivot having its minimum value in September, and its maximum in March, the extreme range being about 14 seconds; and there is a similar change, but of smaller amount, in the position of the Collimator. I cannot conjecture any cause for these changes, except in the motion of the ground. There is a very frequent change of still smaller amount in the Azimuth of the Transit-Circle, accompanied by a nearly equal change in the apparent Azimuth of the Collimator, so that from day to day the Transit-Circle and Collimator preserve their relative position unaltered; these I conceive to be the effects of accident in observation of the circumpolar stars, arising either from fault of the observer, or from irregularities either in the level or in the collimation; at the same time, viewing the great accuracy of the observations of circumpolar stars, and the extreme simplicity of the pivot-supports and of the instrument-frame, I cannot conjecture how such irregularities can arise."

During the past winter Mr. Airy received intimation from Professor Hansteen that the dip, as determined at Greenwich, appeared to have become greater than was consistent with the changes of dip going on in the north of Europe. A similar discordance was found to exist between Greenwich and Kew. This led Mr. Airy to examine the Royal Observatory instrument, and it was found so imperfect in its mechanical construction, that when the needle was lifted up from its agate bearings its upper point almost always struck the brass circle. These defects have been amended, and the apparent dip is diminished by nearly the quantity which Professor Hansteen conjectured. Mr. Airy regrets that this irregularity unfortunately causes the dip-observations at Greenwich for several years past to possess very little value.

The Magnetical and Meteorological Observations continue to be made on the system of self-registration, commencing with August 25, 1856; the thermometers in the magnet-boxes have been read at twenty-four consecutive hours once in every week, with the view of obtaining bases for complete reduction of the observations. Mr. Airy contemplates, as soon as he shall have some computers liberated from the lunar reductions, to take in hand the further reduction of the magnetic observations.

Under the head of Chronometers, Communications of Time, and Operations for Longitude, Mr. Airy makes the following observations:—

"The number of chronometers in the chronometer-room is sixty-eight. All are compared with the Mean Solar Clock, which is sympathetic with the Corrected Motor Clock of the Galvanic System: some every day, others once in the week. The chronometers on trial for purchase have, for several years past, been sometimes exposed to extreme temperatures; and lately I have determined to extend this system in a lower degree to the Admiralty chronometers, subjecting all in turns to artificial heat as high as 80° Fahrenheit. The Observatory takes charge of the valuation of chronometers to be purchased by the Government, and of the receipts, repairs, and issues of chronometers belonging to the Government. The Motor Clock of the galvanic sympathetic system is adjusted every day, after comparison, by means of an auxiliary pendulum, which is put in mechanical connexion for a time with the clock pendulum, and by which the rate of the clock is either accelerated or retarded by $\frac{1}{10}$ of its whole value as long as the two pendulums are united. By this clock our own sympathetic connexion is maintained, and time-signals are sent to other places. I am desirous of introducing the system of galvanic connexion for clocks of small dimensions; a system which would frequently be very convenient. The number of failures of the Time Signal Ball at Deal, dropped by galvanic current from the Royal Observatory, in the course of one year has been nineteen. When it is considered that four connexions must be made on the line before it is fit to receive our current, and that then there must be four contacts at Greenwich and one at Deal, this number of failures will appear very small. Other time signal balls are dropped by currents issued at the same time, at the Strand, Cornhill, and Liverpool; but though I am happy to supply with regularity the currents required for these purposes, I do not hold myself responsible for their success. I have verified experimentally the perfect practicability of dropping a ball at Devonport by a current from Greenwich."

The value of these galvanic clock communications is very great; the clock in the Lombard-street Post-office is adjusted and regulated by the apparatus with the greatest regularity. Besides this, sympathetic movements are maintained with other clocks, and hourly signals sent through the wires of various railways by which time balls are dropped at the Strand, Cornhill, Liverpool, and Deal. The communication with the Post-office clock is remarkable. At 23h. 26m. 0s. of that clock a signal is given to Greenwich, the comparison of which with the Royal Observatory's clock acquaints the Observatory with the error of the Post-office clock. At 0h. 0m. 0s. of the Greenwich clock a signal is sent from Greenwich, which mechanically adjusts the Post-office clock. At 0h. 26m. 0s. of the Post-office clock a second signal is given to Greenwich, by which the efficiency of the adjustment is shown. The system answers so well that it is purposed to extend this system to other clocks.

The Astronomer-Royal concludes his Report by expressing his entire satisfaction with the zeal of the assistants and observers placed under him. The duties of the Observatory have been so well performed that the ordinary astronomical reductions are now more completely brought up to a level with the observations than at any period within Mr. Airy's recollection. At the same time the Astronomer-Royal wishes to see improvements in the education of his assistants, which would at once be creditable to the establishment which he directs, and beneficial to science.—*Athenæum*, No. 1546.

SPOTS ON THE SUN.

THE Astronomical Society have presented their Medal to M. Heinrich Schwabe, of Dessau, who has made daily observations of this phenomenon for a period of thirty years; and the President's address on the occasion of presenting the medal offers in itself an interesting reply to the queries of our astronomical correspondents. The result of M. Schwabe's investigations has been to establish, with a degree of probability almost amounting to certainty, that the Solar Spots pass through the phases of maximum and minimum frequency, and *vice versâ*, through a period not very different from ten years; but that during the last three years the results have shown symptoms of disturbance.

M. Schwabe's merits are in no way affected, though, no doubt, the value of his discovery is enhanced by this remarkable episode. No longer is its scope confined to the disclosure of a physical peculiarity in the constitution of the Sun. It promises to be the means of revealing the prevalence of a principle, throughout the solar system, co-extensive with gravitation, and of establishing another link in the chain of analogies binding earth with other worlds, the ultimate effect of which on the progress of physical research no one can foresee.

THE AUGUST METEORS.

M. Coulvier Gravier, the zealous observer of these Meteors, gives the following Report for the month, from 13th July to 13th August, in the past year. The figures show the *mean hourly number* of falling stars at midnight:—

July 13	8·5	August 4 to 5	20·2
" 18 to 19	6·9	" 7	26·2
" 22 to 23	11·8	" 9, 10, 11 . . .	44
" 27 to 28	20·4	" 12	40
" 31	17·2	" 13	26·5

It will be seen that there is a pretty regular increase from the 22nd July to the 10th August, where the maximum occurs as usual. In another table, he gives the mean hourly fall for twelve years (1846-1857), from 20th June to 31st August, by averages for each three days. From this second table it appears that the number of meteors is pretty uniform from 20th June to 20th July, varying from 5 to 9; from 23rd July it increases pretty regularly to 7th August, when it reaches 27·8; at the 10th August it leaps up to 69·9; on the 13th it is 31·2, and then falls gradually to 10·7 on the 31st. The present maximum is thus beneath the average, and M. Gravier concludes, as he did last year, that the number of the August meteors is gradually diminishing. Sir John Herschel observes that the August meteors, though less brilliant than those of November, are more certain, as the latter sometimes disappear for some years. M. Leverrier announced lately that the observations made under his direction on a former occasion to discover the *height* of the meteors, would be repeated this year, and that the stations chosen for observers were Paris, Melun, and Rambouillet, forming a nearly equilateral triangle with a side of 48 kilometres (30 miles). If a fire-ball, or remarkable falling star, capable of being distinguished from the others, is observed from these three stations, and its angle with the horizon at each taken, its height can be found by calculation.—*Scotsman.*

Mr. T. Forster, the well-known astronomical observer, at Ostend, witnessed the Meteors on August 12 as of very unusual forms and colours. From a good position above the sea he watched them great part of the night. Many hundreds fell in various directions, but particularly towards S.W. and W., not N.W. as usual. They did not in general move fast, and leave the white trains behind them, as is usual, but descended slowly with a bright yellow flame; others were splendidly crimson, and some bright-blue and purple. This fact is very curious, as favouring the hypothesis of ignited gases adopted by M. De Luc of Geneva. During the whole of August, meteors were numerous all along the Rhine and in Germany. Such numbers had not fallen since the 10th August, 1811, nor have we any record of such a quantity as on the present occasion, extending over four days consecutively, and exhibiting such very brilliant and diversified tints of light.

Collaterally with these meteors the following phenomena should be noticed, proving the highly electric state of the air. In the storm which raged in Holland on the 5th July, the hailstones were larger than pigeons' eggs, and broke nearly all the windows in Arnheim. The same occurred at Spa on the 5th of August, when every pane of glass exposed to the hail was beaten to pieces. All the electrical instruments indicated a high positive charge. A *trombe* or water-spout was witnessed by Mr. Forster in the distance on the 11th.

TWINKLING OF THE STARS.

A CORRESPONDENT (M. F.) in the *Philosophical Magazine*, No. 86, writes:—"The stars twinkled much at Brighton on the evening of the 16th of March. Sirius and Aldebaran were in sight; and on passing the axis of the eyes across them so as to produce a changing place for their image on the retina, it was seen that the difference due to twinkling was so great as at certain moments to cause the apparent extinction of the stars. A mirror was therefore held in the hands so as to send a reflected image of the selected star to the eye, and then the mirror was moved in such a manner as to throw the image of the star in a line or circle, which could easily be done. Upon examining the brightness of the star image at the moment when it was reflected from different parts of the moving mirror, the light was seen to differ enormously, and very frequently, indeed, to be replaced entirely by darkness. In fact, the successive phases of the star, which, being seen in one direction, gave a continual but wavering light, were now separated into their luminous and their absolutely dark conditions; and thus the effect of twinklings was made far more manifest than by the ordinary mode of observation. The apparent extinctions were not for long together; but they often cut up a circular path of light of about 10 degrees angular space into six, seven, or eight parts, separated by short dark intervals without sensible light."

STARS ON THE DISK OF THE MOON.

MR. HIPPESLEY, of Stow Easton, near Bath, has related to the Astronomical Society an experiment which he lately performed for his own satisfaction, illustrative of the projection of Stars on the Disk of the Moon. He formed an artificial star with a candle placed at a distance of about 185 yards, and an artificial moon with a disk of card attached to a rod applied to the end of his telescope. Illuminating his artificial moon, he was able to make the relative brightnesses of the artificial moon and star nearly in the proportion of nature, and to make the appulse as gradual as he pleased. He thus had an opportunity, he says, of witnessing the overlapping of the two images at leisure, and of convincing himself of the sufficiency of optical considerations for the explanation of what he saw.

INTENSE COLD IN THE NEW WORLD.

THE American Continent and the Antilles were visited by Intense Cold in January, 1857. At Lynchburg, on the 10th, the thermometer was down to 11° above zero. At Savannah it indicated 18° above, and in Florida 21° above, being the coldest weather ever known in that region. Ice formed two inches in thickness. In Havana, a severe frost did considerable injury to crops—a phenomenon almost unknown in that latitude. In all the western rivers steamers were frozen up. The great lakes were covered with firm ice, extending many miles from shore. In the North-western States, the severity of the weather was almost unprecedented, and men and animals perished in great numbers. Accounts from Iowa, written in the first week of January, state that the roads were impassable. Sleds, merchandise, and property were abandoned to the storms. Many men and cattle were frozen to death in the highways. A party of Government surveyors took shelter from a snow-storm in a ravine, which seemed a prairie. They pitched their tent upon three feet of snow, rigged a stove whose pipe ran up through the top of the tent, ate, and went to sleep. A difficulty of breathing aroused the party early, and it was discovered that the ravine had drifted chock full of snow, and that it was then three feet above the top of the tent and the top of the pipe. Out of the entire surveying company, of which they were a part, two men froze to death, two waded the prairie snows in their stockings, unable to draw on their stiff boots, and all were disabled, permanently or temporarily, by the freezing of the extremities.

The mouth of the East River, in New York, was blocked up on 12th of January by a field of ice fifteen acres in extent, through which nothing could pass.

THE GREAT COMET OF 1556.

CONSIDERABLE interest has been excited in the past year, by the expected re-appearance in June last of this Great Comet, which a German astronomer not only foretold, but that on the 13th of June it would destroy the world! To meet this alarm, Mr. Hind, the astronomer, published a small work, wherein he disposes of the probability of near approach and collision.*

The Comet did not re-appear; but, by turning to M. Arago's *Popular Astronomy*, "we easily identify the expected visitant with the great comets of A.D. 1264 and A.D. 1556. We learn that it is one of those comets that are visible to the naked eye, and that it has a period of about 292 years. Its numbers in the catalogue are 17 and 30. We see at a glance, by a comparison of the recorded elements, why it is that these have been pronounced to be appearances of

* *The Comet of 1556; being Popular Replies to Every-day Questions, referring to its anticipated Re-appearance.* By John Russell Hind. J. W. Parker and Son.

The reading of the barometer was above its average value in February, May, June, July, August, October, November, and December, 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 29·880 inches, being somewhat above the average value.

The mean temperature of the air in January was in excess of the average value of 86 years by ¾°; February, by 1°; March, by 1°; April, the average value; May, in excess 1½°; June, by 3¾°; July, by 3°; August, by 6°; September, by 3°; October, by 3½°; November, by 3¼°; and December, by ¾°; according to Mr. Glaisher's determination of the mean temperature of each month.

The mean temperature of the air for the year was 51°·1; that of evaporation was 48°·2; and that of the dew-point was 45°·7. The mean degree of humidity was 83, complete saturation being represented by 100. Rain fell on 126 days; the amount collected was 21·5 inches.

Till January the 4th the weather was very mild, and the mean daily excess of temperature was 7¾°; from the 5th to the 8th the amount of defect was 8¼° when a milder period commenced, and to the 20th the mean daily amount of excess was 2½°; and to the end of the month it was in defect to the mean daily amount of 5¼°. February was warm, being from the 6th to the 24th 3¼° in excess; on the 25th and 26th, 8¼° in defect; and for the rest of the month, 3° in excess. March was 3° in excess to the 7th; from the 8th to the 13th, 4¾° in defect; from the 14th to the 20th, 5° in excess; from the 21st to the 27th, 4° in defect; and for the rest of the month, 4¼° in excess. April, till the 10th day, was hot, the temperature being 5¼° in excess; from the 11th to the 16th it was cold, being 6° in defect; it was again hot from the 17th to the 21st, being 5¾° in excess; and then again cold to the end of the month, being 6° in defect, with snow falling every day. The temperature for this month was about 1° below that of the average of the preceding 16 years. May was cold till the 10th, being 6° in defect, and warm for the remainder of the month, rising to summer temperature in the middle of the month. June was warm till the 8th; cold from the 9th to the 18th; and hot from the 19th; on the 28th, the temperature near the sea rose to 75°; in London, to 83°; and at other places it was somewhat below 90°. This day was the hottest we have experienced since 1846 (July 6th); and it was also remarkable for the small amount of water in the air in the invisible shape of vapour, the temperature of the dew-point being fully 35° below that of the air at times during the day. July, the mean high day temperature was 78°, being 4¾° above the average; the low night temperature was 51½°, exceeding its average by 1°. The mean temperature of the month was 3° nearly in excess. August was warm throughout nearly, the mean temperature being 5° in excess nearly. Since the year 1771, there has been no instance of so high mean temperature—viz., 65°·8—in August as in this year. September was also warm nearly throughout, the temperature being about 3° in excess. October was warm; the temperature was 3¼° in excess. November was 2½° above the average. December was remarkably warm throughout, particularly in the few days preceding and including Christmas Day; the temperature of the month was 5° nearly in excess. In the year 1806, and again in 1852, the month of December was somewhat warmer than in this year; but there are no other instances since 1771 of the month of December being so warm as the one just passed, according to the results obtained by Mr. Glaisher.

The temperature of the year 1857 was about 2¼° above the average of 86 years. The highest temperature in the year was 92°·7 in June; the lowest was 20° in both January and February; the range of temperature in the year was therefore 72¾°. The greatest range in one month occurred in June, and was 54° degrees nearly. The average monthly range of temperature was 38½°, and the average daily range was 17°. The average weight of a cubic foot of air, at the level of the sea, was 555 grains in January, 527 grains in August, and the mean for the year was 543 grains.

During the year two remarkably heavy falls of rain occurred. On the 7th of August a storm commenced at Scarborough, which resulted in a serious destruction of property; and by the end of the storm, rain was measured to the depth of 9 inches. So heavy a storm has not been known before in the town by the oldest inhabitant. The other storm took place on the 22nd of October, and fell with greatest violence over London and the counties round about. The fall over London was about 2¾ inches, and at Royston reached the amount of 3 inches.

Obituary.

LIST OF PERSONS EMINENT IN SCIENCE AND ART. 1857.

ANDREW URE, M.D., the chemist, well known by his *Dictionary of Chemistry*, *System of Geology*, and *Dictionary of Arts, Manufactures, and Mines*.

JOHN BRITTON, who, by his industry, talent, and integrity, raised himself from humble life to an eminent position among antiquaries and topographers.

The EARL OF ELLESMERE, "in whom the man of letters, the artist, the explorer, the scientific investigator, have each to mourn a friend."—*Athenæum*.

ELISHA KENT KANE, M.D., the intrepid (American) Arctic navigator.

The REV. THOMAS DEX HINCKS, LL.D., Professor of Hebrew and Oriental Languages in the Royal Belfast Academy.

M. DUFRENOY, the eminent mineralogist, who was associated with M. Elie Beaumont in the management of the French Government mines, and in the execution of the geological map of France.

DR. ROBERT BALL, of Dublin, an esteemed naturalist.

JOHN MACGREGOR, author of several statistical works.

PROFESSOR KARL AUGUST HAHN, of the University of Vienna, one of the greatest old German scholars belonging to the school of the Grimms.

FREDERIC SCOT ARCHER, the inventor of the Collodion Process in Photography.

M. CAVERY, the celebrated mathematician.

BARON LOUIS JACQUES THENARD, Member of the French Institute, and distinguished chemist.

MORITZ RETZSCH, German painter.

JEAN PIERRE DE BERANGER, the great French poet.

LIEUTENANT HOLMAN, R.N., "the blind traveller."

DR. THOMAS DICK, author of *Celestial Scenery*, &c.

BISHOP BLOMFIELD, the eminent Greek scholar.

CHARLES LUCIEN BONAPARTE, Prince of Canino, the accomplished ornithologist.

The VERY REV. DEAN CONYBEARE, one of the distinguished geologists of his time. Soon after leaving college, he turned his attention to Geology, then an infant science. One of his first acts was, from some very imperfect remains, to infer the characteristics of an unknown reptile, called by him a "Plesiosaurus." This speculation brought down upon him the sneers of Sir Everard Home, the great authority for comparative anatomy, at that time, in England; but the discovery shortly afterwards of a perfect skeleton proved Mr. Conybeare's sagacity to have been equal to his boldness, and placed him at once in the highest rank of English geologists. In consequence, Cuvier, to whom he was personally unknown, recommended him as Corresponding Member of the Institute of France—an honour never lightly conferred, but which he amply justified by the production, in conjunction with Phillips, of his *Outlines of Geology*; afterwards, in conjunction with Dr. Buckland, of a very able paper upon the "Geology of the Bristol and South Welsh Coal Fields."

ELIZABETH PHILPOT, the skilful geologist, of Lyme, and companion of Mary

ETIENNE QUATREMERE, the Oriental scholar.

RICHARD TWINING, one of the oldest Fellows of the Royal Society.

THOMAS CRAWFORD, the sculptor, of New York. "His later works are a bronze statue of Beethoven, in the Athenæum at Boston; an equestrian figure of Washington, standing on a plinth, with medallions of his principal generals in the Square of Richmond, Virginia, and the pediment for the Capitol at Washington."—*Athenæum*.

REAR-ADMIRAL SIR FRANCIS BEAUFORT, formerly Hydrographer to the Admiralty, and a distinguished traveller.

CHRISTIAN RAUCH, the German sculptor: he had just completed his model for an equestrian statue of Frederick the Great.

DR. JOHN FLEMING, the distinguished Professor of Natural Science in the Free Church College, Edinburgh. His *History of British Animals*, and *Philosophy of Zoology*, though written thirty years ago, are still standard books. He was, besides, the author of a great variety of papers and treatises in the *Encyclopædia Britannica*, the *Edinburgh Philosophical Journal*, &c.

ALCIDE D'ORBIGNY, author of the *Paleontologie Française*, and various other works of merit connected with Natural History.

WILLIAM HENRY PLAYFAIR, architect, of Edinburgh.

JOHN MITCHELL KEMBLE, Saxon scholar.

JOHN TOWERS, writer on Agriculture.

A. L. CAUCHY, French mathematician.

DR. MARSHALL HALL, Physician.

THOMAS UWINS, R.A., Painter.

AUGUSTE COMTE, French mathematician.

The REV. W. SMITH, Professor of Natural History, Cork.

The REV. WILLIAM SCORESBY, the venerable Arctic explorer. His health was greatly impaired by the fatigues of his voyage to Australia, in 1856, in the iron steamer *Royal Charter*, to add his own personal experience to the views held by him on the Magnetism of Iron Ships. (The result was given in the *Year-Book of Facts*, 1857, pp. 117—121.) He never recovered from the exhausting effects of this great scientific labour for a frame approaching 70 years of age. Upon one occasion during the voyage, while a violent cyclone was raging, he is stated to have ascended the mizen rigging, in order to judge of the height of the waves, which were then running, as he calculated, 30 feet high. Upon his return to England, in shattered health, he retired to Torquay, and commenced preparing the results of his investigations for publication, amidst which he died in May last, and was buried in the church at Torquay, where a marble tablet has been erected by subscription, in testimony of this excellent philosopher's eminent services to science and his species. "Few men have been more thoroughly loved and respected. His life was consistently and successfully devoted to the good of his kind, in directions requiring most various, and in some cases uncommon, talents. The emigrant, merchant, shipowner, and underwriter, all owe no slight debt of gratitude and respect to the memory of Dr. Scoresby."—*Liverpool Mercury*.

GENERAL INDEX.

ADDENDA.

ON THE CONSERVATION OF FORCE.—On Feb. 27, Professor Faraday delivered, at the Royal Institution, an exposition of the principle of the Conservation of Force, based upon the conclusion that all the varied forces of nature are but modifications of one general force. The subject cannot be conveyed in an abstract; and the reader is referred to Dr. Faraday's own report of the lecture in the *Mechanics' Magazine*, March 28, 1857.

SOUTH KENSINGTON MUSEUM.—The offices, schools, and museum of the Science and Art Department have been removed from Marlborough House to South Kensington, where the average monthly number of attendants has been upwards of 44,000.

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