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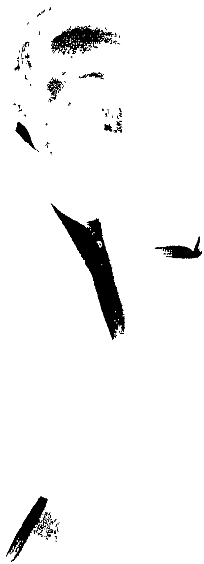

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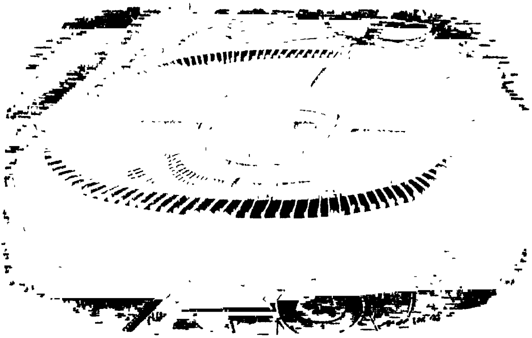

The Paris Universal Exhibition Building.—(See p. 15.)

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PROFESSOR WHEATSTONE, F.R.S.

(*With a Portrait.*)

[The present volume is the Fortieth Annual Collection of Facts in Science and Art which its Editor has had the gratification of presenting to the reading public. He commenced his labour of love by the publication of the *Arcana of Science and Art*, in 1828; this series extended to the year 1838—11 volumes. In 1839, he commenced a new series, entitled the *Year-Book of Facts*, in which the design was extended, and carried out with closer attention to matters of detail: the result was a twofold increase of sale. With the publication now before the reader, the *Year-book* extends to 29 volumes, making—with the *Arcana of Science and Art*, 11 volumes—40 volumes, each of which has been produced by the Editor almost on the same day in each year. The retrospect is suggestive of anything but thankless feeling, in this brief note of forty years' work; while the Editor is fortunate in having to commemorate, as the leading accomplished fact of the past year, the Atlantic Telegraph. Of the scientific labours of its originator the following is an outline.]

Charles Wheatstone, Professor of Experimental Philosophy in King's College, London, was born at Gloucester, in 1802. In early life he was engaged in the manufacture of musical instruments, which led him to the study of the Laws of Sound. The results of some of his researches he presented to the Royal Society, in 1833, in a paper "On Acoustic Figures;" and he brought forward at the Royal Institution various new experiments in this branch of science, an account of which will be found principally in the *Quarterly Journal of Science.*

Mr. Wheatstone was next led to investigate the sciences of Light and Electricity; and in 1834, communicated to the Royal Society his "Experiments to Measure the Velocity of Electricity and the Duration of the Electric Light." In this year he received the appointment of Professor of Experimental Philosophy in King's College. In 1838, Professor Wheatstone submitted to the British Association his Stereoscope, the instrument contrived by him for illustrating the phenomena of binocular vision. Sir David Brewster considered this communication to be one of the most valuable optical papers presented to the Association; and Sir John Herschel characterised Mr. Wheatstone's discovery as one of the most curious and beautiful, for its simplicity, in the whole range of experimental optics. It is described and illustrated in the *Philosophical Transactions*, 1838, part I.

In 1843, Sir David Brewster published a memoir in the *Transactions of the Royal Society of Edinburgh*, in which, while dissenting from some of Mr. Wheatstone's conclusions, he said: "In prosecuting this subject, my attention has been particularly fixed upon the interesting paper of my distinguished friend, Mr. Wheatstone, 'On some remarkable and hitherto unobserved Phenomena of Binocular Vision.' It is impossible to over-estimate the importance of this paper, or to admire too highly the value and beauty of the leading discovery which it describes—namely, the perception of an object of three dimensions by the union of two dissimilar pictures formed on the retinæ." Subsequently, in the *North British Review* (No. 33), he attacked the originality of Mr. Wheatstone's discoveries; but he still admitted that "Mr. Wheatstone has the merit of having been the first to exhibit practically, by combining the pictures of objects as seen with each eye, by means of an apparatus consisting of two plane mirrors, at an angle of 90°, in which the eyes of the observer see, by reflection, the superimposed images of the two plane representations of the object."

We now pass on to the invention through which Professor Wheatstone has acquired his high reputation, by bringing out that most remarkable invention, the Electric Telegraph. In 1819, Oersted made his grand discovery of the deflection, by a current of electricity, of a magnetic needle at right angles to such current. Dr. Hamel, of St. Petersburg, states that Baron Schilling was the first to apply Oersted's discovery to telegraphy. In 1836, Professor Muncke, of Heidelberg, who had inspected Schilling's telegraphic apparatus, explained the same to William Fothergill Cooke, who, in the following year, returned to England, and subsequently, with Professor Wheatstone, laboured simultaneously for the introduction of the electro-magnetic telegraph upon the English railways; the first patent for which was taken out, in the joint names of these two gentlemen, in the year 1837, and laid on the London and Blackwall Railway. The wires employed were of copper, inclosed in an iron tube, each wire being separated from its neighbour by some non-conducting material.

Meanwhile, a misunderstanding had arisen respecting the relative positions of Messrs. Cooke and Wheatstone in connection with the invention; when Sir M. Isambard Brunel, engineer of the Thames Tunnel, and Professor Daniell, of King's College, signed a document, stating that:—

"Whilst Mr. Cooke is entitled to stand alone, as the gentleman to whom this country is indebted for having practically introduced and carried out the Electric Telegraph as a useful undertaking promising to be a work of national importance; Professor Wheatstone is acknowledged as the scientific man whose profound and successful researches had already prepared the public to receive it as a project capable of practical application; it is to the united labours of two gentlemen so well qualified for mutual assistance, that we must attribute the rapid progress which this important invention has made during the five years since they have been associated."

This document is dated 27th April, 1841, and is acknowledged by Messrs. Cooke and Wheatstone to be correct. But the above document refers only to the first patent in which Mr. Wheatstone was associated with Mr. Cooke, and it forms only a very small portion of the many investigations connected with the Electric Telegraph: these have been mostly carried out by Mr. Wheatstone, independently of Mr. Cooke, and even the document in question has been misinterpreted, as will be seen by the following letter from Professor Daniell, and extract from his work, both written since the above document:—

"King's College, London, May 24, 1843.

"My dear Wheatstone,—In reply to your note of yesterday, I beg to state that I have a perfect recollection of all the circumstances under which the 'Statement of facts' regarding the Electro-Telegraph was agreed to, and signed by Sir M. Isambard Brunel and myself. You have, not quite correctly, called it an 'Award' of the arbitrators; for, strictly speaking, the arbitration was not proceeded with. The arbitrators, considering the pecuniary interests at stake, and the relative position of the parties in those respects, were of opinion that, without entering into the evidence of the originality of the inventions on either side, a statement of facts might be drawn up, of the principal of which there appeared to be no essential discrepancy in the statement of either party, which might amicably settle the unfortunate misunderstanding which had occurred. [As a preliminary step, certain printed statements, which were objected to, were withdrawn and destroyed.] This having been complied with, the "Statement" in question was agreed to, and signed both by the arbitrators and joint-patentees.

"This document makes no assertion whatever as to the originality of the inventions on either side, neither was it necessary or expedient that it should do so; for, whenever you and Mr. Cooke may think it advisable to publish the details of your several inventions, the scientific public will want no guide in forming their own opinion upon their resemblances, differences, and merits.

"Intimately acquainted as I am with the particulars and progress of your own undoubted inventions, I have no hesitation in expressing to you upon paper the opinion which I have always expressed to others, viz. that they are of incomparable beauty and simplicity, and by themselves sufficient to supply all the purposes of the most extended telegraphic communication. I will, moreover, repeat that which I have already published in my *Introduction to Chemical Philosophy*, viz. that your contrivances would have been of no avail for telegraphic purposes without the investigation which you were the first to make, of the laws of electro-magnets, when acted on through great lengths of wire.

"I remain, my dear Wheatstone,
"Ever faithfully yours,
"(Signed) J. F. DANIELL.

"To Professor Wheatstone, &c."

The following is the extract from Daniell's *Introduction*, referred to above:—

"But the applications which Professor Wheatstone has made of the almost instantaneous transmission of this wonderful power to unlimited distances to telegraphic purposes are far more perfect, ingenious, and practically useful than anything which has yet been contrived for the concentrated action of the force. Like the daguerreotype and the voltatype they have sprung from scientific principles at one leap to perfection. It is not difficult to foresee, that these modes of distant communication will rank, ere long, amongst the necessary conveniences of a highly civilised community. Professor Wheatstone, in conjunction with Mr. Cooke, has taken out patents for these valuable inventions, and under the superintendence of the latter gentleman a telegraphic line of fourteen miles has already been laid down upon the Great Western Railroad."

The following *précis* contains the leading facts relating to the invention of the Submarine Telegraph:—

A submarine electric telegraph was, from the commencement of Mr. Wheatstone's experiments, a prominent object in his thoughts. He has several letters, dated in the spring of 1837, from gentlemen acquainted with his plans, referring to this project. The first occasion on which any allusion to this subject appears in print is in the Fifth Railway Report of the Select Committee of the House of Commons. Mr. Wheatstone was examined before this Committee on February 6, 1840; and Sir J. Guest, who was previously acquainted with his plans, put the question, "Have you tried to pass the line through water?" to which he replied, "There would be no difficulty in doing so, but the experiment has not yet been made." The Chairman (Lord Seymour) then asked, "Could you communicate from Dover to Calais in that way?" His answer was, "I think it perfectly practicable." Shortly after this, having been furnished with the necessary hydrographic information by his friend Sir Francis Beaufort, and received much useful counsel from the late Captain Drew of the Trinity Board, Captain Washington, and other scientific naval friends, he prepared his detailed plans, which were exhibited and explained to a great number of visitors at King's College, among whom were the most eminent scientific men and public authorities. He also made the subject known in Brussels. In a notice of his new telegraphic instruments, by Professor Quetelet, published in the *Bulletin of the Académie Royale de Bruxelles* for October 7, 1840, it is stated,—"On sera sans doute charmé d'apprendre que l'auteur a trouvé le moyen de transmettre les signaux entre l'Angleterre et la Belgique, malgré l'obstacle de la mer. Son voyage se rattachait en partie à cette importante opération, qui mettrait l'Angleterre en rapport immédiat avec notre pays, la France, la Hollande, l'Allemagne, et même la Russie." And in *Le Fanal*, a Brussels paper of September 30, 1840, it is observed,—"M. Wheatstone pense qu'il est possible de communiquer avec son appareil entre Douvres et Calais; il répète en ce moment ses expériences à l'Observatoire de Bruxelles, en présence de plusieurs savans littérateurs."

Mr. Wheatstone's plans were also shown, in 1841, to some of the most distinguished scientific men in Paris, who came to see his experiments at the College de France.

In the agreement entered into by Mr. Cooke and himself in April, 1843, it was stipulated that certain limitations therein expressed "should not extend to prevent the said Charles Wheatstone from establishing electric telegraph communication between the coasts of England and France, which he is hereby expressly authorised to do if he shall so please, and for his own exclusive profit."

The agreement made with Mr. Cooke in October, 1845, by which he undertook that the Company to whom he was about to sell the patents should assist Mr. Wheatstone in carrying his project into effect, is as follows:—

"It is understood that Mr. Wheatstone will take the chair of a Committee of three, to take charge of the manufacture of the patent Telegraphic instruments, and the taking out and specifying future patents and matters of the like nature, at a salary of 700*l.* a year, and shall devote to such objects what time he shall think necessary. It is also understood that a patent shall be applied for immediately to secure Mr. Wheatstone's improvements in the mode of transmitting electricity across the water; that Mr. Wheatstone shall superintend the trial of his plans between Gosport and Portsmouth; and if these experiments prove successful, then in the practical application of the improvements to the purpose of establishing a telegraph between England and France; the terms on which such Telegraph is to be held being a matter of arrangement between the proprietors of the English and French patents. These terms are understood as a part of Mr. Cooke's plans for disposing of the patents to a company.

"(Signed) WILLIAM F. COOKE.
C. WHEATSTONE.

"1, Copthall Buildings, London,
3rd October, 1845."

The Abbé Moigno was in England in the spring of 1846, whilst Mr. Wheatstone's experiments were in preparation, and he published an account of what he had seen in *L'Epoque* of October in that year. This notice he afterwards reproduced in the first edition of his *Traité de Télégraphie Électrique* (Paris, 1849):—It states that in 1840 M. Quetelet had announced that Mr. Wheatstone had invented the means of transmitting signals between England and France, which he, the Abbé, had witnessed.

In consequence of Mr. Cooke's non-fulfilment of his engagement, and the proceedings of the Company referred to in the pamphlet, Mr. Wheatstone was obliged to relinquish an object which had been a cherished one with him for many years. . . . . His previous arrangements with Mr. Cooke precluded him from attempting to accomplish it through other channels. The result was, that for a time the subject was in abeyance; but five years afterwards it was taken up from Mr. Wheatstone's starting-point, and was successfully accomplished by the enterprise and skill of other parties, unconnected either with the Company or with himself."

Vice-Admiral Smyth, in his *Speculum Hartwellianum*, 1850, bears the following testimony to Professor Wheatstone's claim:—

"This gentleman, the most remarkable inventor of our day, has had much obfuscation to put up with. Though he is undoubtedly the first contriver of the Electric Telegraph in the form which made it available for popular use, yet shaky claims were cooked up in other quarters. His discovery of the elegant stereoscope was carped and nibbled at; and his Submarine Telegraph, of which he showed me plans, and publicly explained the details, upwards of eighteen years ago, has been all but smothered in other names; hence the Abbé Moigno, in his *Traité de Télégraphie Électrique*, pointedly says: 'M. Quetelet avait annoncé, dès 1840, que M. Wheatstone avait trouvé le moyen de transmettre les signaux entre l'Angleterre et la France malgré l'obstacle de la mer.' I am not aware of any cuckoo yet sitting upon his incomparably simple Polar Clock, though invasion may be looked for. Ma spetta un poco! Time is a great adjuster of these anomalies!"

Two papers by Mr. Wheatstone, on electrical subjects, ought to be recommended to the reader, namely, "Experiments to determine the Velocity of Electricity, and the Duration of Electric light (1834)" and "New Instruments and Processes for determining the Constants of a Voltaic Circuit (1843)."

M. A. De La Rive, in his *Treatise on Electricity*, 1858, writes:—

"The philosopher, who was the first to contribute, by his labours, as ingenious as they were persevering, in giving to Electric Telegraphy the practical character that it now possesses, is, without any doubt, Mr. Wheatstone. This illustrious philosopher was led to this beautiful result by the researches that he had made in 1834 upon the velocity of electricity,—researches in which he had employed insulated wires of several miles in length, and which had demonstrated to him the possibility of making voltaic and magneto-electric currents to pass through circuits of this length."

In the year 1854 an article appeared in the *Quarterly Review*, in which the sole merit of the invention of the Electric Telegraph was attributed to Professor Wheatstone. This paper provoked a rejoinder from Mr. Cooke, in the form of a pamphlet, a third edition of which came out in October last, in consequence of a larger amount of credit having recently been publicly accorded to Professor Wheatstone than Mr. Cooke deems him entitled to. A fourth edition has appeared, owing to Mr. Cooke having heard that Professor Wheatstone's friends assert that, on the sale of the patents to the Electric Telegraph Company, the Professor received less compensation than he was entitled to. The present edition therefore contains Mr. Cooke's answer to this imputation, which, it appears, had been made before.

In one of the many commemorations of the Laying of the Atlantic Cable in the past year, it was emphatically declared —"The credit of the original idea—that is, of the invention itself, belongs to Mr. Wheatstone." (*Times.*) This was followed by a letter from a Correspondent:—

"I rejoice in the ultimate reward of those who, at immense expense and risk, boldly but skilfully, and with careful and profound calculation, made every preparation which talent and skill could devise for the accomplishment of the important work. I rejoice also in the universal appreciation of this grand achievement, and in the desire to load with expressions of gratitude and approval all the parties by whose combined efforts the grand success has been attained, including those who contrived the plan and supplied the means of carrying it out. All hail to their honours! But how happens it, that, in the midst of this jubilee and triumph, the philosopher who invented telegraphic communication is left in the shade?

"I had the honour to be one of a small party who, many years ago, were admitted to Professor Wheatstone's laboratory, at the London University, to see his models and the operations he was at that time enabled to exhibit; on which occasion Mr. Wheatstone privately revealed and demonstrated his invention of telegraphic communication, and not only foretold but proved, to the amazement of all present, the wonders it would accomplish. Mr. Wheatstone had not the wealth necessary for carrying out his invention, but sold his patent to men of capital and ability. I need not dilate on the great things these gentlemen and their associates have accomplished. I may say they have astonished the world; but I cannot help thinking, that in this season of jubilee and triumph the man of science and genius, who elaborated his own idea and manifested its practicability, should not be forgotten in the dispensation of honours and dignities."

This was followed by a letter from Mr. George Cruikshank, a friend of Mr. Wheatstone, stating "that the discovery arose, I believe, from the circumstance of Mr. Wheatstone, when first appointed lecturer at King's College, having seven miles of wire in the lower part of that building which abuts upon the river Thames, for the purpose of measuring the speed of lightning, or the electric current, and upon one occasion, when explaining his experiments to me, he said—'I intend one day to lay some of this wire across the bed of the Thames, and to carry it up to the top of the shot-tower on the other side, and so make signals,' and this was, I believe, the first idea or suggestion of a Submarine Telegraph. We are also indebted to Mr. Wheatstone for the electric bell, for, long before this telegraph came before the public, in explaining the machinery to me, he said, as it was possible that one party might be asleep at one end of the wire, he had so arranged the working that the first touch should ring a bell at the other end, even if thousands of miles apart. This, it will be admitted, is an important part of the discovery."

In the present volume we have recorded the laying of the Cable in August last, and the honours which have been conferred on those who took an executive share in that great event. The distribution of these honours, has, however, drawn from a contemporary,* and we think with justice, these remarks:—

"Capt. Anderson of the Atlantic Cable expedition, and one of the hardest and most successful workers in it, cannot be made a G.C.B. because the 'rules of the service' are against it. Meanwhile, his able and scientific fellows are created knights and baronets, while Wheatstone, but for whose marvellous following in the track of his gifted predecessors, there would as yet have been no Electric Telegraph at all, is left out in the cold, without being named! Add to this, that Mr. Bright, in his speech at Leeds, conferred on his American friend, Mr. Cyrus Field, the honour of naming him as the sole person to whom the completion of the cable was due. Mr. Bright was as silent as to that excellent gentleman's English colleagues in the great work as if they had never existed."

Professor Wheatstone, D.C.L., LL.D., F.R.S., is a corresponding member of the Academies of Science of Paris, Brussels, Berlin, Munich, Stockholm, Turin, Milan, Rome, Washington, &c.; and Chevalier of the Legion of Honour.

The Telegraphs used in this country, whose signals are transient, and must be read off one by one as they appear, are the double and the single needle telegraphs of Cooke and Wheatstone, used by the Electric Company and the South-Eastern Railway Company —the single needle requiring one wire, and the double needle two. The Telegraph of Professor Wheatstone, in which a hand points to the letter itself on a dial, is gaining ground for private use.

Electro-telegraphy owes much to Professor Wheatstone; but his latest achievement excels all we have yet heard of. With his improved automatic instrument, properly manipulated, he can transmit six hundred distinctly legible signs or letters in a minute.

In the following *Year-Books of Facts* will be found the subsequent papers descriptive of some of Professor Wheatstone's valuable contributions to science; 1849, pp. 124–127, The Polar Clock or Dial described; 1852, p. 145, Cook and Wheatstone's instrument set in motion from Dover to Calais; 1857, p. 154, Duration of the Electric Spark measured by Professor Wheatstone's apparatus; 1858, p. 147, his Evidence before Parliament as to the practicability of submarine communication between England and France; 1861, p. 166, his Universal and Military Telegraph described; 1866, p. 119, his Thermo-Electric Battery.

The accompanying portrait is engraved, by permission, from a portrait taken by the London Stereoscopic Company.

* *The Athenæum.*

CONTENTS.

THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

GUILDHALL INDUSTRIAL EXHIBITION.

THIS display of beautiful Manufactures was opened by the Lord Mayor and Sheriffs on March 6, 1866. It was termed the City of London Working Men's Industrial Exhibition, which was characterised by the Lord Mayor (Alderman Phillips), with his usual felicity, as follows :—

"He felt that it was a high honour to represent on that occasion the working citizens of London, to whom the whole of the present Exhibition was solely due. To them he would say, on the part of the corporation and of the capitalists of the city, 'our welfare is bound up with yours.' Within the limits of fair competition the capitalist was as dependent on the workmen as the workmen were on the capitalist. Enterprise and industry must go hand in hand together in all progress, and when fairly combined under our free institutions, which give every citizen a free and open field for his exertion, we might say, 'Come east, come west, we are ready to exchange the products of our capital, skill, and labour with all the world. We offer to all connected with art, science, and industry the right hand of fellowship, and seek in the spirit of brotherhood to promote universal happiness.' In the name of the committee I now declare the Exhibition duly opened, and may God speed it!"

The collection included objects which were more or less worth seeing under the following heads :—Architectural models, designs, and drawings; books and bookbinding, curiosities, carvings, turnings in wood and other materials; drawings in crayon and pencil, water-colours, and pen and ink; engravings on wood, metal, &c.; artificial flowers, feathers, and hair; frames, decorative furniture, and cabinet-work; graining, marbling, and paper-hanging; glass-work for decorative purposes, and cut glass; heraldry; illustrations; inventions for promoting domestic economy; inventions for protecting life by sea, rail, and road; iron and hardware; masonic and other jewellery; leather-work, boots and shoes; ladies' work and millinery; medical and surgical instruments; modelling in marble, plaster, and bronze; mechanism (working models); sewing machines, musical instruments, naval architecture, paintings in oil, photography, scientific instruments, stuffed birds, insects, &c.; tailoring, wirework, watches, chronometers, and miscellaneous. The prizes awarded to the Exhibitors were distributed by Mr. Peabody.

INDUSTRIAL EXHIBITION, ISLINGTON.

THIS Exhibition was opened on the 1st of September, 1866, in the Agricultural Hall, Islington, and was closed after a prosperous career of ten weeks. It is a noteworthy fact, that whilst, during the past two years, nearly all these Working-class Exhibitions have been failures, this one was a most unquestionable success. This is no doubt attributable to the excellent management, and to the low prices of admission. In their Report the adjudicators make the following remarks, which should be well weighed by intending contributors to future exhibitions of this class. They say:—"We feel bound to state that, with certain honourable exceptions, the objects exhibited do not attain to great excellence. The chief deficiencies are in those important qualities which result from well-directed study, and in originality of design, the offspring of independent thought. At the same time there are abundant evidences of patient, laborious perseverance, of earnest assiduity, and particularly of technical skill and manual dexterity, which give promise of more decided excellence in future Industrial Exhibitions." All this was accomplished without any royal presence or patronage; and the success of the Exhibition showed what the English working-people can do for themselves.

During the ten weeks the Exhibition was open, no less than 599,248 persons entered the building, of whom 530,797 paid for admission, 4,664*l.* 7*s.* 10*d.*; receipts from other sources, including rent of stalls, making a total of 5,400*l.*; expenditure, 4,530*l.*; leaving a balance in favour of the executive for disposal of 870*l.* The gross number of exhibitors was 1,492; and the awards of prizes by the adjudicators consisted of 85 silver medals, 187 bronze medals, and 189 certificates of honourable mention, making a total 461. In addition to these, there were a number of special prizes, amounting to 57*l.*; and a framed view of the Exhibition was presented to every one of the 1,500 exhibitors. The Directors of the Agricultural Hall Company, and other persons, liberally gave money prizes.

After the distribution of the prizes, which took place in Exeter Hall, Mr. Beresford Hope, M.P., addressed to the assembly these admirable remarks upon the requisite connection of workmanship and art:—"Exhibitions like the one recently held at Islington were most creditable to those who took them up; but even in such exhibitions there might be mischief lurking, if they led persons to think that their own natural ingenuity would enable them to dispense with instruction in the principles of art. The working men should not require those exhibitions as fields on which they could canter their own ingenuity, in order to see how they could go without real systematic learning. The great object to be achieved was the particular improvement of every man in his own particular studies; and, with all respect to the gentlemen who organised working men's exhibitions, he must express his opinion, that while prizes should be given to those who in their hours of recreation produced works out of their own business, something more special should be given to those who, as a labour of love, prepared articles for exhibition in that profession to which they had devoted their life." These remarks of the hon. member were much applauded.

Whilst, however, we admit the importance of art-instruction, we cannot approve of some of the means taken for enforcing it. Mr. Tom Taylor, in an address at the Lambeth School of Art, gave this dreary view of the slow progress of art in this country:—"In these times, more than in the days of old, the lower classes were almost wholly deprived of every opportunity of art-education, except such as were specially put in their way. The growth of London was so rapid that, if it were not for excursion trains and the parks, the artisans of this huge city might pass their whole lives without ever seeing the green grass or smelling the sweet breath of the country. The *ugliness of our modern suburbs, the sordidness of so many of the phases of the nineteenth century life*, the universal haste to be rich at any cost of mental cultivation—these, and other influences of the same description, exercised a deteriorating effect upon the national life. Proof of this might be found, if proof were needed, in the general ignorance of art which was manifested in the workmen's exhibitions that had recently been held throughout the country."

Mr. Taylor has here overlooked the fact that much of this "general ignorance" is to be attributed to the excess of amateur art in the above Exhibitions; other points of his argument are, to our thinking, equally unsound and untenable.

THE PARIS EXHIBITION BUILDING.

(*See Vignette.*)

The Building for the Paris Universal Exhibition of 1867 is in plan a colossal oval, erected in the Champ de Mars, thus commemorating the triumphs of Peace in what is literally termed the Field of War. In addition to the main building, the park itself is rendered available for the display of articles in two of the ten groups into which the Exhibition is divided. Those two groups will include articles for which the interior of the building is not suited, such as agricultural implements and model buildings, as well as machines and apparatus for the exhibition of which the direct application of fire is necessary. The building itself has been specially arranged so as to present a division or separation of the objects exhibited, not only by countries, but also by classes —an idea which is not new, for it was actually proposed by the Society of Arts for the Exhibition of 1862; but, for reasons unnecessary to enter into here, that plan was not adopted. The building presents a series of concentric passages, in juxtaposition with each of which one of the groups into which the classification is divided will be shown, whilst each country has a segment of the oval divided by passages radiating from the centre; so that in passing round the building by any one of the concentric passages, we shall come upon each country in succession, and shall find in each group objects of the same class.

The system of classification which has been adopted forms a special feature of the Exhibition, the shape and arrangements of the building being specially adapted for the display of the objects thus classified. The classification is based on the idea that these exhibitions are intended to bring into notice all the resources which industry can create for satisfying the wants of mankind, and the Exhibition is divided primarily into groups, which are intended to correspond with the great wants of the human family.

FIRES, FIRE-ENGINES, AND FIRE-BRIGADES.*

A LARGE octavo volume, of some 550 pages, with the above title, has appeared. It is the result of long and laborious application to the subject, and it is difficult to imagine any better assurance of the practical value of the work than is contained in the following paragraph from the preface to the volume:—"For several years past the author has made the subject of Steam Fire-engines, their construction, management, and requirements, his peculiar study. He has also been in the habit of attending various trials of them, private as well as public, and of seeing them at work at fires, making his own notes and observations thereon, taking the measurements himself personally, or assisting in so doing, and carefully noting particulars and results whilst on the spot."

Every one who acknowledges the truth of the home proverb, how good a servant and how bad a master is fire, will receive this work as a handbook to our social economy. The opening chapters of the work are specially of this value; and now that the subject of volunteer and paid fire-brigades and fire-engines is very properly attracting a considerable amount of attention, the real worth of the book will not fail to be appreciated. In its thirty-four chapters, the important subject is treated in all its phases; and, besides the construction and uses of fire-engines, which are treated and illustrated in detail, we have all sorts of provisions and precautionary rules for fire-brigades, and their organisation and management. Thus we have means for subduing fires, fire-proof-structures, manual and steam fire-engines, appliances and equipments, the whole supplemented by thirty-four large pages of closely-printed index. Altogether this is a large book, upon a very important subject, more especially to large communities; and it has truthful record, judicious observation and experience, to recommend it to the attention of readers.

* "Fires, Fire Engines, and Fire Brigades; with a History of Manual and Steam Fire Engines, their Construction, Use, and Management." By CHARLES F. T. YOUNG, C.E., Memb. Soc. Engineers.

SCIENCE FOR "PRACTICAL ENDS."

At the late Meeting of the British Association,* Mr. Hawksley, the president of the Mechanical Science Section, pointed out that their inquiries were limited for the most part, if not altogether, to those branches of statics and dynamics which were or might be employed for the realisation of so-called "practical ends;" and then continued,—"Whatever may have been the advancement which civilised people have made in the arts of peace, it is only too evident that those peoples have even outstripped themselves in advancing the arts of destruction. We have seen in the great internal contention of our American brethren, and still later in the struggle in which several of the most important States of Europe have engaged, that war is no longer carried on by means of mere animal courage and brutal force. On the contrary, we perceive, much to our amazement, I believe, that the highest branches of mechanical science and the most refined processes and operations of the mechanical arts are resorted to by the modern warrior for the purposes of offence and defence; and we are taught, by the logic of facts, that the modern soldier must cease to remain a passive machine, but, on the contrary, must henceforth be trained as a skilled labourer, if, indeed, not even as a skilled artisan.

"At the present moment the internal and external defences of this country are in a most unsatisfactory condition. Many endeavours have been made, and much money, reckoned by millions, has been expended—I will not say wastefully or unworthily, but certainly for the most part uselessly, in endeavours to secure our coasts against the attacks of a foreign enemy. Forts have been erected where an adversary would never seek to land. Ships of an enormous size, and carrying enormous armaments, have been constructed, which can neither sail on shallow waters nor safely encounter a hurricane in deeper ones—which, with vast mechanical power on board, can yet not carry a sufficient quantity of coal to enable them to find their way to, and

* The British Association met at Nottingham in August, and proved a great success, especially as regards the hospitable reception given to the *savans* in the town, as well as in the excursions made in the neighbouring country, which were very attractive. The papers read were of average interest, but scarcely of higher character; but, according to the *Athenæum* Report, the meeting will be remarkable and remembered for the boldness and ability of the Presidential Address, in which Mr. Grove so fearlessly advocated the much-attacked doctrine of Continuity. Only two papers were ordered to be printed *in extenso* in the volume of *Transactions*. It was observed that there was a remarkable absence of some of those most eminent men whom the world has been in the habit of regarding in past years as amongst the magnates of the Association. The attendance, however, of men of mark was very good, and the proceedings were conducted with a regularity which has never been exceeded; the plan of separating the excursion-days from the working-days deserves to become a fixed rule of the institution. The numbers present at the meeting were:—Old life members, 207; new life members, 3; old annual members, 218; new annual members, 105; associates, 906; ladies, 771; foreigners, 11; total, 2,221; amount received, 2,469*l*. The Association will meet in 1867 at Dundee, under the presidency of the Duke of Buccleuch.

act as protectors of, our colonies, and which, for the same reason, are wholly unable to convey our merchantmen to those distant climes, without a safe communication with which the trade and commerce of England must be annihilated. Arsenals have been enlarged, if not constructed, in situations in which they can only be secured from an enemy's fire by fortifications, which it will require an additional army to man. Guns, each one larger or more elaborate than the last, have been invented and constructed, and tried; and floating castles, each one heavier and uglier, and more unmanageable, and more useless (except for special applications) than the former one, have been built and cast upon the waters to resist them; and yet, it is lamentable to have occasion to say it, nearly all the many naval and military officers with whom I have come in contact freely acknowledge that this great country is not in a position to defend either herself or her colonies against a combined attack from more than one of those foreign friends we have heretofore recognised under a different appellation. There were present gentlemen who would enlighten the Association upon the mechanical appliances best adapted for the improvement of our defences; and who would also not neglect the consideration of so much more of our science as contributed to the material wealth and prosperity of our country, and to the social comfort and intellectual improvement of its inhabitants, and of the whole world."

Mr. Hawksley then directed attention to points of interest peculiar to Nottingham and its neighbourhood. "You will find here (he said), in the lace-machine, combinations and arrangements of mechanism of the most complicated yet of the most exact kind, all tending to the cheap and rapid fabrication of an article of commerce which has made its way over the entire world, and without the possession of which no home, and, I had almost said, no lady's dress, can be considered complete. The present state and extent of this really wonderful manufacture is an instance, and even a remarkable one, of the effect of that law of continuity which last evening formed the staple of our President's address. It has not only been by little and little, but by close and continuous progression, that the lace mechanism of Nottingham has become developed into that condition of almost perfection to which it has now attained."

"Within a very few miles many of the most interesting formations of the earth's crust come to the surface, from the syenite at the base of the system to the more recent deposits of lias and oolite. Coal and ironstone are very abundant, and although it is to be regretted that the town of Nottingham has not yet availed itself of the vast amount of mineral wealth within its reach, yet, in the large undertakings of Butterly, Riddings, and other places, as well as the great extent to which the Midland Coal Field is being wrought for the supply of distant countries, you will see evidences of the growth of a local industry, which, as I believe, is yet in its infancy."

It was subsequently mentioned by Mr. Felkin, in illustration of the importance of diffusing scientific knowledge among the working classes, that since 1780 no less than 660 patents for inventions connected with the manufacture of lace had been taken out, of which all but some half-dozen were the discoveries of working men themselves; while in the last 14 years alone machinery to the value of 2,000,000*l.* had been laid aside as no longer required for the attainment of the object in view. Mr. Babbage, on the occasion of his visiting Nottingham, sat for two hours looking at a particular machine, by which some surprising results were accomplished, and, in reply to a question addressed to him, gave the reason for his narrow inspection of the machine, which was, that although effectual for its purpose, it had been contrived and put together by a man whose contrivances showed that he was no mechanic at all, but merely felt his way from stage to stage. In machines now in use in Nottingham the same mesh which used to require 60 motions could now be made with six. What an enormous saving of time, money, and labour would have been effected, if the inventors who patiently found their way from one improvement to the other had known beforehand the principles by which it was necessary to be guided!

PERMEABILITY OF IRON.

The Master of the Mint, Mr. Graham, the well-known chemist, has announced to the Royal Society his discovery that Iron at a low red-heat absorbs a considerable quantity of carbonic oxide; and that, contrary to long-standing belief, this gas does not act on the surface of the metal only, but permeates its entire substance. Having taken up the gas, the iron will retain it for any length of time, and in this condition it is best adapted for conversion into steel, as, by the permeation of the carbonic oxide, the subsequent process of carbonisation is largely facilitated. Hence arises the suggestion that the process of acieration would be best accomplished by changes of temperature; a low red heat to fill the iron with carbonic oxide, after which it may be put away, if required, to await the final process, at a high temperature, of conversion into steel. Concerning another form of iron, Mr. Graham remarks that wrought iron, in the course of its preparation, "may be supposed to occlude six or eight times its volume of carbonic oxide gas, which is carried about ever after. How the qualities of iron," he asks, "are affected by the presence of such a substance, no way metallic in its characters, locked up in so strange a way, but capable of reappearing at any time with the elastic tension of a gas, is a subject which metallurgists may find worthy of investigation."

NEW METHOD OF ROLLING IRON.

This process, given in the *Boston* (U.S.) *Advertiser*, consists of rolling into irregular shapes, by which chequered surfaces, projections, and depressions can be obtained with the same facility as plain surfaces have heretofore been produced. This result is accomplished by means of adjustable discs, of any desired pattern, placed upon ordinary rollers, which leave upon the bars drawn through them the impress of the figures which they bear. Instead of solid rolls turned with grooves and peripheries in the ordinary manner, the inventor uses cast or wrought iron spindles, on which are slipped cast-iron or steel rings or discs, forming grooves and peripheries corresponding to those of ordinary rolls, and susceptible of an almost infinite variety of combinations. The spindles are allowed to project beyond the housings on one side, thus giving an opportunity of placing upon them every variety of pattern disc, and requiring but a very few minutes to effect any desired change. —*Mechanics' Magazine.*

IRON CEMENT.

M. Szerelmey has exhibited two iron plates, each a yard square, which were joined by his iron cement. The plates were joined diagonally, and a weight of 10 cwt. was placed upon each corner of the under plate which buckled under the pressure, but the cement remained intact. Numerous examples were given of iron bars and plates, deals and bricks, cemented by M. Szerelmey's zopissa.—*Ibid.*

A REAL SAFE.

Mr. John Chubb, in a letter to *The Times*, describes a strong-room lately constructed at a London bank. The walls, 2 ft. thick, are formed of hard bricks laid in cement, and with hoop-iron worked in. The room is lined throughout with wrought-iron half an inch thick. There are two doors, the outer a strong iron one with two locks, and the inner one of combined steel and iron of extraordinary strength, with two locks throwing ten bolts. A safe placed inside, weighing eight tons and throwing twenty bolts, contains the cash and securities. An alarum in the resident clerk's bedroom is attached to the inside of the strong-room; so that if the outer door be opened a gong is set going. A porter sleeps on a bed in front of the outer door, and by pulling a handle he can set the alarum off if necessary, and there is a watchman always on duty. Safes are and can be made practically secure in many ways, but watchfulness and caution ought not to be dispensed with by those who have valuables to take care of.

NEW IRON-PRESERVING AGENT.

Dr. Henry Edward Francis de Briou, a Parisian physician, has discovered and patented a process for preparing from India-rubber what we may designate an *enamel paint*, which is absolutely proof against the action of the atmosphere, as well as against the power of all liquids (including the most potent acids) to affect iron. This enamel paint possesses all the remarkable qualities of india-rubber, without combining with them any other substance or element that is calculated in the slightest degree to counteract their thoroughly efficient operation. The preparation is applied cold and in a liquid state, and in consistency and general appearance it resembles such common oil-paint as is ordinarily used for iron-work. It may be applied with ease; but of course it is necessary that the process of application should be conducted with such care as will insure a complete covering of the surfaces to be protected. This covering may be so thin that its presence cannot be detected; while it leaves the protected surfaces in all their original sharply-defined freshness. It hardens also at once, and immediately forms a smooth and lustrous enamel-like covering, air-proof, damp-proof, water-proof, and acid-proof. Thus protected, the iron is safe. Rust cannot accumulate upon the surface of this enamel-paint, nor corrode beneath it.—*Art Journal.*

IRON FOIL.

MESSRS. W. HALLAM and Co., of the Upper Forest Tinworks, near Swansea, have succeeded in producing still more wonderfully thin sheets of iron than those exhibited by Messrs. Lloyds, Fosters, and Co., of Wednesbury, and Mr. Parry, of Ebbw Vale, which attracted so much attention at the Birmingham Meeting of the British Association. The sheets exhibited by Messrs. Lloyds, Fosters, and Co. on that occasion weighed only two grains per square inch; and those exhibited by Mr. Parry were thinner still, weighing only one grain and a half per square inch. These were really marvels of tenuity, but Messrs. Hallam and Co. have now far surpassed them, for they have produced sheets of iron which are less than one-fourth as thick as Mr. Parry's and not much more than one-sixth of the thickness of Messrs. Lloyds, Fosters, and Co.'s, and which weigh, per square inch, only *thirty-six hundredths of a grain.* It would take 200 such sheets of iron, laid one on the top of the other, to make up the thickness of a sheet of ordinary note-paper.—*Mechanics' Magazine.*

LARGE CYLINDER CASTING.

AN immense Cylinder has been cast at the works of Mr. George Bayliff, Soho Foundry, in a short space of time. The cylinder was cast with a steam-jacket round it, and donkey arrangements for starting the engines. The cylinder is for a large pair of horizontal marine engines, in course of construction by Messrs. Laird Brothers, of Birkenhead. It is said to be one of the most intricate cylinders yet made, the weight being thirty tons finished. There were employed for the purpose two air furnaces, each containing fifteen tons of molten iron, and two cupolas. When the iron was melted and ready for being tapped out of the furnaces, it was run into two large fixed wells, so constructed with shutters and levers that one man to each had complete command of the metal whilst running into the mould. In addition to the wells, two ladles of molten iron, one containing seven tons, and the other five tons, were worked with the crane, in order to keep up the supply in the wells. The total weight of molten iron employed in casting the cylinder was about forty tons. Being the first one of this kind, a few tons over the weight were, of course, considered advisable.—*Ibid.*

STEEL FOR COLUMNS.

IN France a few experiments were made some time ago by M. G. H. Love, upon small pillars made of Turton's steel, and having rounded ends. These pillars were one centimètre or 0·39 in. in diameter, the lengths being ten, twenty, and thirty times the diameter. The steel of which the pillars were composed was found by experiment to have a tensile breaking strength of 108,500 lb. per square inch. According to *Engineering*, the results show that, as in the case of cast and wrought iron, the resisting power of steel to compression decreases as the proportion which the length of the column bears to the diameter is increased; but this decrease in strength does not seem to be so rapid as in the case of the two first-mentioned materials. M. Love's own deductions are; that steel and cast-iron columns, having a length of from one and a half to five diameters, offer about the same resistance to compression; whilst columns of wrought-iron of the same proportions offer only about half such resistance. When the length of the column is increased to ten diameters, however, he considers that steel offers a greater resistance than cast-iron, in the proportion of 41 to 31, the proportionate resistance of wrought-iron being represented by 17. As the proportion of length to diameter increases, the resisting power of cast-iron diminishes more rapidly than that of wrought-iron, and that of wrought-iron more quickly than that of steel, so that when the length reaches forty diameters, he estimates the strength of similar columns of the three materials to be in the proportion of the numbers 375, 562, and 1,500. It is wrong to found a law upon so few experiments; but, if the data above given are confirmed by future trials, steel will prove a valuable material for resisting compressive strains.—*Builder.*

ANNEALING WIRE.

A NEW principle has been introduced by Mr. Hibbell, in the manufacturing process of wire-drawing, which consists of an entire alteration of the method of annealing. Under the old system, annealing pots consisted of hollow cylinders of cast-iron, closed at the bottom, and furnished with a lid or cover at the top, which was closed nearly airtight during the annealing process. These pots were built in a furnace, and charged with the articles required to be annealed. When the pots were filled, the furnace was heated to the required degree, and allowed to cool, together with the pots. By this process, however, the surface of the wire became more or less covered with scales, which had to be removed by pickling, before the wire could be drawn to the required thickness. By the new process the annealing pots are constructed of two hollow cylinders of cast-iron, of different diameters, the smaller one being placed within the larger; a ring-like space is thus left between the two cylinders, which constitutes the chamber in which the articles to be annealed are placed. The bottom of this chamber is closed; and the top is also closed and made airtight during the annealing process. When these pots are placed on the furnace the flames not only encircle them, but come up through the hollow centre, and the wire is thus more thoroughly and uniformly heated. They are made airtight by a very simple process, and when the wire is taken out it is as smooth as possible—there is no scale about it —and therefore does not require pickling, as under the old system. The quality of the wire is also much improved; it is considerably more ductile, and a considerable saving is effected in weight, as the process of pickling reduces the wire considerably. Under the old system, a No. 4 rod, before it could be drawn to No. 18, would require pickling six times, and annealing five times. Under the new system, the same rod requires pickling once, and annealing once. By the old process it would take eleven days to draw the wire to the required thickness, but by the new plan it is done in five days. It will therefore be seen at once that the saving of time, fuel, and vitriol (for pickling) must be very great, while the quality of the wire must be much improved. The new pots take four diameters of wire; they are only 18 in. in depth, but hold 10 cwt. 2 qr. Being so much smaller than the old ones, they can be easily moved about.—*Mechanics' Magazine.*

REMOVAL OF COLUMNS.

MR. FAIRBAIRN has described to the British Association the means employed for removing and replacing in a new position the iron columns of a fireproof mill. By the method described by the author of the paper, the old weak supports of a cotton-mill eight stories high were cut away and new iron columns substituted without the working of the mill being interfered with in the slightest degree, and the machinery of the mill was made of use in doing a portion of the work. This method was regarded by many gentlemen present as being of the greatest importance, because it rendered it unnecessary, when it was desired to use more powerful machinery, to erect a new building at a vast cost, and also prevented the loss that must accrue by the works being stopped.

STEAM-HAMMERS.

IN an article upon the invention of the Steam-Hammer, the *Mining Journal* observes that although Patricroft was undoubtedly the birthplace of the steam-hammer in its present compact and manageable form, it is now conclusively proved (by the testimony of Mr. Gaskell and Dr. W. Fairbairn) that Mr. Smiles was not justified in giving, as he has done in his *Industrial Biography*, the credit of its invention to Mr. Nasmyth. The first practically useful hammer made in England was produced at the works of Messrs. Nasmyth, Gaskell, & Co., at Patricroft, but Mr. Nasmyth's hammer was similar to, and no advance upon, the hammers of James Watt and Deverell, patented nearly half a century previously, until the self-acting motion was designed and applied by Mr. Robert Wilson, then manager to the firm, and now managing partner in the works at Patricroft. From the time of Mr. Wilson's invention being applied, the steam-hammer has become a necessity in every engineering workshop, its introduction marking a new era in the history of mechanical progress.

Considerable attention has been given to the Steam-hammer by Mr. Charles Emmet, an engineer, of Dalton, near Huddersfield, with the view of further perfecting its working parts and extending the sphere of its useful application. Mr. Emmet's invention may be divided into four parts, the first of which has for its object the rendering of steam-hammers self-acting in reversing the piston immediately on the blow being given, and at whatever length of stroke required or thickness of metal under operation. This is effected by the employment of a weight supported on a spring attached to the piston rod, and carried thereby. A bell-crank lever is also attached to the piston rod, and another bell-crank lever is hinged to the cylinder, one arm of which is connected to the valve spindle. The momentum of the weight acquired by any stroke of the hammer overcomes the spring, allowing the weight to move forward after the blow is given, and to act upon the first-named lever, which lever operates upon the second lever, and thereby reversing the valve shuts off the steam and opens the exhaust, and thus releases the steam from the top side of the piston, when the steam (which is always on the under or annular side) will cause the piston to make the return stroke. The second part of the invention consists in adapting or arranging steam hammers to be used for ordinary forge or smith work so as to strike at any desired speed and force of blow at the will of the smith. This is effected by means of a treadle, which (in addition to a rocking motion) is capable of a slide movement, which will act upon a lever in communication with the throttle valve for regulating the quantity of steam to be admitted to the under side of the piston, according to the speed required: the force of blow is regulated by the rocking motion of the treadle.—*Mechanics' Magazine.*

SAFETY APPARATUS FOR BOILERS.

MR. J. K. FISHER has presented to the Society for the Promotion of Science, in America, a drawing of an upright tubular

Boiler, in the upper part of which is a chamber of half an inch deep, through which the upper ends of the tubes pass loosely, leaving annular spaces around them. Into this chamber water is pumped from below by a circulating pump, and forced downward through the annular spaces around the tubes, so as to keep the tubes wet, and prevent their becoming hot and superheating the steam. The intention of the device is to prevent the injury which frequently occurred in fire-engine boilers, when, for the sake of raising steam quickly, the water is purposely kept low, and the fire made as strong as possible; in consequence of which the upper part of the tubes becomes lengthened by heat, and pushed into the tube sheets, and, after a few instances of such treatment, becomes leaky.

STEAM AND MACHINERY IN AGRICULTURE.

The use of Steam and Machinery in agricultural operations is making progress, although there remains much to do ere this branch of manufactures will rival spinning and weaving by Steam-machinery. Mr. William Smith, of Woolston, Bletchley, has practised Ploughing by Steam for eleven years; and within the previous $12\frac{1}{2}$ days to the date of his communication he had worked 90 acres, doing the seeding into the bargain, and had thus taken advantage of the previous fine fortnight. The consumption of coal had been 5 tons 3 cwt., at 15*s*. per ton. "Here am I," he adds, "at the end of this wet season, with the principal part of my wheat-seeding done, and the first planted coming up well."

The East Lothian Agricultural Society have passed a formal vote of thanks to the Rev. Patrick Bell, of Carmylie, Forfarshire, the inventor of the Reaping-machine, who has never received any benefit from his invention since, nearly forty years ago, he gained the prize of 50*l*. on account of it from the Highland Society. How great the benefit which his invention has conferred on British and American agriculturists can hardly be exaggerated.

A new Reaping-machine, of English invention, manufactured by Messrs. Burgess and Key, is stated to effect a considerable saving of manual labour. It is a self-acting back-delivery reaper, and is described in the *Haddingtonshire Courier*. Instead of a man seated on the implement, rake in hand, to tilt off the sheaves, this important part of the work is done by the action of a "clam," moved from the driving-wheel, which raises and depresses the tilting-board at regularly recurring intervals, and lays off the sheaves, it is said, as neatly and evenly as if done by hand-labour. The raking is effected by a wooden reel of light construction, one of the flanges of which is toothed to catch the grain and press it firmly against the cutting-knives. The self-action necessitates no greater expenditure of horse-power, if as much, as in the case of the ordinary back-deliverers. By the use of a machine of this character, the services of one, two, or three hands, according to the number of machines employed on the farm, could be set free for work of the harvest field.—*Mechanics' Magazine.*

IMPROVED EXCAVATOR.

An improved Excavator has been introduced in Iowa, by Mr. Bradley, in the working of which two plough-like shovels are propelled through the earth, from 2 in. to 6 in. below the surface, as regulated by the foot of the driver; a huge revolving hoe comes down and takes the earth behind, up an inclined plane, upon a long revolving apron or elevator, which carries it backward and upward, over the main wheels, till it is nearly 20 ft. above the ground behind; and there is another transverse apron, adjustable to a rise or fall of any distance, which takes the dirt to wagons, or dumps it outside the track. The whole is drawn by six or eight horses, cutting a trench 3 ft. wide at each advance; and, if working at the full capacity designed, it will remove from three to four cubic yards of earth per minute, equivalent to ninety men. But if it attains to only one or two yards per minute it will be a great thing.

ENGLISH GUNNERY EXPERIMENTS.

In the *Times*, January 1, 1867, appeared an elaborate review of the recent progress of Gunnery in England,* the details of which would occupy more space than we can spare; but we quote that portion of the paper which enumerates "The practical conclusions to be regarded as established by English gunnery experiments:"—

For actual perforation of iron-plated targets of modern construction heavy guns are required, and as these must be capable of throwing a projectile with a high velocity, they must be strong enough to stand large charges of powder.

The projectiles must be of hard material. Palliser's chilled iron shot and shell are equal, if not superior, to steel, and far cheaper. Shells should be so constructed that the bursting charges may act in a forward direction; their heads must be solid, and the best form is the "ogival pointed."

With hard projectiles, the *perforation* is directly proportional to the "work" attained, and inversely proportional to the diameter of the shot or shell.

The resistance of wrought-iron plates equally well made varies as the square of their thickness. Placing them at an angle to

* Transactions and Reports of the Special Committee on Iron. Extracts from the Minutes of the Ordnance Select Committee. Report on various Experiments carried out under the direction of the Ordnance Select Committee relative to Penetration of Iron Plates by Steel Shot, by Captain W. H. Noble, M.A., Royal Artillery, Associate Member, Ordnance Select Committee.—*Proceedings of the Royal Artillery Institution.*

the line of fire diminishes the effect of the shot in the proportion of the sine of the angle of incidence to unity.

The resistance of plates to perforation is hardly effected by a backing of wood simply, but much increased by a rigid backing of iron combined with wood, or of granite, iron, brick, &c., much of the shot's effect being transferred to the backing, which suffers proportionately. Iron-built ships with compact oak or teak backing are stronger than similarly clad wooden ships; the best form of backing being wood combined with horizontal plates of iron, as in the *Chalmers*, *Bellerophon*, and *Hercules* targets. Palliser's bolts are found to be the best for securing iron plates.

An inner skin of iron is almost essential, for it not only renders the backing more compact, but prevents many splinters from passing into the ship. Every ironclad, whether built of wood or iron, should therefore have an inner iron skin.

Laminated armour is much inferior to solid armour.

RESISTANCE OF IRON PLATE TO STEEL SHOT.

CAPTAIN NOBLE has read to the British Association a very important paper "On the Penetration of Shot and Resistance of Ironclad Defence," in which he detailed the results of certain experiments on iron plates which had been made by the Ordnance Committee. The experiments were directed to the solution of the power of resistance of iron plates to steel shot, and, though they had been only partially carried out, enough had been done to prove that in the main penetration was the rule. The experiments had been made on 4½-inch and 5½-in. plates, with shells and spherical shot, and it was proved that the plates might be perforated by heavy shot at low velocity, and by light shot at high velocity, while the latter was probably the more effectual agent. These results had been obtained by direct firing; and in regard to the oblique firing, it was found that a much greater force of shot was required to perforate. The difference between cast-iron and steel shot was markedly in favour of the latter, and, in fact, it was useless to employ cast-iron projectiles against armour plates. But Palliser's chilled iron was found to be as good as steel (the latter would only be used for shells). In regard to the power of shot, the pointed-shaped was found to be superior to both the flat and the hemispherical-headed shots. On the whole, the result of the experiments which had been made was that iron plates could, as a rule, be penetrated by steel projectiles from a 12-ton gun, whether heavy at a low velocity, or light at a high velocity.

The conclusions which might be drawn from the whole of the experiments were—1. Where it is required to perforate the plate the projectile should be of a hard material, such as steel or chilled iron. 2. The form of head best suited for the perforation of iron plates, whether direct or oblique, is the pointed orbical. 3. The best form of steel shell is that in which the powder can act in a forward direction, and which is furnished with a solid steel head in the form of a pointed orbical. 4. When chilled iron can be made of the best quality, it is almost if not quite as effective as steel for solid shot, and where the projectile can perforate with ease the chilled shot is more formidable than steel, as it enters the ship broken up, and would act as grape. 5. To attack well-built ironclads effectually the guns should be, if possible, not under 12 tons weight and nine inches calibre, firing an elongated projectile of 250 lb., with about 40 lb. of powder. 6. When the projectiles are of a hard material, such as steel, the perforation is directly proportionate, and the "work" in the shot is inversely proportional to the diameter of the projectile, and it is immaterial whether this "work" be made up of velocity or weight within the usual limits which occur in practice. 7. The resistance of wrought-iron plates to perforation by steel projectiles varies as the square of their thickness. 8. With a plate at an angle, diminishes the effect as regards power of perforation in the proportion of the size of the angle of incidence. 9. The resistance of wrought-iron plates to perforation by steel shot is not much, if at all, increased by backing simply of wood—it is, however, much increased by a rigid backing, either of iron combined with wood or of granite, iron, bricks, &c. 10. Iron-built ships, in which the backing is composed of compact oak or teak, offer much more resistance than similarly clad wooden ships. 11. The best form of backing seems to be that in which wood is combined with horizontal plates of iron, as in the Bellerophon, Hercules, and Chalmers target. 12. An inner iron skin is of the greatest possible advantage. It not only has the effect of rendering the back more compact, but it prevents the passage of many splinters which would otherwise find their way into the ship; therefore, no ironclad, whether iron-built or wooden-converted, should be converted without an inner skin. 13. The bolts known as "Palliser bolts" are the best for securing armour plates. In these bolts the diameter of the shank is reduced to that which it is at the screwed end. The author of the paper preferred the English punching system of high charges with small shot to the American rocking system of heavy shot propelled with low charges, on the ground that by the former method a ship might be sunk or some vital part injured, in much less time than would be required to destroy her by the American system.

This paper was followed by one by Capt. D. Galton, R.E., "On the Chalmers Target." This target may be understood by looking upon it as a beam in which the top flange is the front plate, the bottom flange a thinner plate behind, these two flanges being kept apart by means of a web of plates at right angles to the flanges. These intermediate plates are supported laterally by layers of wood, to prevent their breaking. The author stated that the results of the experiments made by the Iron Plate Committee had been most successful, and showed that the principle was correct.

A discussion followed the reading of these two papers. The Marquis of Lorn, responding to the appeal of the President, stated that he had an opportunity of examining the American ship, *Donderberg*, during her construction, and found her a very formidable vessel. She was a broadside ship, completely protected both above and below her water-line. Her plates were solid, five inches thick. She had only one fighting-deck; and, in consequence of the peculiar form of her build, her broadside was on an inclined plane.

NEW SYSTEM OF ORDNANCE.

MR. W. D. GANSFORD has described to the British Association á newly invented System of Ordnance. The projectile thrown by the proposed gun is a sharp-edged disk, formed by the junction, at the basis of the frusta, of two equal and similar cones. Each frustum is half the height of the original cone, and each cone is one-third its base diameter in height. Consequently, the major is three times the minor axis. The disk is fixed in an upright direction, and the rotation is upon the minor axis. To propel this projectile a gun is used, which internally consists of two parts, a chamber for the powder and the barrel or receptacle for the shot. The barrel is very short, so that, when loaded, the front of the disk is level with the mouth of the gun. Direction is given by the close fitting of the sides of the barrel to the disk, rotation by a pin passed through the barrel in a horizontal direction, in its lower part, so as to take hold of a notch cut in the edge of the disk. It is thus evident that the disk, on leaving the gun, will acquire a rotation equal in speed at the mouth to the speed of the disk itself where it touches the catch. By putting the catch nearly under the centre of the disk, a speed of rotation of the periphery nearly equal to the initial velocity of the projectile would be obtained. As, however, much less than this will suffice to keep the axis of the disk at right angles to its line of motion, the catch is placed further back, and offers but little resistance to the exit of the projectile. Thus an efficient rotation is obtained without friction: and from the absence of friction great initial velocity is obtained; and the recoil being small, from the same reason, large charges of powder may be used. A long maintenance of the velocity is insured by the shape and rotation of the disk, which is more adapted for retaining its velocity than a conical or bolt-shaped shot. The recoil is small from the absence of friction, which in rifled guns amounts to from one-third to one-half the power employed. In the proposed gun the only recoil is that due to the simple propulsion of the shot. An experimental gun has been made on this principle, throwing a shot of 4 lb. 2 oz. The charge used was one-eleventh, or 6 oz. of powder. The first shot was fired from H.M.S. *Cambridge*, the gunnery ship at Devenport, at the target in the creek, a distance of 1,000 yards. The rotation was perfect, and the direction excellent. The gun was again fired from Boviesand, Devonport, and gave a range of 2,000 yards first graze with the same charge. Had the construction of the gun allowed a heavier charge of powder, no doubt a much greater range would have been obtained. Further experiments were prevented by the cracking of the gun at the muzzle.

IMPROVED GUN-STOCKS AND LOCKS.

Mr. James Graham, Wallace Foundry, Dundee, has introduced a spiral spring instead of the ordinary lock of a gun. This spring consists of a coil of steel wire, placed in what is called the small of the stock. One end of the spring is secured to the breech-piece, and the rod of the hammer passes through the centre of the spring and draws back the other end. The hammer is kept at half-cock or full-cock by a catch, which passes through a vertical round hole in the breech-piece. When the trigger is drawn back, it forces up the catch and relieves the hammer; and the catch is made in such a manner that the hammer cannot be relieved at half-cock, although the trigger be drawn. In this gun the hammer does not fall on the nipple in the ordinary way. The nipple is placed horizontally in the end of the barrel, and on the spring being relieved the hammer is propelled straightforward upon the cap. By this means, it is believed, the ignition of the powder will be more certain and instantaneous, and that, as the hammer must strike the nipple fair on the end, and the stroke being on the end of the barrel, there will be less chance of putting the gun off the line. One great recommendation of this new spring is, that there would be a great saving in the expense of the construction, as the spring would not cost more than a penny; and any person could replace an old spring by a new one in a few minutes.

STEEL GUN-BARRELS AND ORDNANCES.

The gun-barrels in ordinary use are formed by bending a flat strip of gun-barrel iron into a cylindrical shape, and welding the two edges. The welding of steel is, however, so nice an operation that no means of effecting it on a large scale can ever be depended upon, and as all attempts to produce a good barrel by casting have failed, and boring is so slow and costly, a new and less expensive method was a great desideratum. This, it is claimed, has been achieved by Messrs. Deakin and Johnson, as the patentees of an entirely new process of manufacturing Steel Tubes. It is based on sound metallurgical, but, at the same time, very simple principles. Mr. Deakin is the senior partner in the firm of Messrs. Deakin and Dodd, of the Monmer-lane Ironworks, near Willenhall, in South Staffordshire; and Mr. J. B. Johnson, the other patentee, is well known as a manufacturer of rolls, having supplied those with which John Brown and Co., of the Atlas Works, Sheffield, have succeeded in rolling the great armour-plates for which they are famous.

The manufacture of gun-barrels by the new process has been going on for some time at works at Bradley, not far from Wolverhampton, and may be briefly described. A round bar of Bessemer steel is cut into lengths, which are heated in an ordinary furnace. The short, round block is then put under a vertical punch of considerable power, which is worked by steam, and a hole punched through it—an operation which requires only a few seconds. The perforated block is allowed to cool, and is then carefully examined to see whether any cracks appear on the outer surface. The expansive force required to pierce a hole through a solid lump of steel necessarily subjects its outer particles to a severe strain, and is sure to develope any inherent defect, whether arising from faults in the material or unskilful workmanship. Should any external cracks appear, they are carefully cut out with a chisel if shallow, and if they penetrate deeply, the block is rejected. Thus the first operation applies a most severe test to the metal. A piece of steel which can sustain without a flaw a force sufficient to punch a hole through it will not give way from the explosion of any charge of powder to which as a gun-barrel it can ever be submitted. The steel barrel having thus been perforated, requires only elongation and reduction in thickness. This is effected by heating it and passing it through a succession of grooved rolls, with a mandril in the hollow of the tube, when it is ready for the lathe.

Barrels made in this way have been tested at Enfield, in the Small Arms Manufactory of the United States Government at Springfield, and at Liège; and in each case the testimony has been very strong in their favour, no barrel having been burst by the severe tests applied. It may be observed, too, that the existing machinery at these places is applicable to the new barrels without any alteration whatever. The result is, that a steel barrel of admirable quality can be made at a cost not exceeding that of an ordinary welded iron barrel, and from the nature of the machinery employed the production can be indefinitely increased in a short period, which cannot possibly be the case with bored steel barrels, as the machinery for them must take a long time to construct, while the production, when the necessary appliances exist, must be slow. It is not necessary entirely to perforate the block of steel, and barrels are rolled with a solid lump at the breech end for loading at the muzzle.

The inventors, however, by no means limit the application of their patent to the production of gun-barrels. It is being employed in the fabrication of ordnance of the largest calibre by John Brown and Co., of the Atlas Works, Sheffield, who have obtained a licence from the patentees. They have provided very powerful machinery, by means of which it is found practicable to perforate a block of steel large enough to roll into a tube of the greatest diameter required for a gun. By producing a series of these steel weldless tubes rolled out to a thickness which will admit of the utmost strength of the metal being developed by manipulation, and fitting one tube upon another, it is believed that a gun will be formed far superior in strength to any yet made.

The invention has been secured by patent in this country, in the United States, and in almost every country in Europe.—*Abridged from the Times.*

BRASS FIELD-GUN.

At Shoeburyness, some very interesting experiments have been made with a brass Field-gun of position, proposed by General Lefroy. This is an ordinary 23-pounder brass gun, bored out to a calibre of 6·3 inches, and rifled in three plain grooves to within three inches of the bottom of the bore, and having a slow pitch or turn of once in the length of the bore. The gun thus converted is made capable of throwing a 64 lb. conical shot or shell. With a charge as low as 2 lb. 8 oz. of powder it threw this tremendous projectile a distance of more than 1,200 yards with the most beautiful precision. The value of the improvement is, that with a gun of only the weight of a 32-pounder to move, a 64 lb. shell can be thrown from it to a distance with precision. Such a weapon, even if used only as a gun of position, would be invaluable for field service. As yet it has not been thoroughly proved, but as far as the tests have gone they have been eminently satisfactory.

CAST-IRON GUNS.

In the Report of Commander H. A. Wise, chief of the Bureau of Ordnance of the Navy Department in America, it is stated that during the recent rebellion the cast-iron smooth-bore Guns of the navy endured all of the severe service to which they were subjected, and proved their excellence everywhere and under all conditions of actual war. Not a single gun of the Dahlgren system burst prematurely; and none of the 15-inch guns, even when fired with their heaviest charges, ever failed, except in the case of two or three which had their muzzles ruptured by the premature explosion of shells—the body of the gun even then remaining uninjured. For the ordinary warfare of wooden ships against each other, or against forts, these smooth-bore guns are undoubtedly the best of their kind; while the practice at the test battery against armour-plating shows that even the 11-inch at close quarters is capable of piercing any thickness of iron or steel with which the sides of an ordinary cruiser, intended to keep the seas, could be covered with safety, and this without any danger of rupture from the use of increased charges, unless the gun has been very much weakened by previous service.—*Mechanics' Magazine.*

AN INVULNERABLE COAT.

In *Le Nord* is described the invention, by M. Charles Bernard, of a light Coat, impenetrable to musketry. In a trial made at the Belgian Tir National, a cavalry carbine was charged with three grammes and a-half of powder, and the conical ordonnance ball for that arm. The carbine, after having been tested and regulated, was placed upon a stand pointed at the level of the breast. M. Bernard, placing himself at the distance of 100 mètres, commenced by taking off his coat, and showed that between his breast and his *capote* there was absolutely nothing but his shirt and his waistcoat. He then put on his *capote*, which is a flowing garment falling to the ground, and covered his head with a steel casque. The shot was then fired. The public were greatly moved when they appeared to see M. Bernard stagger and fall. Happily, he had only made a false step in stooping to pick up the ball, which had struck him a little above the waist and to the left side. The ball, deadened against the stuff, had fallen at his foot, and he came running towards us to show it. At a short distance he threw the ball to the marksmen, crying to them not to approach. Not yet having taken out a patent, M. Bernard absolutely refused to let the garment be examined by which he obtained so marvellous a result. The ball was only slightly beaten out of shape, and bore on its point the impress of the stuff. The inventor offered to renew the experiment; but, in presence of the result obtained, those present declared a new experiment unnecessary. The coat is said to weigh very little, so that there can be no objection to it on the score of burdensomeness.

THE NEEDLE GUN, AND THE SNIDER-ENFIELD.

The history of the invention of this formidable weapon has furnished a strange chapter in many a journal during the past year. As in most cases where celebrity is attained, the claim to the invention is disputed; and, possibly, each claimant may be entitled to share the merit. Our first object is, however, to describe the invention itself; and this we proceed to do, from a carefully written memoir which has appeared in the *Illustrated London News*, July 28, 1866, where the Needle Gun is attributed to an Englishman, as follows:—

The first patent for the needle gun was taken out in 1831, by Abraham Adolph Moser, of Kennington, engineer. The original idea had reference principally to the method of igniting the charge—the detonating powder is attached to a wad placed in front of the powder and behind the projectile: the needle, being struck forward through the powder-chamber, discharges the fulminate, and ignites the powder in front of the charge, instead of behind it, as in the ordinary percussion gun. Moser's ... shows the applications of this principle to a muzzl these steel weldless tubes rolled out to a thickness which will admit of the utmost strength of the metal being developed by manipulation, and fitting one tube upon another, it is believed that a gun will be formed far superior in strength to any yet made.

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This was the needle gun in its original form. But Moser could not get his invention investigated in practical England; and he tried his fortune in Prussia, where his plan was experimented with, and eventually adopted, with various modifications and improvements suggested by Dreyse, a gunmaker, of Sommerda, by whom the breech-loading arrangement was applied in 1835. The gun was definitively introduced in the Prussian service in 1848. The mechanism at the breech of the gun very much resembles the ordinary bolt of a street-door, and in the same way has a large projecting knob or handle, by which it is moved into or out of the grooved catch which fastens it. In the body of this bolt, the arrangement for cocking and discharging the needle is enclosed, and this part of the contrivance is extremely simple. Five pieces, including the needle and spring, serve the office of the fourteen pieces employed in the ordinary gun-lock and hammer; and these five are so arranged that they can be taken apart, and cleaned by the soldier in a few minutes, without the use of any tools but his fingers; or the breech-piece can be entirely removed, and the gun rendered useless, if he is compelled to abandon it to the enemy. A better notion of the nature of the mechanism may be obtained by examining the interior of an ordinary child's toy-gun, in which the spiral spring which fires the wooden pellet, and the method of maintaining it and discharging it by the direct action of the trigger, are precisely similar to the lock of the needle gun. The cost of the gun was only 34*s.* 9*d.* English. In 1850, several rifles on this model were made at the government factory at Enfield, and condemned, partly from the supposed danger of having the fulminate in the cartridge, but mainly from the escape of gas round the needle. It did not, however, occur to the authorities to inquire whether this defect existed to the same extent in the Prussian arm. Various improvements have been made in the Prussion weapon; but in all the various patterns, the principles of Moser's invention are retained in the position of the fulminate and the elongated projectile. In the cartridge a new and very doubtful principle is, however, introduced. The bullet, which fits into a pasteboard *sabot*, or shoe, containing the fulminate to be exploded by the touch of the needle, is made so small that it *does not touch the barrel* in its passage through it, the rotation of the rifling being communicated by the sabot only. Thus perfect cleanliness is ensured, absence of leading (as the bullet never touches the barrel), and of fouling, since the barrel is wiped clean during each discharge by the pasteboard case. The powder also serves to extract the exploded cartridge-case, avoiding the separate mechanism generally employed for this purpose; but these advantages, undoubtedly great, are obtained at the sacrifice of accuracy. The Prussian needle-gun will not compare with the muzzle-loading Enfield for precision to 500 yards, and its maximum of efficiency, even against masses of troops, is 700 yards, the Enfield being effective at 900. In short, in this arm the main feature is quickness, which the progress of Prussia may help to teach us is likely to prove of supreme importance in modern warfare. In the converted Enfield rifle we have succeeded in obtaining the same rapidity, with increased solidity and much greater accuracy.

The cartridge was said to be so great a secret that it could only be manufactured in Prussia; but this was untrue. When first introduced, the smaller diameter of the bullet, which would escape any but very accurate measurement, was a secret; as also the composition of the percussion powder, which, in the Prussian cartridges, remains unchanged after fifteen years, though the usual fulminates deteriorate rapidly. There is no novelty in the composition of the powder, which is generally the fulminate of mercury intimately combined with meal gunpowder; but it is mixed with collodion, and moulded into the cartridge whilst moist. The collodion adds nothing but combustible matter (gun-cotton) to the mixture, and it forms an impervious varnish, preserving its contents from alteration by time or temperature. The conversion of the Enfield musket being decided on, experiments with various plans showed conclusively that the cartridge which contained ignition was in principle the best plan, and the choice fell upon the Snider. We need not detail the conduct of the government to the poor inventor, Jacob Snider, which has been so strongly condemned. Meanwhile, the Ordnance Committee resolved to employ the skill of its own officers; and, with the improvements of Colonel Dixon in the mechanism of the arm, the special ammunition contrived for it by Colonel Boxer, of the Royal Laboratory, at Woolwich, our troops will, by next April, be armed with a breech-loading weapon which is really equal to that possessed by any army in the world.

This rifle possesses the advantages of being simple, safe, cheap, non-capping, and little liable to get out of order. Moreover, it does not require such a reduction of the stock as to destroy the efficiency of a weapon which, for military purposes, is required to act as a pike as well as a firearm. The arrangement is as follows:—A portion of the upper side of the breech end of the barrel is cut out for the admission of the cartridge. This vacant space is closed after loading by a lump of steel—the "breech-stopper" or "breech-piece"—which hinges upon one side of the barrel, and forms a false breech, against the face of which the back end of the cartridge rests; the barrel is, in fact, shortened to this extent. A plunger or piston transmits the blow of the hammer through the stopper to the cap of the cartridge, which is withdrawn after firing by a little instrument which forms part of the stopper. The cartridge is on the "central fire" system, the chief novelties being the case and bullet. As regards the former, the object has been to provide a case which shall uncoil or unwind to a certain extent on discharge. The bullet is a combination of various constructions;

none of them original, but producing together a projectile of a sufficiently distinctive character. It has the general form and appearance of the Enfield rifle bullet, with its hollow base and baked clay plug; it has the cannelures which originally characterised the Tamisier and the Minié bullets; and the wood plug in the head to which Mr. Metford and Mr. Whitworth may both lay some claim. The cartridge is perfectly impervious to moisture; it is safe, not liable to lead or foul; it admits of about 14 rounds being fired in a minute; and it shoots from 20 to 25 per cent. better than the service Enfield ammunition.

We have already mentioned one English claimant to the invention, to which has been added the following. Mr. John Hanson, of Folly Hall, near Huddersfield, states in the *Leeds Mercury*, that the so-called Prussian needle gun is an English invention. Mr. Hanson states himself to be the inventor of the gun, but not having the opportunity of bringing it out, he gave it to a townsman of his, Mr. Wm. Golden, gunmaker, of Huddersfield, who patented it, and made some of the guns. They were but rook guns, of small range. The specifications of English patents find their way abroad; and, in consequence, Mr. Golden received an order from the King of Prussia for two of his patent needle guns. They were duly sent to his Majesty, through his Ambassador in London, as three letters of correspondence, with the large Prussian seal upon them, now in the possession of Mr. Golden, will testify. This is how the needle gun got into Prussia. In two years after, this gun, with some little modification, and made larger for military purposes, was introduced into England as the Prussian needle gun. It was exhibited daily at the Polytechnic Institution, and caused a great sensation. Happening to be in London at the time, Mr. Hanson went to see it, and was astonished to see his needle gun there—not the identical gun sent to Prussia, but on the same principle. The young man who exhibited it said it was not known who was the inventor, only it was a Prussian invention. After inspecting the specification and drawing he said the patent and the gun he was exhibiting were identical.

The invention of the needle gun has been claimed by the Prussians, the French, and the Belgians. According to the Prussians, Nicholas Dreyse* proprietor of large establishments of firearms at Sommerda, a small town near Erfurt, presented this gun to the King in 1844; some years after it was introduced

* Dreyse is described as one of the workmen of Pauly, at Paris, who had constructed an experimental gun, in which Dreyse took great interest. In 1821 he left Paris and established himself in his native town as an engineer and ironfounder; in 1824 he set up a manufactory for percussion caps; which caps he improved by the invention of the copper interior lining; this supplanted the old coating of varnish, and for it he obtained a patent and special privileges. This business brought Dreyse into official connexion with the Prussian Ministry of War, and, taking advantage of the occasion, he was not long in suggesting plans for the improvement of his country's armaments.

into the regiments of the Guard, and for twelve years it has been in use in the whole army (infantry, cavalry, and engineers). In 1848, when the Berlinese attacked the arsenal, they managed to get hold of a dozen of these guns; and in 1850 one of these very guns is said to have been exhibited at Paris at the shop of a marchand d'armes. In 1849 the needle gun was used in the Grand Duchy of Baden, where it made great havoc among the ranks of the insurgents.

Others attribute the invention to a M. Descoutures, an old member of the Polytechnic, and brother of M. Descoutures, Advocate-General of the Court of Paris. It is said that M. Descoutures presented this gun to the Emperor, who was struck with its advantages, and charged Colonel, now General, Favé, to make experiments; and that the same having proved successful, the Emperor placed it in the special armoury, and even proposed to give it the name of *Fusil Napoléon.* The first objections to its employment were made by the Minister of War. The commissions and sub-commissions formed to examine it agreed in the advantage which it possessed in point of quickness, but at the same time reported that the rapidity of the firing heated the gun, and soiled the breech. Their principal objections, however, were:—1. That the weakness of the butt end was injurious to the handling of the bayonet. 2. The rapidity of the fire rendered the carriage of cartridges difficult both for the soldier and for the ammunition wagon. In consequence of these objections, M. Descoutures is said to have carried the invention to Prussia, where it was, with some improvements, adopted.

A writer in one of the Belgian papers says: "There were at one time several sorts of breech-loading needle guns, but of all these the essential point, that upon which the invention is based, is the ignition of the cartridge by the prick of a needle; and this discovery is neither French nor Prussian, but is due to the celebrated gun manufacturer, Joseph Montiguy, who dwelt in Brussels from 1818 to 1835, and who, in 1832, invented the first breech-loading gun ignited by a needle. Montiguy likewise invented a breech-loading cannon, to which he also applied his system of ignition by the needle. His invention was submitted to the Belgian Government, who, however, refused to entertain it. In 1834 the Czar proposed to Montiguy to proceed to St. Petersburg, in order to make a trial of his system of *bouches à feu.* He accordingly set out in 1835, and constructed at the arsenal at St. Petersburg some 24, 18, 12, and 6-pounders, and howitzers of ten cwt., all of which were breech-loaders and ignited by a needle. The trials were very successful, but the heads of the artillery department were also obstinate, and imbued with old and false ideas, and Montiguy was so disappointed that he died of grief in 1845."

The cartridge is composed of two parts—namely, the charge of powder with the conical ball, and the *Zündspiegel,* a little piece of card with two cavities, in the middle of which is the tinder, called the *Zündpille.* Whoever may have been the original inventor of the needle gun, there can be little doubt that Herr Dreyse invented the cartridge now used by the Prussians.—*From the Mechanics' Magazine.*

IMPROVED BREECH-LOADING FIRE-ARM.

MESSRS. SEARS & HUNT have patented a gun, which is stated to be an improvement on the celebrated Prussian needle gun, and applicable to all kinds of military and naval service. It is strongly recommended for sporting purposes in India, Africa, &c., and also for deer-stalking in the Highlands. An important feature in its construction is the great ease and facility in loading and firing, it being possible to effect the same from four to six times in one minute, if necessary, and without any alteration of its position after firing; an object of paramount importance to a rifleman, who thereby need not remove his eye from the object. Its range is equal to that of any gun in existence, while its accuracy is not to be surpassed. The escape of gas, so painfully present in breech-loading arms, and which in fact has hitherto been the great drawback to their general adoption, is in this weapon entirely prevented, and consequently its force and penetrating power greatly augmented. The recoil is scarcely perceptible; the gun may be fired many hundreds of times without fouling. The simplicity of construction consists in its having fewer pieces than any other gun; it can be taken asunder and again put together in less than one minute, without any implement whatever; and, should occasion require, may be rendered perfectly useless to an enemy. Another advantage connected with this gun is, that with every one a complete instrument for cartridge-making is provided, thus rendering the possessor independent of the annoyance, so much complained of, in the supply of ammunition. The cartridge is most easily made, and a licence can be granted by the patentees to any purchaser of a rifle for his own use.

To be obtained of Mr. Sears, 49 Myddelton Square, Islington; and Messrs. Potts & Hunt, gun manufacturers to Her Majesty's Honourable Board of Ordnance, &c., 33 Leman Street, Whitechapel.

NEW BREECH-LOADING NEEDLE RIFLE.

MR. T. WILSON, of Birmingham, has invented a new Breech-loading Needle Rifle, which in many respects is a great improvement upon the Prussian needle gun. The entire mechanism is enclosed in the rear of the barrel, and is never exposed to wet or accident either in its closed or open condition. The Prussian and most other needle guns we have seen have many weak points, and among others are much exposed to injury when open for loading. In the new gun there are no projecting parts, and, therefore, there is no liability to injury in this respect. The gun, moreover, requires but two movements for opening and closing the breech, which are themselves so simple and rapid that, according to the inventor, the arm can be loaded and fired twenty times in the minute. Another great advantage in this gun is that the mechanism in closing the breech carries the cartridge into its chamber, and there being neither lock, hammer, nor extractor required in the gun, it is necessarily of very simple construction, and can be made new at a less cost than the ordinary Enfield rifle. By a very simple alteration, and without additional cost, the gun can be made to fire the Snider cartridge or any similar ammunition.—*Mechanics' Magazine.*

NEW PRUSSIAN WAR WEAPONS.

Herr von Dreyse, the inventor of the needle gun, has completed several new weapons, said to surpass the old ones in many respects. The first is a Rifle entirely of iron, with a semi-circular hook where the butt-end ought to be. By the shoulder fitting into this horse-shoe like termination, the aim is considerably steadied, an advantage of no small moment for ordinary shots, especially in the thick of the battle. The barrel has a coating of some composite substance to prevent its scorching the fingers after several discharges. It is 3 lb. lighter and 7*s*. cheaper than the present needle gun, can be fired eight times in a minute, and, in the hand of an experienced marksman, hits a man at a thousand paces. In addition to this one we have another specimen, from the hands of the same ingenious gunsmith, looking exactly like the first, only that the barrel is a little more bulky, and the bore proportionately wider. The projectile belonging to this latter gun tells at a distance of 1,500 paces, and, by bursting into eight pieces at the moment of striking, approaches in its effects the deadly execution done by the modern grenade. Ammunition wagons are easily exploded by it as by shot thrown from a cannon; and, as its weight admits of its being carried by men of ordinary strength, it is this rifle to which, in the eyes of its originator, ought to be accorded the palm. The internal mechanism of both new rifles is that of the needle gun in an improved form.

But a still more remarkable instrument for the prompt and artistic transference of an animate being from the state of life to that of death than any of the foregoing has, simultaneously with them, left the famous workshop at Sommerda. This is a Breech-loading Double-barrelled Cannon, with ammunition chest inserted between the two tubes, and semi-circular hooks, such as before described, fixed at the end. No more than one man is needed to work each barrel, the ammunition being propelled towards the gunner by a simple process, and each falling into its allotted place directly the valve is removed. Each barrel fires off an average four shots a minute, the two together accordingly discharging eight in that space of time. The few who have seen the new instrument in operation speak of the effect, both morally and physically of its continuous volley as something tremendous. Dreyse has constructed specimens of different calibre corresponding to the 3-pounders and 6-pounders of the Prussian service. A conical projectile shot from the heavier sort was seen to penetrate an iron plate two inches thick, and ignite the wooden frame behind, at 2,000 paces.

THE CHASSEPOT MUSKET.

THIS new gun insures great rapidity of fire. A man with a lot of loose cartridges beside him can fire the Chassepot Musket twelve times in one minute; but that rate the most skilful and robust soldier cannot keep up beyond about thirty rounds; past that the fire perceptibly slackens. The same thing occurs with the Prussian needle gun after the twenty-fifth round. The cause is purely physical, *i. e.* the fatigue of the man, whose left arm has often to support unaided the whole weight of the weapon. If, instead of having loose cartridges by the soldier's side, he has to take them out of his pouch, the rate of firing declines to six rounds per minute; but it averages seven or eight rounds per minute if the man is allowed to take his cartridges from the right-hand pocket of his trowsers. The accuracy of this weapon has been ascertained by making the men fire at targets two mètres high by two in breadth, at a range of 500 mètres, using a rest for the rifle. At that range a great many men firing a hundred rounds lodged a hundred bullets in the target. The point-blank range of the Chassepot musket is fixed at 500 mètres, the extreme range exceeds 1,000 mètres, and the weapon requires no cleaning before 250 rounds have been fired—1,000 and 1,200 shots have been fired with the same musket without its sustaining any damage. The Chassepot musket may therefore sustain very advantageously a competition with the needle gun. Its superiority arises chiefly from the more perfect closing of the breech, which is complete, whilst it is very defective in the needle gun. All the gases developed by the ignition of the charge are utilised to propel the bullet, which adds to its range and penetrating power, whilst the perfect combustion of the powder naturally obviates the necessity of frequent cleanings, which the Prussian weapon cannot do without.—*Abridged from the Revue des Deux Mondes.*

PALLISER'S CHILLED PROJECTILES.

EXPERIMENTS at Shoeburyness, resulting in the penetration of an 8-in. plate, with 18 in. of teak backing, by a Chilled Cast-iron Palliser Shot, have produced a profound impression in naval and scientific circles of the futility of all our iron-clad fleet to resist the penetration of shot from powerful ordnance in the event of a naval war. The gun with which the penetration was effected (the 9-inch gun) is a less powerful weapon than many guns which have been constructed both in this and other countries. But the superior penetrating power which has been manifested in this case is imputable to the hardness of the projectile, which obviated loss of effect from breaking the ball up or changing its form. The power generated by the gunpowder and imparted to the ball is expended in producing two distinct effects, one of which is the penetration of the armour, and the other the fracture or distortion of the ball. With ordinary cast-iron shot it is reckoned that about half the energy is expended in penetrating the plate, and the other half in breaking up the ball. But with the chilled shot, which suffers no change of figure, nearly the whole force is available for the penetration of the plate, and the amount of penetration is consequently greater than it would otherwise be. It was found, in the Shoeburyness experiments, that whereas the steel shot fired against the target were so hot when picked up that they could hardly be touched, the chilled cast-iron shot were quite cool; showing that in the case of the steel shot a part of the energy was expended in the generation of heat, whereas in the chilled cast-iron shot nearly the whole force was expended in effecting penetration. The introduction of the chilled shot is tantamount to the introduction of a more powerful gun, and it may now be reckoned roughly that a wrought-iron gun will pierce armour of the same thickness as the diameter of the bore.—*Illustrated London News.*

The process of "chilled casting" or "case-hardening" is an old one, and is very generally employed in the production of articles like ploughshares, and of such portions of machinery in which great surface hardness is required.

"Chill casting" means simply casting the metal in cold metallic moulds, instead of in moulds of loam or sand. The rapid solidification which results from bringing the metal into direct contact with a metallic mould "favours," as Dr. Percy tells us, "the retention of the carbon in a combined state," instead of allowing it to be diffused through the mass in the form of graphite; and it thus greatly hardens the iron, or its surface—converting, in fact, characteristic grey iron into perfectly white iron. This is the principle which Major Palliser has applied so successfully in his shot.

The success of the Palliser projectiles is due not to the material alone, but to that particular combination of form and material which has been adopted. In a discussion which took place in the *Mechanics' Magazine*, in 1864, Major Palliser stated that an essential feature of his invention was that the fore part of the shot was "of such a form as would convert the sudden shock of impact as much as possible into a uniformly increasing pressure, when the brittle nature of the material would not be of much consequence;" and, as far back as 1863, he formally proposed an elongated pointed head as necessary to the success of his system. The precise form of head is susceptible of modification, but the principle of employing a pointed head is as essential an element in the Palliser projectiles as is the

We owe to Major Palliser the enunciation and persistent support of the principle that a cheap material, thoroughly hardened outside, will penetrate equally well with steel, while its brittleness will render its effect inside the pierced vessel extremely severe. To this statement Mr. James Nasmyth has replied as follows:—

"Without desiring in the least degree to detract from the deservedly acknowledged high merit of Major Palliser, in having practically introduced the employment of chilled cast iron as a vastly superior material, when compared with hardened steel, for shot and shell intended for penetrating armour plate, in justice to myself, and as a contribution to the history of modern artillery practice, I beg to state, that at the meeting of the British Association at Cambridge in October, 1863, I did, with most earnest confidence in the results, urge on the attention of the members of the Mechanical Section the desirableness of substituting chilled cast iron in place of hardened steel for shot and shell. This I did, from the long practical acquaintance I had with the vastly superior hardness of chilled cast iron, as compared with the hardest steel."

To this letter, in the absence of Major Palliser, his brother, Capt. E. Palliser, rejoins, that "as early as the 21st of May, 1863," the Major "carried out some private experiments of firing small conical-headed chilled shot at a model iron-plated target, in the presence of some officials in Woolwich Arsenal, and that his patent is dated the 27th of May, 1863." But Mr. Nasmyth, it appears, made an error in his previous letter: the Cambridge meeting of the British Association took place in October, 1862, not in 1863, as he inadvertently stated.

But the priority is further claimed by Mr. Pritchard, President of the Royal Astronomical Society, who writes thus:—

"In the *Times* of to-day (Jan. 3), I observe a contested priority regarding the date of the proposition to apply chilled cast-iron to instruments of destruction, such as shot and shell. Major Palliser appears to claim May, 1863, and Mr. Nasmyth

October of the same year. It may not be without its lesson and its interest to many of your readers to know that, full sixteen years previously to these dates, the present Astronomer Royal, Mr. Airey, availed himself of the then well-known properties of chilled cast iron for the construction of one of the most delicate and important parts of the magnificent transit circle in the Royal Observatory, Greenwich, which for the last sixteen years has rendered memorable services to the arts of peace. The pivots of that noble instrument, at this hour, are reported to be as perfect in figure as they were when first completed, notwithstanding the wear and tear of so many years."

TORPEDO EXPERIMENTS.

SEVERAL interesting experiments have been made, during the past year, with this formidable implement of destruction. One was carried out, on May 15, upon the old sailing frigate *America*, which at high water floated over the mud in the north-eastern part of Portsmouth harbour. The Torpedoes, twelve in number, contained charges of gunpowder, varying from 20 lb. to 60 lb., and they were fixed to the sides of the vessel, below the water-line, at distances varying from five to fifteen feet. An additional torpedo, charged with gun cotton, was suspended from the bows of the ship. The whole of these machines were connected by means of a magnetic wire, which was, by a submerged line connected with a battery fixed in a boat belonging to the *Excellent*, about seventy yards distant. At a given signal the torpedoes were ignited, and a violent explosion immediately took place, causing the ship to lurch upwards, and immediately afterwards she partially collapsed, the upper deck having fallen in.

The object in making this experiment on the *America* is understood not to have been so much to ascertain the exact amount of mischief that could be inflicted on a ship by the explosion of a given number of torpedoes, as to ascertain to what extent torpedoes may be relied upon for certainty of action at distances from the bottom of a passing ship. The main inferences to be drawn from the result of the above experiments may be considered to be, that all torpedoes should be brought in close contact with the body they are intended to destroy, or they run the chance of proving harmless; and they should be brought directly under that body, or their force may be deflected. The first inference is supported by the undamaged state of the *America's* after-body, where the torpedoes were placed furthest from the ship; and the second by the fact of the slight damage done to the ship's port bow by the single gun-cotton torpedo, which evidently expended its force upwards with its immense column of water deflected off by the angle of the bow lines.

In fact, the explosion of torpedoes such as were used above adds nothing to our previous knowledge of the subject. It is now many years since Captain Warner became famous by his "long-range shell." In 1846 torpedoes were supplied by the Admiralty to Captain E. Belcher, now Admiral Sir Edward Belcher, on leaving England on his Arctic expedition, for breaking up the ice in Wellington Sound. Elaborate plans of torpedoes for attacking the Russian fleet at Sebastopol, and also for destroying those laid down in the Baltic by the Russians themselves, were laid before the English Admiralty by their chemist, Mr. Hay, but from some cause were never brought into use.

A torpedo of a more powerful and destructive kind than any hitherto invented has been tried in the dockyard of Castigneau, Toulon, with complete success. The *Vauban*, ship of war, attacked by a boat 20 ft. long, supplied with a spur armed with a fulminating torpedo, was lifted 3 ft. out of the water, and instantly sunk, in consequence of an enormous hole in her keel caused by the torpedo. The success was the more remarkable, as the charge of powder was only 6 lb., but it is of a new invention, and more powerful than any yet tried. According to the *Times*, the spur, which contains the explosive matter, is solidly fixed to the keel of a boat employed to approach the vessel to be sunk, and is longer than the boat by from 12 ft. to 15 ft. Another spur, but shorter, and supplied with an elastic buffer, is nailed to the stem of the boat, parallel to the spur under water. When the first spur was driven into the plank of the frigate, the upper one struck the ship, but the elastic buffer disengaged the lower spur and caused it to recoil. At that moment the electric spark ignited the fulminating powder, the frigate and her four boats were lifted more than 3 ft. out of the water, and again fell into the sea, giving passage through the keel to an immense column of water. This destructive effect was produced by 6 lb. weight of fulminating powder fabricated by a Paris chemist. Naval officers who witnessed the experiment, and who had served in the Baltic and in the Black Sea during the Crimean war, are said to have stated that none of the instruments of destruction then used produced such effects, or so completely destroyed a ship against which they were directed.

A correspondent sends to *Trubner's Record* a suggestion for destroying an iron-plated ship. "I would suggest (says the writer) a magnetic torpedo—a torpedo carrying a magnet of sufficient power to attract it against the bottom of an iron vessel, and to be exploded by the concussion, forcing a needle into a detonating battery. The simplest experiments with a floating iron tea-kettle and a pocket magnet in a tub or cistern of water, will show the surprising distance at which a floating magnet is moved in the water, and the maximum of its increased speed and force at its contact. The magnet for a surface or horizontal transit should be placed on a float sufficient to support it, and for an ascendant motion, to the same float should be attached a slight weight, just sufficient to overcome its buoyancy and hold it at the bottom, or in equilibrium at the point where it is required to be stationed. Torpedoes constructed upon the above plan might be conveyed under a fleet at sea, within reach of attraction; and in front of harbours (no matter what depth of water), or in ship channels leading into harbours, they could easily be adjusted with a slight weight resting on the bottom (somewhat in the manner of harbour-buoys), suspending them in a floating, upright position, at the proper depth for vessels to pass over them; and the weight attached not being heavy enough to interfere with the attraction, they would be sure of rising and striking a vessel, and exploding in the most effectual place, for the rays of magnetic attraction converge to a centre. The external form of the torpedo should be such as to incur the least resistance possible from the water in its ascendant motion."

NEW FIRE-EXTINGUISHING CARTRIDGE.

M. Aimé Maurice and M. Muterse (a chemist) have invented a sort of Cartridge, containing ingredients which are eminently capable of Extinguishing Fire. This is effected by the sudden development of a large quantity of hydrochloric (muriatic) acid gas, well known to be such an enemy to combustion, that even a small portion mixed with atmospheric air is sufficient either to prevent combustion or to arrest its progress, if it has already commenced.

This scientific principle has been known for many years, but it has never been put into so simple a practical form as in the present. These cartridges are like brown paper parcels, and are of two sizes. No. 1 is about 8 inches long and 2½ in. wide, and is intended to be thrown by the hand into the heart of the fire. A string is also attached by which it may be projected as from a sling. The cartridge is slightly explosive, so as to well disseminate to the greatest extent the substance producing the extinguishing gas.

No. 2, or the second-sized cartridges, are simply thrown (the cover being torn off) into the water of the engines, which they saturate with a substance producing hydrochloric acid gas as soon as the water touches the fire. Experiments have proved that one-tenth of the water that would have been necessary to extinguish a fire is only requisite when the cartridges are mixed with it; and that the saving of time is in the same ratio. They are very inexpensive.

No. 1 cartridges, in some cases, require no manipulation whatever, all that is necessary being to place a number of them at intervals in the most hazardous places of a workshop, a ship, or a dwelling-house, where fire may be likely to break out, and they will have the effect of keeping down any fire that may occur till the arrival of the engines.

It is well known that there are few fires (except those occasioned by explosions) that cannot be extinguished at the first outbursts by a bucket, or even sometimes a jug of water applied immediately before the fire is well alight. But water is not always at hand, nor can it be conveniently kept in every room in a house, so that a cheap "Extinctor" like this, which may be placed anywhere at hand, in a cupboard or some corner, even if it be supposed to only lessen and keep in check the flame till the arrival of water, may save many an edifice and many a town from the horrors of a conflagration.—*Builder*.

A NEW GUNPOWDER.

G. A. Neumeyer, of Döblitz, near Leipsic, originally a blacksmith by trade, has invented a new Gunpowder, which, by experiments made at Hassfurt, Zwickau, Leipsic, and Bouchet, near Paris, has been proved to possess the superior advantages of not exploding so long as the air has access to it, of acting with greater force in an airtight enclosure, and of leaving less residuum there than the ordinary powder, and of producing less and more evanescent smoke. In the Mansfield mining operations, where it is largely employed, the smoke emitted has been ascertained not to exercise any injurious influence whatever on the health of the miners. It is cheaper than the ordinary powder.

BARYTIC POWDER.

Mr. C. Vignolles has read to the British Association a paper "On Barytic Powder for Heavy Ordnance," communicated by Capt. Wynants, of the Royal Belgian Artillery. This particular kind of powder has been much experimented upon, both in Belgium and in France, with a view to counteract the injurious effect which is produced when large charges of powder are used in heavy ordnance. The principle on which this barytic powder is compounded is simply that of substituting nitrate of barytes in the composition of the gunpowder, instead of saltpetre, in certain proportions; the consequence being that the powder, when ignited, consumes more slowly, and the gases are developed less rapidly, than in ordinary gunpowder, while the same effect is produced upon the projectile as regards its ultimate velocity. This lessens the injurious effect upon the sides, vent, and chamber of the piece of artillery. Capt. Wynants entered into the details of a very large number of experiments made with this powder. The general result to be deduced from these experiments is, that we have to choose between imparting a higher degree of velocity to the projectile, at the risk of damaging the piece more rapidly and more considerably, or confining our attention to the American plan of projecting heavier shot at a lower velocity. The preponderating feeling in the minds of English engineers and artillerists, and particularly of sailors, is for a higher degree of velocity with a smaller weight of shot. The question is an exceedingly interesting one, and has excited considerable attention both in Belgium and in France, as it has done in Prussia and America. If these experiments could be continued, we should obtain some very useful information on the subject. Capt. Wynants considered that the principal difficulty in dealing with the present enormous artillery arose from the too rapid consumption of the powder, by which the generation of gas was so rapid that the interior of the gun was destructively affected before the projectile was moved. Capt. Wynants found, that by substituting nitrate of barytes for saltpetre in the composition of gunpowder the rapidity of the combustion was reduced without the propelling force of the powder being diminished—in fact, the propelling force was rendered more uniform in its action.

Mr. F. A. Abel would prefer to regulate the rate of the combustion of the powder by mechanical means, such as, by increasing the size of the grain, and by subjecting the powder during its manufacture to high pressure. Thus, the power of the powder would be preserved, while its destructive effect on the inside of the gun would be in a great measure done away with. When Capt. Wynants first brought forward his invention, he distinctly stated that the powder to which the nitrate of barytes was added fouled so much that it could only be used for blasting purposes. This would be a great objection to its use in rifled ordnance. In the course of the discussion which followed, Mr. Abel said, that Capt. Wynants did not intend that his powder should be used for small arms, but only for heavy ordnance. Capt. Noble incidentally remarked, that having had much experience on the subject, he could say most distinctly, that the gunpowder manufactured in this country—not only by Government, but by our private firms—was of a far superior quality to that made abroad.

FLUID STEERING GEAR.

At the Conversazione of the Institution of Civil Engineers has been exhibited a large working model of Esplen and Clark's Fluid Steering Gear, by which the power exerted by the steersman may be transmitted to the rudder through a considerable distance. Two hydraulic cylinders are placed in a line a short distance from each other, the mouth of each being opposite to that of the other. The plungers are united, forming in effect but one, each end of which enters a cylinder. By means of a screw, the steering wheel gives a longitudinal movement to this plunger, which is alternately withdrawn from one cylinder and forced into the other, according as the wheel is turned. Two toothed quadrants are fixed to the rudder-head, and into these gear racks connected to the plungers of another pair of hydraulic cylinders, which are ranged one on either side of the vessel. A pipe connects one of each of these cylinders with one of each of the first-described pair; and thus, when the apparatus is charged with water, the action of the steering wheel on the plungers of the first pair of cylinders is transmitted to the second pair, and so to the rudder.—*Mechanics' Magazine.*

NEW SYSTEM OF PROPULSION.

A METHOD of Propulsion by forcing out water at the stern of a vessel has been brought into successful operation in the iron-plated gun-boat *Waterwich*; and the result obtained in speed, relatively with the power consumed, is equal to what would have been obtained by the screw or other ordinary propeller. The plan of propelling by ejecting a stream of water from the stern has often been propounded, but the effect realised has not been quite so good as that obtained in other ways. In the *Waterwich*, a great wheel, or turbine, rotated by a steam-engine within the vessel, forces a stream of water through two nozzles situated near the level of the water at the stern, and, by the reaction thus produced, the vessel is propelled. The benefit of the contrivance in the case of a war vessel is, that there is no external propeller to be fouled or shot away, the whole of the machinery by which the propulsion is effected being situated within the ship (*Illustrated London News*). The above "New System" very closely resembles the following, which has been termed "Neither Paddle nor Screw."

Trial has been made of a new principle of motion, as applied to vessels, entitled the Hydraulic Propeller, Ruthven's patent. The *Nautilus*, to which the power has been applied, was built expressly to show that it can, with less horse-power than ordinary river boats, equal them in speed. The *Nautilus* at the trial started from Vauxhall-bridge pier at 11 o'clock in the morning, and ran up and down the Thames in company with the *Citizen* and other river steamers, and held way with them steadily, gaining a little on some. She ran between Vauxhall and Westminster bridges, with the wind and tide, in 4 minutes 26 seconds, and against, in 8 minutes 22 seconds, being at the rate of 13·5 and 7·2 miles per hour respectively, or at an average speed of 10·35 miles per hour—say 10½. She then steamed down the river, and when off the Tunnel-pier, with both strong wind and tide in her favour, going at full speed, was made to stop suddenly by reversing the valves. She stopped dead in less than ten seconds, and in about a quarter of her length. The new propeller is nothing more nor less than water taken in under her bottom, and set in motion by simple machinery worked by steam engine. The water is discharged in a heavy stream on both sides of the vessel; consequently, there is nothing outside the vessel to be injured by any accident. Another important novelty is, that the vessel is quite independent of her rudder, and is worked under the complete control of the master, officer of the watch, or man on deck, without any communication with the engine. The *Nautilus* is also fitted with Ruthven's steering apparatus—an invention which gives a large amount of power to the rudder.

ZINC SHEATHING FOR IRON SHIPS.

Mr. Mackie has read to the British Association a paper "On the Application of Zinc Sheathing to the Bottoms of Iron Ships." In this he explained the method of affixing the zinc sheathing to the iron plates invented by Mr. Daft. The galvanic action set up by the contact of the zinc with the iron gradually destroyed the former, but preserved the latter. The exfoliation that took place on the surface of the zinc prevented the growth of barnacles, grass, and sea-weed, and thus the ship's bottom was kept clean. Admiral Sir E. Belcher expressed his approval of the system adopted by Mr. Daft, but did not consider it a new one, as the practicability of preserving iron-bottomed ships by means of a zinc sheathing had formed the subject of experiments undertaken by the direction of the Government in 1830. Professor Rankine thought the invention a most valuable one. It was a matter of regret that the method had not hitherto been practically tried, as he believed that by its means iron ships would be rendered much more durable than they were under the present system. Mr. Hugh Brown had applied an external coating of zinc for the preservation of rifles. Mr. Galloway suggested that the Government should offer a reward for the discovery of the best method of affixing the zinc to the iron. Mr. Mackie, in reply to the various questions put to him, explained that the external coating of zinc would prevent the oxidation of the iron on the inside of the vessel. The plates could be made of any required size, and were affixed to the bottom of the vessel by means of zinc nails driven into compressed teak, which was inserted between the edges of the iron plates forming the hull of the ship. The iron plates, instead of overlapping, would be fastened together by being riveted to narrow bands of iron inside the joints, a space being left between the plates to admit of the insertion of the compressed teak. The nails securing the zinc plates passing through the teak would be clenched against the iron bands, and thus there would be no danger of their dropping out. If the plates of zinc were large, holes might be drilled in the iron plates and stopped with wood, into which nails might be driven, thus securing the centre of the zinc plates, and preventing them from bulging out. The cost of the zinc sheathing would be only one-third of that of copper sheathing, the former metal being as durable as the latter.

FROM NEW YORK TO LONDON IN A BOAT.

The boat of 2½ tons, named the *Red*, *White*, and *Blue*, ship-rigged, has made a most remarkable passage across the Atlantic from New York to the Thames off Greenhithe. This extraordinary little vessel is built of iron—27 ft. long, and 6 ft. 1 in. beam; and, considering the rough weather which she at times encountered in the course of the voyage, it is really surprising that she has got safely over. She had only two persons on

SPEEDS OF OCEAN STEAMERS.

A RETURN showing the time occupied by the Cunard and Inman steamers in their voyages out and home during the years 1864 and 1865 affords some interesting particulars. For the voyage out from Queenstown to New York, the *Scotia*, *Persia*, and *Australasian*, of the Cunard Company, stand at the top of the list—the two first averaging under 10 days, the latter 10 hours over. The *City of Boston*, of the Inman line, is next in order of speed, averaging 10 days 14 hours. The other vessels of both companies stand almost alternately, the lowest Cunard average being the *Asia*, 13 days 2 hours, and the lowest Inman average 15 days 17 hours. For the voyage home, the Cunard steamers almost all average considerably less than the Inman. The *Scotia* leads off with an average from New York to Queenstown of 8 days 23 hours. The highest average for an Inman steamer is the *City of Boston*, 10 days 4 hours. The lowest

Cunard average home is the ancient *Asia*, 11 days 18 hours; and the lowest Inman, the *Glasgow*, 13 days 5 hours.—*Mechanics' Magazine.*

THE LARGEST SHIP IN AMERICA.

The *Great Republic*, the first of the new steamers building for the Pacific Mail Company's line between San Francisco and China, has been successfully launched from the shipyard of Mr. Henry Steers, at Greenpoint, New York. The following are her measurements:—Length, extreme, 380 ft.; length between perpendiculars, 360 ft.; width of beams moulded, 48 ft. 6 in.; width of beam, extreme, 50 ft.; depth of hold, 31 ft. 6 in. The *Great Republic* is believed to be the strongest ship afloat: her frame timbers are of white and live oak, these are fastened with copper and iron, and braced with straps of iron 5 in. wide and ⅞ in. thick, crossing each other diagonally every 4 ft.; over this comes the inner planking, caulked and payed with pitch, and then double strapped as before; and outside this double strapping comes an exterior of double planking of Georgia yellow pine. The vessel is ship-rigged, but her foremast will be the tallest one of the three. She has three decks, unusually stout and strongly fastened, and four water-tight bulkheads. Her engines are vertical beam, having a single cylinder (in which the piston works) of nearly 9 ft. in diameter and 12 ft. stroke. The paddlewheels are to be 40 ft. in diameter, having a face of 12 ft., and each wheel is provided with 34 oak buckets or floats. During the late war the Pacific Mail Company built seven first-class ships, whose total register tonnage was 21,806 tons; while, by carpenters' measure, they were, in the aggregate, 26,046 tons. The *Great Republic's* registered tonnage is 4,100, 5,200 builder's measurement, exclusive of engine-rooms. The Company's fleet consists of 19 vessels afloat, and they are building three others as large as the *Great Republic.*

ARMOUR-PLATED VESSELS.

In a lecture delivered at the Plymouth Mechanics' Institute, Mr. Reed, the Chief Constructor of the Navy, has said that the unfair and perpetual depreciation of our ships has caused a loss of public confidence; but it is not true that English ships are inferior. The *Warrior*, in spite of some imperfections, is a magnificent ship, well adapted for performing ocean service in the interests of commerce. The *Achilles* is splendid, as regards some of the most important qualities of a man-of-war; but she, too, of course has her drawbacks, the greatest of which is her extreme length, and consequent unhandiness under steam; and the *Bellerophon*, for this reason, on account of her thicker armour and having heavier guns, is preferable to her as an engine of war, although costing 100,000*l.* less. These ships are not failures, nor anything resembling failures. He said we ought to build some ships upon the turret principle, neither purely on the American plan nor purely on Captain Coles's, but embracing the best points of both; to carry armour 15 in. or 16 in. thick, and 20-ton guns; and to steam at fifteen knots. The ship which he described as "by far the most powerful iron-clad yet built in this country" is not one of her Majesty's fleet, but a ship called the *Fatikh*, built for the Sultan, and subsequently purchased by the Prussian Government.—*Mechanics' Magazine.*

ARMOUR-CLAD TURRET VESSELS BY LAIRD.

MESSRS. LAIRD, BROTHERS, of Birkenhead, have completed three Armour-clad Turret Vessels of small tonnage, carrying heavy guns, viz.:—

1. The *Huascar*, a fully-rigged sea-going turret-ship, of 1,100 tons old measurement, and 300-horse power (her foremast being fitted with tripods on Captain Coles's plan), and carrying two 12-ton Armstrong guns, two 40-pounder broadside guns (the four guns throwing a broadside of 680 lb.), and all coals and stores, on 16 ft. draught, and having attained a speed at the measured mile of 12¼ knots. This vessel has made a most successful passage as far as Rio Janeiro.

2. The *Bahia*, a twin-screw vessel for coasting and river work, of 1,000 tons old measurement, and 140-horse power, having a speed at the measured mile of 10½ knots per hour, carrying two 150-pounder Whitworth rifled guns in one turret and all coals and stores on a draught of water of only 8 ft. This vessel made the run out to Rio Janeiro at an average speed of about nine knots per hour, and has since been engaged in the attack on the forts on the Paraguayan river, when she came out without damage to hull or turret, though struck with heavy shot 39 times.

3. The *Bellona*, a twin-screw vessel, for sea-going and coasting service, of 1,340 tons, old measurement, and 300-horse power, having a speed at the measured mile of 12 knots, and carrying four 150-pounder rifled Whitworth guns in two turrets (a broadside of 600 lb.), coals, and stores, on a draught of water of 12 feet. This vessel has made the run from Liverpool to Rio Janeiro at an average speed of more than 9½ knots per hour.

These vessels are all constructed with turrets on Captain Coles's plan; they have made the voyage across the Atlantic without requiring any vessels to convoy them, and are capable of being sent to any part of the world where their services may be required.—*Communication to the Times.*

ARMOUR-CLAD GUNBOATS.

A VESSEL of this description, possessing great powers of offence and defence carried on an exceptionally light draught of water at a high rate of speed, has made a trial trip on the Thames, and it was the unanimous opinion of all on board that not only was the vessel a success in point of speed, but that also for her tonnage she was unequalled by any other vessel afloat, turret or broadside-gun vessel, in her fighting powers. The *Medusa*—so the vessel referred to is named—is an Armour-clad Gunboat, 190 ft. in length, 36 ft. in breadth, with a builder's tonnage of 1,160. Her hull is built of iron, with eight water-tight compartments, and is covered in with a $\frac{3}{4}$-in. iron-plated deck, on which is laid the usual wood planking. Round the water-line of the hull is fixed a belt of armour-plating, $4\frac{1}{2}$ in. thick and 4 ft. wide, going completely round the bows and stern at the same thickness as on the sides. The stem of the ship is fitted on the "ram" principle, as introduced by the Chief Constructor of the English Navy, and which, on the coasts or rivers of a country, must prove a powerful weapon of offence in attacking an enemy. In a central position on the hull is built up a square armour-cased battery, covered with $4\frac{1}{2}$-in. armour-plating, and pierced with eight gun ports—two on each broadside, and two at each end; the latter sweeping the fore and after decks, and firing in a line with the keel, the lower cills of the gunports on the broadsides, when the vessel is complete in all respects for sea, being 6 ft. from the water-line. This square battery is 54 ft. in length by 36 ft. in width—somewhat astonishing dimensions for so small a vessel, and will mount four ten-ton rifled Whitworth guns, on improved carriages and slides. The sides of the battery are built up of the outer $4\frac{1}{2}$-in. armour, backed with nine inches of teak, the latter carrying an inner skin of $\frac{3}{4}$-in. iron. This iron inner skin is supported by vertical iron frames 6 in. deep and 18 in. apart, secured to the $\frac{3}{4}$-in. plating by 3-in. double angle irons, over the latter being laid a 4-in. wooden lining inside all. Through the fore part of the battery rises the pilot-house, covered with $4\frac{1}{2}$-in. armour.

The engines of the vessel are direct acting, horizontal; the cylinders having a diameter of 34 in., and the stroke being 21 in. They drive a pair of independently working screws of 7 ft. 6 in. diameter, and 11 ft. 6 in. pitch, distance between centres 12 ft. In the *Medusa*, contrary to previous practice with twin screw engines fitted on the Thames, the engines throw inwards —*i. e.* the two screws work towards each other. The draught of water of the *Medusa*, with all on board and complete for active service, will be but 8 ft. forward and aft; and this fact, if considered in connection with the power of the ship's armament, the size of her battery, and the extent and completeness of her defensive armour, will quite sufficiently demonstrate her formidable character: her speed under steam, her manœuvring powers, her extraordinary capabilities of attack and defence, were very satisfactory. It was proved that, with the bulwarks of the *Medusa* thrown down as for action and her guns pointed through the four forward or after ports, a more rapid and heavy fire could be maintained upon an enemy ahead or astern than could be effected from any turret-ship of similar tonnage; the *Medusa*

their apportioned work. Six of these engines drive the blowers which receive the air from the main air-shaft (standing between the two funnels on the upper deck, about 9 ft. in height), and distribute it along shaftings and up through gratings in all parts of the ship; for at sea the ship is necessarily battened down fore and aft, and the only air that can enter the ship then, except down the main air-shaft, is through the perforated tops of the turrets and pilot houses. With two of the blowers set slowly to work on board there is a strong upward rush of cool air through the air gratings in the floor of the ward-room and other parts of the ship; the thermometer in the captain's cabin, previous to the blowers being set moving, marking 75 deg. There is, however, a feeling of oppressiveness, which was perhaps due to the absence of the greater portion of the daylight, and the knowledge that air was being then breathed which had been sucked into a part of the vessel below the water line by mechanical means, through an iron column communicating with the outer atmosphere. All the officers of the *Miantonomoh* declare that they rather like being at sea in a closed vessel. They get plenty of air below from the blowers, and must do so as long as there is any steam to drive them; and of the two, for comfort, they rather prefer for a sea voyage a vessel like their own to an ordinary cruiser. Indeed, the thermometer records kept on board prove that the heat below during the voyage across the Atlantic cannot have been so great as would be imagined by a stranger looking over the ship as she lay at Spithead, and examining the means of supplying and regulating the inboard draught of fresh air. At sea, however, the upper deck is always awash with the seas rolling over it, and this no doubt tends to cool the atmosphere below.

With regard to the seaworthiness of the vessel, no ship, her officers declare, could have behaved better than the *Miantonomoh*, and there was a sufficiently stiff breeze experienced between New York and Halifax to test her in that respect. The seas rolled over her deck whenever the waves rose, on the quarters, the bows, or broadside, but they washed over without affecting the ship; and the officer of the watch, from his roomy perch on the raised platform between the two turrets, could look with perfect equanimity upon the submerged hull of his vessel below. In this respect the *Miantonomoh* only differs from many deep-loaded sailing clipper-ships, in having no bulwarks to hold the water on her decks. Of the exact amount of work to be got out of the 15-inch guns there appear to be no exact data available for comparison with the work of our best present ship-gun, the 12-ton 9-inch rifle, or 250-pounder. Commander Cornwall, of the *Miantonomoh*, who commanded a monitor before Charleston, once fired a total of 750 rounds from one of these guns, but the greatest number he ever fired in one day was 60 rounds. No phraseology would describe the outline of this gun so well as the accepted "soda-water bottle." Although of the immense diameter of bore of 15 in. at the muzzle, the outer diameter there is only

21 in., but the breech is immensely weighted with metal. The gun, however, is so evenly balanced upon its trunnions, that the captain of the gun can elevate or depress it with one of his fingers only on the screw lever. The elevating screw is 4½ in. in diameter, and works loosely with its heel in a flat-bottomed metal cup, so as to "give" with any sudden shock from the gun. The carriages are, as has been already stated, superior to anything of the kind previously seen in this country. They are simply made, and have a "continuity of strength" throughout. The compressors are three iron plates working between four wooden balks. The slide lies on a level with the turret floor, and is merely two iron beams 9 in. by 3 in., planed true on their upper edge, and connected to beams and plates at each end. Two men can run the gun in or out with ease, and one man can regulate the compressors. The sights over the top of the gun give a range of 2,300 yards. The extreme of the gun's elevation is 9 deg., and of depression 3½ deg. The turrets are 9 ft. in height above the iron 3-inch deck, the 3-inch wood deck above the iron deck being above the actual base of the turret on the composition ring on which it rests. When fitted to the ship, the under surface of the turret-plates, where they rest on the composition ring, and the ring there itself, are both planed true, and are always afterwards kept well oiled and greased, to reduce the friction when the turret is revolving. Supposing that the turret is raised, as it is termed, for revolving, the fact is, that only about two-thirds of the weight is taken on the spindle, the remainder slipping round on the composition ring. The turret is built of ten one-inch rolled iron plates, the surfaces of which are all carefully planed, and the whole then set up together in a cylindrical form, each plate breaking joint with its next neighbour. The bolts are "marlin-spike" shaped, of less diameter, but much more numerous than in our turrets; and their heads are clinched on the outer face of the turret, instead of being cut off, as with us. The top of the turret is closed in with iron bars, 4 in. by 3 in., which are again covered with iron plating of one inch, perforated. The two gunports are each 2 ft. wide by 3 ft. 10 in. in depth. They can be closed when the gun has been discharged, by a 13-in. iron stopper, which is pivoted on the floor and roof of the turret, and easily swings into and out of position. The pilot-house on the top of each turret weighs about 30 tons. The side armour of the ship is 7 ft. in depth from the deck level to below the water-line, and is formed of seven one-inch plates.

The engines of the ship are of 800-horse power, nominal, on the back action principle of Mr. Isherwood, United States Navy, the connecting rod working towards each cylinder-head. The cylinders are 30 in. in diameter, with a 27-in. stroke of piston, driven at full speed at 80 revolutions, with from 35 to 38 pounds of steam. The screws work inwards. The average heat in the engine-room, in coming over, averaged 80 deg., and in the stoke-hole, 120 deg.

The main fault to be found with the *Miantonomoh* is that she has been constructed of wood, instead of iron. The enormous weight she has to carry in turrets, guns, side and deck armour, and engines, must eventually tell upon a wooden hull. If we compare her with our own wooden-hulled *Royal Sovereign*, we find her excelling our ship in smallness of target offered to an enemy's shot, and in manœuvring power by the action of her twin screws. On the other hand, the *Royal Sovereign's* turrets appear to be mounted on a much better system, by reason of the greater diameter and strength of their central spindle, and the solid wide area of support given by the frames of conical wheels under the turret turn-table. The *Royal Sovereign*, too, is very much more habitable than the *Miantonomoh*. On the relative merits of the guns and armour of the two ships no one can give a reliable opinion. One peculiar feature in the American turret was almost omitted from our notice—its ten one-inch iron plates have no "backing." The interior diameter of the *Miantonomoh's* turrets is 21 ft., and their height, from floor to the overhead beams, 6 ft. 4 in.

During a visit of the Lords of the Admiralty to the *Miantonomoh*, the first gun fired was charged with a 35-pound powder cartridge and a *sabot* live shell, at extreme elevation. The effect was very grand as the vast globe of metal propelled from the mouth of the gun with a deep hoarse roar, went hurling on its course until it fell at an estimated distance of about 3,500 yards from the ship.

The second gun was charged with 35 lb. of powder, a solid iron shot of 460 lb., and fired point blank. If the last shot was grand, as exhibiting the flight of a 15-inch shell, this was more interesting, as exhibiting—what we have as yet made no provision for in rifling our heavy naval artillery—the perfection of *ricochet* firing. The immense ball spun along its course over the surface of the water as truly as the cricketer's ball passes over the smooth green sward towards the wicket. The noise of the explosion, the concussion felt, and the smoke, which entered the turrets on the firing of the guns, were neither more nor less than would be naturally expected in firing 35 lb. powder charges.—*Times*.

HER MAJESTY'S SHIP "ROYAL SOVEREIGN."

THE great duel between the $12\frac{1}{2}$-ton 9-inch rifled naval service gun, with its enormous steel bolt and powder charge, and the after (single gun) turret of the *Royal Sovereign* has taken place in consequence of the recommendation of the Turret-ship Committee, in their report to the Admiralty, dated June 28, 1865; combined with the desire of the Admiralty to obtain reliable *data* for their guidance in the construction of the *Monarch* and other turret-ships in the future. There was no other field from which they could obtain such *data*. We know all that the Americans have done, but it would be folly to accept their experience as our guide when the conditions are so opposite. The turrets of the American ships are exposed to an enemy's shot from base to summit above the level of the upper deck, working on a long central spindle on a limited bearing, something akin to the spike of a schoolboy's pegtop when spun. We expose but a portion of the turret to the enemy's shot and protect the base by the vessel's side armour, deck, and glacis plate, and also pivot them over a larger area than is contained in the circumference of their base. To this essential difference in the system of mounting the turrets in the vessels of the two countries may possibly be ascribed the disabling of the turrets of the American vessels *Paissac*, *Nantucket*, *Weehawken*, and *Nahant* before Charleston; their turrets having become jammed—unable to rotate—either by blows from shot on the face of the turret bending the central spindle, by the breaking of the deck or composition ring at their base, or by broken pieces of iron or nut and bolt ends falling between their base and the deck.

The three single and the one double gun-turret of the *Royal Sovereign* are all constructed on the same plan. The one fired is simply a hollow composite cylinder standing on a circular wooden turntable of great strength over a double ring of conical metal wheels which travel over metal roadways; the cylinder with its table being pivoted on a centrally-fixed hollow iron cylinder, and the whole resting on a bed of oak balks, and further supported by iron stanchions springing up from the keelson of the ship.

We have not space for the details of the experiments, but give the results. The important fact now remains, as the result of this somewhat costly experiment, that, drawing an inference from the above trial, no amount of pounding from shot could possibly disturb the equilibrium of the *Royal Sovereign's* turret's base; and that if the whole exposed portion had been shot away, the base with its turn-table and revolving machinery would still remain absolutely perfect. There are errors of construction in the *Royal Sovereign* which may be remedied in future with other turret-ships; such, for instance, as the want of a tie-collar, or ring of metal, round the outer face of the turret at the upper edge, to prevent the plates falling outwards when their fastenings are loosened; as also leaving the bolt-tails and nuts without any over-lining, and thus turning them into grape-shot when the turret is struck by heavy missiles.

The success of the turret of the *Royal Sovereign* over the 12½-ton gun is immense in its importance for many reasons; and it also proves conclusively, by the deck shot, the value of curved or deflective surfaces in warding off shot blows from wood or from iron. All honour, therefore, to Captain Coles for his persistent advocacy of a system of mounting ordnance on board a ship that will, at any rate, add a power to our fleet of iron-clads equivalent in nature and force to the siege artillery of an army before the famous Venetian Quadrilateral! As the turret system was certainly to a great extent placed on its trial by this firing at the *Royal Sovereign's* turret and deck, it was imperative that note should be carefully taken of any unfair disadvantages which appeared to be imposed upon it. From this point of view—1, the turret built in a converted ship to resist the ordnance of 1862 was about to be tested by the ordnance of 1866, the armour on the turrets of the *Monarch* now commenced building at Chatham being twice the thickness of that of the *Royal Sovereign*; 2, the original clear space existing between the sides of the *Royal Sovereign's* turret, and the iron well-ring has been very considerably reduced lately by iron fittings carrying pauls to facilitate the working of the guns, and, therefore, increased the chances of "jamming" the turret against the well-ring when struck by shot; 3, the gun being removed from the turret left the port open for a shot to enter from glancing, or other causes, when the shot would inevitably pass through the inner skin of the turret on the opposite side, and bulge the armour-plating outwards against the well-ring.—*Abridged from the Times.*

LAUNCH OF THE "NORTHUMBERLAND."

At length, after the fourth attempt, the *Northumberland* was safely sent afloat, on April 17, 1866, having remained almost to the hour and minute exactly one month on the ways from which it was first endeavoured to launch her. The great mechanical effort involved in lifting and floating this vessel was one which even the most experienced shipwrights and nautical engineers looked forward to with the utmost uncertainty and anxiety. The wind was against them, and the tide was still lower, for a time, than on the previous day. All the preparations, however, had been made with the most precise exactitude, and the floating and pressing power employed around the ship was of itself almost enough to move her weight, even when not half water-borne by the rising tide. The whole of the cradle had been rebuilt and regreased. A flotation power of empty barrels had been lashed under the bows, and all the old and new-built timber buoys were also employed. No less than seven hydraulic presses were used to push the cradle down, and to lift the fore-part of the vessel. Three of these—one of 1,000 and two of 400 tons pressure—were placed beneath the keel, so as to assist in lifting the huge hull forward and relieve the weight where it most bore upon the launching ways. Four other hydraulic rams were fixed with iron backings, so as to thrust against the cradle and force it down the incline which led to the river. Two were of 600 tons power each, and two of 400 tons, giving an aggregate of 1,800 tons upward lift, and 2,000 tons downward pressure towards the water. The floating power which these and the other smaller "camels" and lines of empty barrels gave was equal altogether to about 1,600 tons. The vessel itself, when immersed at high tide, would, it was calculated, be reduced in its weight upon the ways by about 4,000 tons more, so that literally no greater weight than 2,000 tons would remain to be started, to effect which the hydraulic power was much more than equal. Close on three o'clock, when the men were set to work at the hydraulic presses, there were a few minutes of intense anxiety as the gangs heaved at the pumps, and the huge crowds assembled in all directions kept cheering. Then the vessel at last seemed to move, and as she did so she drew the anchors which moored her to the earth; and their sudden appearance created rather a panic among the crowd of spectators who were standing directly in what would be their line of march if the vessel pulled them after her. Very fortunately the chain-cables were let go by the run, and as they came with a thundering rattle out of the hawse-holes, the *Northumberland* glided slowly, but with the most perfect ease and regularity of motion, into the river.

Thus (says the *Athenæum*) the *Northumberland* was launched, after much additional cost and labour, and speculation on her stoppage on the ways. Among the causes assigned, the true one was, in most instances, overlooked. It was a mistake to plate the big ship while on the stocks; for her weight was thereby enormously increased; and, what is of more importance, such a muddle was made of her magnetism that, without extraordinary precautions, her compasses will be little better than useless. It is well known to the Admiralty, for they were assured of the fact some time ago by the Royal Society, that a ship should never be plated with her head in the same direction in which she was built; that she should first be launched, and her head placed in the contrary direction, and then her armour-plates may be put on. This is the only way as yet known by which the permanent magnetism of an iron ship can be reduced to a manageable quantity; the whole theory of the question and the practice to be followed are duly set forth in the *Philosophical Transactions*, so that it seems not unreasonable to inquire who is responsible for the neglect of the proper precautions. Moreover, there was experience which might have been profited by; for the same neglect prevailed in the building of the *Minotaur*; and the muddle of her permanent magnetism was such that, when ready for sea, her compasses were found to be eight points wrong. There needs but a small acquaintance with navigation to enable anyone to foresee what would be the result of a cruise in the Channel, or indeed in any sea, with compasses whose directive power was so markedly neutralised. Is it transgressing the limits to ask that the mistake be not repeated? When the armour-plated battery *Pernevetz* was built in the Thames for the Russian Government, they sent over a scientific officer to superintend the work; and he, being well acquainted with all that the Royal Society had published on the subject, took care to have the battery plated after it was launched, and with its head placed in the reverse direction to that it had while on the stocks.

NEW PONTOONS.

A COMMITTEE of Royal Engineers have witnessed, at the Gardens of the Royal Horticultural Society, South Kensington, the merits of some new light infantry Pontoons, invented by the late Captain Fowke, R.E. The experiments were performed by the 1st Middlesex Engineer Volunteers. The operations commenced soon after seven o'clock by the construction of a bridge 50 ft. in length, formed of these new pontoons, and throwing it over a piece of water. Each pontoon, says the *Times*, when extended is 8 ft. long and 2 ft. 6 in. wide; but when folded, as it can be, into the shape of a carpet bag, the width of its extended shape becomes its length when thus contracted. The weight of each of these pontoons is only 50 lb., of which 29 lb. is allowed for the lower part of the arrangement, while 21 lb. represents the weight of the superstructure. It will be seen, therefore, that to form a bridge of 50 ft. in length, only 20 of these pontoons are required. The weight of this whole erection—each pontoon, as we have shown, weighing 50 lb.—would amount only to 1,000 lb., or somewhat short of 9 cwt. A bridge of this length and weight was thrown over one of the basins in the Horticultural Gardens, by forty men of the 1st Middlesex Engineer Volunteers, in the space of two minutes, and was immediately after separated into its component parts in a minute and a half. This experiment was repeated several times with singular success.

The peculiar advantage of these pontoons, as indicated by those who are endeavouring to promote the adoption of their use into the service, is their capability of being employed in crossing ditches and moats in sieges, for which the old structures have never been made available. To show their excellence in this respect, a bridge formed of the pontoons was let drop from one of the balustrades of the garden into one of the basins. This was not done, however, without difficulty; and some of the covering of the pontoons got torn, so much so as to permit the water to enter the inner part of the construction. This apparent mishap only tended to exhibit prominently another peculiarity of the invention. Each portion consists of six water-tight compartments, and even though five of these are injured, the remaining one has sufficient flotation power to sustain the complement. In this case, then, though considerable damage was done to the bridge which had been formed on the ground, there was no apparent decrease in its buoyancy and strength. Another distinctive feature in the new arrangement is, that the superstructure can be erected before the bridge is cast on the water; whereas when using the old pontoons it is necessary to make the roadway after the under portion has been launched. The three points, therefore, on which the promoters claim a superiority for this new and apparently successful adaptation are lightness in weight, economy in time, and manageability in cases in which the use of the old instruments were found impracticable.

NOVEL HYDRAULIC MACHINE.

There has been shown, between the Pont Neuf and the Pont des Arts, a new Hydraulic Machine, invented by M. Roman, of Rue de Lille, Paris, for utilising the force of currents and deriving a motive power therefrom. It consists of a large raft or barge, similar in size and shape to the open washhouses on many continental rivers. This is fitted with a series of transverse rollers, on which moves an endless chain passing under the boat, and fitted with a great number of flat boards, 2 mètres asunder. A greater surface is thus brought to play against the current than in an undershot-wheel, which yields, even in the best condition, barely 30 per cent. of the theoretic force of the water. As in all ingenious and useful inventions, the principle on which this machine acts is of extreme simplicity and facility of application. If we suppose a float of an undershot-wheel submitted to the action of a current of water which impels it with a given force; if to this float we add a second parallel to the first, at 2 mètres distance, behind it, the second float will also be impinged upon by the water. It has been clearly demonstrated by experiment, that the effort exerted on the second float is equal to 75 per cent. of that brought to play upon the first. A third float-board will be subject to the same laws as the second, the result being, that a series of parallel floats will obtain from the force of the stream a motive power only limited by the velocity of the water and the constructor's design. In 1865, a small trial-machine, six of the boards being constantly immersed, gave by Prony's dynamometer, a useful effect of three, four, or even five times that of an ordinary undershot-wheel.

The present machine has always thirty-four float boards immersed; and though the velocity of the Seine is only 45 to 48 centimètres (17·72 in. to 18·9 in.) per second, in the trials made in presence of our Correspondent, the useful effect has been on an average twelve times greater than that of ordinary wheels. As to the applications of this hydraulic engine, they are innumerable. Geared into a series of pumps, either for the supply of towns or for purposes of irrigation, it is capable of becoming a great source of economic power; while the working expenses are reduced to the charge of simple inspection, no manipulation being required. —*Mechanics' Magazine.*

NEW HYDRAULIC PRESS.

MM. Desgoffe and Olivier, civil engineers, have invented a new Hydraulic Press. The principle on which it acts is simple. There is no forcing or injecting pump, and instead of a liquid being introduced into the press, already filled, a rope is made to enter, and as it enters it gradually displaces the liquid, causing the plunger to rise. The inventors have given it the name of

Starhydraulic Press. Oil is the liquid with which the chamber is filled, and the rope is made of gut.

According to the description given in the *Mining Journal*, there appear to be two pulleys or drums, one inside the press and the other outside; on the outside pulley is coiled a rope, which passes through a stuffing-box into the interior, when it is wound round the other pulley. The recipient being full of liquid, the inner pulley being set in motion, it is plain that the rope as it coils will occupy the place of the piston and cause it to rise. When the reverse motion is required the outer drum is set in motion, and the cord is wound out of the press, the piston descending accordingly. The joints of the piston and of the axes of the internal pulley are made staunch with leather collars; that of the rope is simply tow. There is no leakage where the rope enters, as when the press is at work any tendency of the liquid to escape is met by the velocity of the rope as it enters in a direction opposed to the effort of the liquid to escape. As these presses are, for the present, only to replace vineyard and oil presses of the olden times, they have as yet only been made up to a force of 50 tons.

HYDRAULIC BUNG.

Dr. Weber has brought before the Industrial Society of Mulhouse a Bung of his invention, which allows of the escape of carbonic acid gas during fermentation, but prevents loss by the evaporation of alcoholic vapours. It is sometimes difficult to know whether fermentation has ceased or not, and if the cask be closed before it has done so, there is a risk of the cask being burst. With the improved bung, which is similar in principle to an ordinary stench trap, there is no danger of this, as the carbonic acid gas can escape whenever it has attained sufficient pressure to force itself under the edge of the inverted trap. The bung is constructed of pottery-ware, and is not, we presume, intended for permanent use.—*Mechanics' Magazine.*

HYDRAULIC COAL-CUTTING MACHINE.

Mr. W. E. Carrett has read to the British Association a paper descriptive of "An Hydraulic Coal-cutting Machine," and exhibited a small working model. The machine, by means of a series of ingenious mechanical arrangements, is capable of being most readily adjusted and moved to suit the various conditions under which it is required to be used in the pit, and these could only be made intelligible by means of elaborate diagrams or inspection of the machine itself or the model. The principle on which the machine works is that of the planing and slotting machine; the cutters acting by direct continuous pressure derived from a column of water, and not by blows. At 15 strokes and 30 gallons of water per minute, at 300 lb. pressure, a result is stated to be obtained which is equal to the work of twenty men.

In reply to Mr. Bateman, Mr. Carrett stated that it would act on hard materials, and that it successfully cut pyrites and "black-band." There was no difficulty in sharpening the tool, as from its shape it simply required the grinding of a flat surface. Mr. Whitwell confirmed the successful working of the machine, which had come under his own knowledge. It has crushed the hard stone in a surprising manner.

CONSTRUCTION OF BREAKWATERS.

An excellent method of constructing Breakwaters has been illustrated in a model sent by Mr. Prichard Baly to the Conversazione of the Institution of Civil Engineers. Mr. Baly constructs an iron framing of $\wedge$ section, the sides being fitted with stepped iron plates, and the interior may be filled with stone for exposed situations. The iron breakwater can be built upon a bank of stone deposit, carried up to 14 ft. below low water-line. Where stone cannot be procured, the structure can be erected upon the natural bottom. The interior space between the iron plates forming the sides of the breakwater can be filled in with stone deposit, or gravel, alone or mixed with lime tipped from wagons running upon the top of the breakwater, so as to back up the plates as soon as they are put into place. This principle of construction, which possesses great merit, has been adopted in the Black Sea breakwater.—*Mechanics' Magazine.*

SIXTY-TON CRANE.

The following are the principal features in connection with the recent application of steam-power to the 60-ton Crane, Quayside, Newcastle. The cylinders are two in number, 10 in. in diameter, 14 in. stroke, bolted to side-frames, and geared direct to the existing gearing. Behind the crane is placed a strong wrought-iron platform, forming a receptacle for coals and water, upon which is placed a boiler of the vertical description. The turning gear is arranged so as to make a complete revolution in three minutes. Formerly, when using manual labour, this ponderous mass required sixteen men and about one hour to make a revolution when loaded, and about the same number of hands when lifting. With the present arrangement, weights up to 60 tons can be lifted at the rate of 3½ ft. per minute, and swung round with the greatest ease, only requiring the attention of one man. The machinery has been constructed by Messrs. Black, Hawthorn, & Co., of Gateshead.

PROPOSED TUNNEL UNDER THE CHANNEL.

Mr. Hawkshaw has long contemplated the practicability of this enterprise, and has for more than two years been engaged in a geological investigation of the localities. Borings are now being made at a considerable expense in the neighbourhood of

Dover, and by permission of the French Government, between Calais and Boulogne; and explorations will be made in mid-channel. Such trials are essential, in order to obtain positive knowledge concerning the nature, extent, and thickness of the strata. It is proposed to carry on the excavation for the tunnel from both ends, as well as from shafts in the Channel. At the top of the shafts powerful steam-engines will be erected for pumping, for drawing up the excavated material, and for supplying power to the machinery by which excavation will be effected. The tunnel will communicate on the French side with the Northern of France Railway; and on the English side with the South-Eastern, and London, Chatham, and Dover Railways, so that there will be an unbroken line of railway communication between London and Paris. Mr. Hawkshaw will not be able finally to decide upon the details of this great work until the completion of the borings now in progress. It is calculated that the tunnel will take 20 years to complete, and cost not less than 20,000,000*l*.

During the past year a brigade of geometricians and naval men have studied the possibility of carrying out this project. Levels were taken, plans drawn, &c., under the direction of M. Thome de Gamond. It will be remembered that a special commission appointed by the Emperor made a report some years ago, in which the feasibility of the project was proved, inasmuch as the submarine rocks of which the Straits are formed offer no serious obstacle to its realisation. M. Gamond has made surveys every year since this report was drawn up of the ground, and has decided that artificial islands will not be required, but that the tunnel can be constructed in four galleries, the longest of which will not exceed ten kilomètres.

The public may be interested in learning the solution proposed by another of our leading engineers. Mr. Fowler, after many months' study of the subject, has formed the opinion that the expense, difficulties, and uncertainties of a tunnel of such unprecedented length would render it unadvisable. He proposes an ocean ferry, worked by steam vessels of immense size, constructed to carry across the Channel, not merely passengers and their luggage, but the railway trains in which they are brought from London or Paris. These boats will start from docks to be specially constructed at Dover and Calais, and will, like the Great Eastern steam-ship, convey their living freight with practical immunity from the discomforts of a sea-passage. The details have already been worked out in the designs of the vessels, under the eye of Mr. Fowler, and they will insure to the passengers protection from weather, and from all the present delays and inconveniences of transhipment. The scheme is one which could be completed and brought into operation in less than two years, with an expenditure of less than a million and a half sterling.

CONCRETE FOR BUILDING.

An ingenious application of the well-known process of moulding blocks of Concrete for building purposes has been patented. The inventor, a Mr. Tall, proposes to erect walls, houses, and other structures, by literally casting them of concrete, in the place they are intended to occupy. An ordinary concrete foundation is first laid, and upon the foundation horizontal frames, constructed of boards lined with zinc or other metal, are set up on edge, so as to form a kind of trough for receiving the concrete. By the insertion of suitable cores, holes for the insertion of the joists, or for other purposes, may be moulded in the concrete as the work proceeds. The proprietor of the patent is now in Paris, superintending the erection of some houses on this principle; and we believe it is the intention of the French Emperor to build some labourers' cottages of this kind at one of the Imperial farms. The invention will be illustrated at the Paris Exhibition, where a space has been set apart for the erection of buildings of various constructions, from the hut of the Laplander to the chalet of the Swiss peasant.

LARGE IRON FLOATING DOCK.

A correspondent of the *Times* describes the trial of the large Iron Floating Dock, which had been sent out in pieces from England some four years past, and only recently completed, at Cartagena, the naval port of Spain, in the Mediterranean. A man-of-war, the *Alceda*, of some size, had been lifted high and dry out of the water, for the purpose of undergoing repairs; and she was then replaced in the water. At 9.20 orders were given to sink the dock and allow the vessel to float out. The engineer in charge, Mr. Fenwick, an Englishman, who was the superintendent of the work, immediately gave orders to open the valves; the dock began to sink gradually, retaining its horizontal position. At 9.40 the water began running over at both ends. The dock having sunk some 5 ft. or 6 ft. in a few minutes, the two streams met in the centre, showing how equally the dock had sunk, the entire floor being now covered with water and touching the keel of the vessel, and half-an-hour afterwards the vessel was afloat. The valves for immersion were now closed, and the vessel hauled out. This operation of sinking the dock was effected with such steadiness and regularity, that unless the height of the water was carefully observed no motion was apparent. Mr. G. B. Rennie, the patentee of the dock, and his wife, were on board. By an arrangement of air or buoyant chambers, the dock cannot sink beyond a certain depth. In order to demonstrate this (after the vessel was clear of the dock), Mr. Rennie requested that the immersion-valves might again be opened, and the dock allowed to sink to its greatest depth; in a quarter of an hour this was done, and she would sink no deeper, leaving the sides about 8 ft. out of water. This will allow of a vessel drawing 27 ft. of water being docked. The engines for

PROGRESS OF NEW BLACKFRIARS BRIDGE.

PROBABLY no structure of its kind in Europe can be said to equal the New Bridge at Blackfriars, either in design or magnificent solidity of workmanship. The total length of the bridge from end to end is to be 922 ft., and this enormous stretch is carried on only five arches. The centre arch has a span of no less than 185 ft., the arches on either side of this have a stretch of 175 ft., while even those which abut immediately on the shore have a headway of 155 feet. The centre arch will give 25 feet elevation above high-water mark, but all the arches are almost flat in the crowns, and form but a small segment of a circle. In fact, the gradient of the whole structure is only 1 in 40, or just half that of the old bridge, and less than a quarter of that of Holborn Hill. The five piers which are to support these arches are each nearly 130 feet long by about 20 feet in width. The piers inside two of the caissons are nearly completed. Massive granite work, which is laid on its concrete foundations far below the bed of the river, and, in fact, some feet into the London clay, have been built above low-water mark. All the caissons for the other piers are more or less advanced in progress. These caissons, inside which the works are carried on, are the largest ever sunk in the river, and six are requisite for the building of one pier. They are ordinary boiler-plate chambers, of wrought-iron, four of them being rectangular, and two at each end being pointed or triangular in shape, to form the cut-waters of each pier. The plan of sinking these caissons is, however, as simple and inexpensive as can well be devised. Guide-piles are driven to keep them in their proper places first, and between these a cross staging is erected at low water to support the wrought-iron chamber. On this, then, is built, piece by piec , a boiler—the first segment of the caisson. When it has reached the height required to keep its upper rim above the water at low tide, it is lifted bodily by powerful steam-cranes, and lowered between the guide-piles into its place on the bed of the river. At the next low tide, whether it be during night or day, the workmen are engaged in screwing on plates to compose another rim, to raise it still higher. Then, as the pressure of the water increases on its sides, it is strengthened from the interior, not only with strong piling, but with powerful wrought-iron ribs, which are bolted all around it; and these again, where the pressure is greatest, are supported by lattice girders of wrought iron. It will readily be imagined that these extra supports are necessary when we say that the pressure at high tide on the side of the caissons for one pier amounts to about 600 tons. Of course, as fast as these great cells of wrought iron are lowered into the river their own weight takes them deep into its bed, and when they cease to sink of themselves they are weighted with masses of iron ballast till no additional pressure can gethem further down. They are then pumped out till perfectly free from water, when the work of dredging out the soil commences. Generally, as this is done, the caisson sinks a little more, till what is called the London clay is reached. This, which is usually called the blue clay, is very hard, and more than a foot or so into it nothing can be forced. On this impenetrable substratum, then when all inside the caisson is perfectly dry, the foundations of the piers are laid on a thick mass of solid concrete. The centre of the pier is built of brickwork set in cement, and perfectly webbed together with a mass of bond iron. The outer circumference is formed entirely of blocks of granite, some of which—indeed, most of them—are as heavy as from 12 to 15 or 18 tons. As fast as each pier is completed within its caisson below low-water, the upper parts of the iron structure itself are removed to nearly the bed of the river, so that even at the lowest of low spring-tides no sign of the ironwork will be visible above the granite. So also none of any piling which may be used around the piers will be "drawn," but all will be sawn by divers just above the earth. The foundations of the abutments are carried down to a depth of nearly 30 ft. below the bed of the river. The springing of the ironwork of the arches commences at about 9 ft. above high-water mark. Each arch will be composed of nine wrought-iron ribs, with powerful wrought-iron lattice girders crossing them diagonally. Over these are to be laid what are termed buckle-plates, which are simply large convex shields of wrought iron riveted to the ribs; over these again will come ordinary ballast of asphalt and ragstone, and above all the granite paving.—*Abridged from the Times.*

It is said that, probably by the beginning of 1868, the bridge will be so far advanced towards completion as to carry the ordinary traffic. The first pier is sufficiently advanced to admit of the superstructure of the first arch being raised. The ironwork is in a very forward state. Large quantities of the wrought iron are being sent up from Wednesbury, from the foundry of Messrs. Lloyds, Foster, & Co., and, for the ornamental work, columns of red granite, quarried in the Isle of Mull, are being polished in Glasgow, preparatory to being forwarded to London.

THAMES EMBANKMENT.

The section of the Embankment between Temple Gardens and Blackfriars Bridge, unlike the other portions, will be constructed on arches, so as to admit of the passage under it to docks between the roadway and the shore, of barges and lighters. The entire length of this portion will be 855 ft. A subway for laying gas and water pipes, and electric telegraphs is to be formed within the work, and a paved carriage and footway are to be provided on the embankment. The foundations of the viaduct are to be formed of cast-iron caissons filled with concrete, carried down to a level of 21 ft. below ordnance datum, and left in permanently from that level up to 6 ft. below datum. When these have been filled to the required level, the upper portions above the concrete are to be removed; and upon the spaces between them, when arched over, the piers are to be built. The arches are to be strengthened by bar iron. The piers are to be carried up to an uniform level of 11 ft. above the ordnance datum. They are to be of cellular construction, the outer walls of brickwork in cement, faced with granite; the cells to be filled in with Portland cement. There are 13 arches, elliptical in form and of various spans, to accommodate the rising gradient of the roadway. The largest of these arches will be 80 ft. span, and they are to be of granite with spandril walls of brick in lias lime mortar. The interstices in the spandrils, and over the arches, up to the underside of the paving, are to be filled in solid with lias lime concrete. The arch stones are to have chamfered joints on the face of the work. The "subway" is to be carried beneath the centre of the roadway, and through the arches of the viaduct, supported by sub-arches of granite, springing from the same piers as the main arches. The internal dimensions of this subway are to be 7 ft. 6 in. in height and 9 ft. in width. Where the subway passes through the main arches of 80 ft. span, it will be formed of wrought iron, the sides being formed of plate girders, and the floor of arched wrought plates, carried by cross girders, and at these parts the subway will be 6 ft. high and 9 ft. wide. The roadway over this portion will be carried by brick segmental arches. The main arches will be surmounted on both external faces with a handsome solid granite moulded string-course, carrying a parapet with boldly-designed moulded base. The carriage-way is to be formed of Aberdeen granite cubes 7 in. in depth and 4 in. wide. The footway is to be formed of York landings, no stone of which is to be of less area than 5 ft. The embankment passes by an easy curve to the level of Bridge-street, Blackfriars, where the line of roadway will be continued by the new street to the Mansion-house.

The construction of an embankment on the south side of the Thames between Westminster Bridge and Vauxhall was commenced in September, 1865, when the first pile of the staging, which is a necessary preliminary to the formation of a coffer-dam, was driven. On the 17th of the following month the dam itself, which consists of two rows of piles from 35 ft. to 40 ft. in length and 6 ft. apart, was commenced. The line of the river-wall will be about 20 ft. inside the line of the coffer-dam, and above Lambeth Bridge will be about 100 ft. inside the existing wharf walls, so that the width of the river at that point will be considerably increased. A cross-dam has been constructed 1,200 ft. above Westminster Bridge, and the foreshore taken in by this first section of the embankment is to be the site of the new St. Thomas's Hospital. The first stone was laid by Mr. Tite, M.P., on July 28, 1866, in the presence of the leading civic authorities, the members of the Board of Works, Lord John Manners, and other Members of Parliament. The new embankment will extend to a great length, and will redeem six acres from the

Thames at this spot. Higher up it will regulate what the French term the *régime* of the river, by giving up to it two acres of land which now extend in a very undesirable line for its navigation.

NEW WEST PIER AT BRIGHTON.

This new Pier has been built under the direction of Mr. E. Birch, C.E. The structure is 1,115 ft. in length, and extends into 8 ft. of water at low spring tides. The abutment, or first portion of the structure, is 290 ft. long and 140 ft. wide; the second portion, reaching to the head, is 560 ft. long and 55 ft. wide; and the head, or seaward end, is 310 ft. long and 140 ft. wide. The foundations consist of cast and wrought iron screws, fixed in the bed of the sea; and upon these are raised cast and wrought iron columns and piles, which sustain the whole superstructure. These columns and piles are braced and tied, to obtain the greatest amount of stiffness with the least amount of resistance to the sea; and immediately upon them are placed the main wrought-iron girders and transverse wrought-iron girders, for the support of the roadway, which is of close planking, covered with a light coat of asphalte. On the top of the main girders, and along the entire length of the structure on either side, ample and continuous sea-accommodation for 2,000 to 3,000 persons is provided. The entrance to the pier from the Esplanade is 265 ft. wide, with ornamental gates, and the necessary toll-houses, &c.

THE LONDON WATER-SUPPLY.

Mr. Hamilton Fulton, the engineer, proposes to supply London with Water from the sources of the river Wye, in the neighbourhood of Plynlymon. Meetings have been held, and it is said the measure has already the earnest support of the landowners and others interested in the locality. The abstraction from the Thames of the present quantity of water required by five Water Companies for the supply of London greatly deteriorates the town or tidal portion of the Thames, and also militates against the purity of the river water below the point of abstraction, much to the annoyance and the injury of the health of persons resident in the neighbourhood. This being the case, what are the New River and East London Water Companies to do to improve their sources of supply but to go to Mr. Fulton's proposed source—namely, the tributaries of the upper portion of the Wye? For, as the water requirements of London augment, so will the evils above referred to, but in a much greater ratio. The navigation of the Wye, again, is said to be of little importance, comparatively speaking, to that of the Severn and the Thames, and therefore the abstraction of the necessary quantity of water from the upper portions of the Wye would hardly be appreciable. Mr. Fulton's intended area of water-shed of 180,000 acres is at present almost a total waste—a clean surface, and free refuse of lead-mine workings, with an available rainfall of 60 in. per annum. The probability of the execution of such extensive works will enhance the value of property in the vicinity. The Crown and Sir W. W. Wynne are said to be the principal owners. The estimate made by Mr. Fulton exceeds 7,000,000*l.*

PARIS WATER SUPPLY.

DURING four centuries the Parisians had to draw themselves whatever supply of Water they required from the Seine; but, thanks to the Municipal Council of Paris, such a condition of things no longer exists. At the present hour eighteen hydraulic machines are in full work. The city possesses, besides, thirty-two fountains where water can be purchased, whence 1,959 cube mètres are daily sold, at the rate of a franc per cube mètre, to 1,253 water-carriers, who sell it in retail at the rate of five francs per cube mètre; thus the carrier makes four francs on every 1,000 litres. These 1,253 men, says the *Star*, employ 312 boys, and 400 among them have a cart and horse. During 1865, the *fontaines marchandes*, as they are styled, sold water to the amount of 675,000f., that is, above 25,000*l.* Of 56,481 houses, 21,921 subscribed for a supply of 38,569 cube mètres per day, the subscribers paying an annual sum of 2,790,760f. Besides these *fontaines marchandes*, there are in the city at this moment 54 public fountains, 27 ornamental *jets d'eau*, 1,207 drinking fountains, 1,147 water-pipes opening on the street gutters, 725,000 water-pipes, 44 reservoirs in case of fire, &c. The water company is independent of the city company; the latter gives the head inspector 4,500f., under whose orders are sixteen clerks, who receive from 1,600f. to 3,600f. per year; 112 overseers, who are paid from 1,100f. to 1,200f. annually; and fourteen men at 1,000f. (40*l.*), whose sole business is to keep the fountains clean. When the distribution of the waters of the Dhuys and the Vanne shall be organised, Paris will rival ancient Rome in the abundance of its water-supply.—*Mechanics' Magazine.*

BEACH-MARKS IN FRANCE.

A MOST important work is now in progress throughout France —viz. the levelling and establishing of Beach-marks all over the country. The object of this undertaking is to furnish a series of levels that will enable the course of canals, railways, &c., systems of drainage and irrigation, and other public and private works, to be laid down on the map and marked out on the ground without any error. The operations were commenced in 1857, under the control of the Minister of Public Works, and will be terminated in five or six years hence. The work has been, since the beginning, under the superintendence of M. Bourdaloue, civil engineer, to whom is due the series of levels taken from the Isthmus of Suez from the Mediterranean to the Red Sea. The datum line of the levels in France is the usual sea-level; the beach-marks established on the ground consist of cones of cast iron, set in masonry, on the spot where the levels are required to be noted; and a great number of these have been placed in lines of level which touch seaport towns, groups of rivers and canals, lines of railway, roads, &c. More than 18,000 linear miles have been thus laid down as base lines; but, in order to complete the work, the operations must be extended to 120,000 miles, a length equal to five times the circumference of the earth, and more than half of our distance from the moon. This gigantic undertaking is very costly; but, when once completed, it will enable every engineer or contractor, who may wish to attach a series of levels in any part of France with those of the remotest districts, to do this by the aid of a beach-mark on the spot, or near at hand, for the *maximum* space between the levels is to be only three-quarters of a mile. The accuracy of these levels is such that they are true to three centimètres, or 1·2 inch for the whole length throughout France.—*Builder*.

DECAY OF THE STONEWORK AT WESTMINSTER PALACE.

THE Hon. Mr. Cowper has stated in Parliament, that with respect to the alleged Decay of the Stonework of the building for the Houses of Parliament, he thought there was a great deal of misunderstanding and exaggeration abroad. As far as he could ascertain, by a careful study of the building, the only portions of it which showed serious signs of decay were certain horizontal lines below projections, where the drip of the rain collected without any means of escape. When this was the case, the acids of the soot with which the rain was charged, acted injuriously on the stonework, and produced decay; but it was not at all general, or of a character to excite any particular apprehension regarding the future. When he came into office he found that there had been a trial of two solutions, which it was proposed to employ for the purpose of arresting decay; and a commission which examined the volutions gave a preference to that of Mr. Szerelmy. That had accordingly been applied to all the interior courts, and, so far as it had gone, it had answered perfectly, nor was there any appearance of decay; but there were no sufficient grounds of encouragement for confidence in its efficacy. It was composed chiefly of zinc and bitumen, and he had not thought himself warranted in sanctioning its continued application. He had taken measures to have six of the most promising schemes which had been recommended to him applied to the western front near the House of Lords, under the careful inspection of an experienced chemist, and he expected that, in the course of the year 1867, a satisfactory report of the result would be made.

CONCRETE IN FIRE-PROOF CONSTRUCTIONS.

MR. F. INGLE has read to the British Association a paper "On Recent Improvements in the Application of Concrete to Fire-Proof Constructions." The author pointed out what he considered a radical defect of concrete formed of lime, as ordinarily used, viz. that by the action of fire it becomes reconverted into lime, which, when the water from the engines is brought to bear upon it, expands greatly, and forces out the walls to the destruction of the building. He advocated the use of a concrete formed from gypsum, which is not liable to this defect. The gypsum, which is of a coarse and inexpensive character, is formed into plaster of Paris by roasting, and mixed with a peculiar kind of clay found in connection with the beds of gypsum.

NEW WATER-METER.

MESSRS. ROBERTON-BRISSON & COIGNARD have invented a new Meter for measuring supplies of Water in such a manner that the smallest quantities, as well as the full supplies, are accurately registered, whatever be the velocity or pressure of the quantity delivered; it measures the quantity without causing any sensible intermission in the current or diminishing the pressure in an appreciable degree beyond what may be the result of the friction of the parts of the apparatus. The meter consists of a pair of coupled cylinders, in which pistons move, giving motion to two slide-valves, which open and shut alternately the entrance and exit of the water. The two cylinders are of cast iron, as are the rest of the pieces except the slide-valves and the rods, which are of copper and brass. The water enters into the valve-box, passes into one of the cylinders, and acts on the piston. When this has arrived near the end of its stroke, the ports are partly open so as to admit water to the second piston, so that it may commence its course when the first has finished its course; consequently, there is no interruption in the flow, nor any intermittence in the registering of the quantity passing through the meter. The reciprocating motion of the slide-valves, which are fixed immediately upon the end of the piston-rod, sets in motion a small lever in connection with the register and dial-plates, which are similar to those in use for gas-meters. Constructed in the workshops of Coignard & C^ie., this new machine has received practical sanction on a large scale. The towns of Nantes and Angers, the Imperial School of Arts and Manufactures, the administration of the Versailles Water-works, those of Marly and St. Cloud, and the water service of the Imperial Palace of Meudon, have employed it, to their satisfaction.

OLIFEROUS STRATA AT CHICAGO.

THE sinking of an Artesian well at Chicago has brought to light the existence of Oliferous Strata beneath that enterprising city. In the first forty feet the rock is Upper Silurian, and so charged with petroleum that it burns freely; and 100 gallons of oil, which accumulated in the shaft, were pumped out. A compact, yellowish-white stone, 200 feet thick, but showing no trace of oil, was next penetrated. Then came 200 feet of grey limestone, with oil in thin seams, succeeded by a bed of shale, 156 feet in thickness, saturated with petroleum, and yielding much oil where it rests on the Lower Silurian. Below this occurs a reddish sandstone, 71 feet thick, also containing oil; and at a depth of 711 feet a stream of water was tapped, of good quality, which delivers through the 3½-inch bore 500,000 gallons a day.

ARTESIAN WELL AT KINGSTON.

THE proprietor of the Kingston Brewery, being desirous of obtaining a pure supply of water, has recently had an Artesian Well sunk on his premises in Brook-street. It was commenced early in last November; engineers, Easton, Amos, & Son. The first operation was to sink a shaft 6 ft. 6 in. in diameter, which was carried to a depth of 90 ft., and lined with 9-inch brickwork, set in cement. The top of the shaft, to the depth of 18 ft., was lined with iron cylinders to keep out the surface water, which would otherwise in time have percolated through. The shaft being completed, cast-iron pipes were erected from the base, to some height up, and there a platform was erected. The work of boring was then commenced. The pipes first used were 7-inch, and were sunk to a depth of 325 ft., when 4-inch were put down till chalk was reached; after sinking 40 ft. in that, the boring was proceeded with, but no pipes were used. This was in order that no springs might be shut out from contributing towards the supply. Directly the vein was tapped, water rose like a fountain 8 ft. above the surface. For the first 200 ft., when passing through soft soil, the pipes sank by their own weight as the earth was removed from under them; but, as the depth became greater, the pressure of the earth upon them became such that great pressure had to be exerted to force the tubes down. For that purpose the stageing down the shaft was used; on it was placed an hydraulic press, and a weight of ten tons had at last to be brought to bear before the pipes could be induced to descend. When the pump is not at work, from eighteen to twenty gallons flow away every minute. The steam-pump used at the brewery has three throws, and raises about seventy gallons per minute. To keep the whole establishment supplied with water, or, as called in a brewery, "liquor," this pump raises on an average 25,200 gallons daily; but yet, for all that, and when at its greatest speed, the water in the reservoir—90 ft. deep and 5 ft. in diameter—is only reduced and kept down rather more than a foot. The quantity of water which flows every day will be 25,200 gallons added to that which runs away—18 gallons a minute for 18 hours—equal to 19,440 gallons daily. The yield of the well may thus be estimated at 44,640 gallons each working-day, a total of 292,760 in a week. The overflow—nearly 20,000 gallons daily—is turned into the sewer, thereby flushing it considerably. Total depth 470 ft. 2 in.

NEW MODE OF SAWING STONE.

Instead of the Saw ordinarily employed, a disc of lead, kept well covered with emery, has been used for some time past in France with great success and economy. The lead is cast on a circular plate of cast iron, of sufficient thickness and diameter, and pierced with holes, which, by means of the lead with which they become filled in the casting, unite together strongly the thin sheets of lead at its two sides, which are joined also at the circumference of the disc. The emery falls from a reservoir above the disc, and the surplus is conveyed into a trough underneath, whence it is brought back to the vessel which feeds the disc. This apparatus is either moved on a carriage to the rock which is to be cut, or the block of stone is brought up to it on a carriage. A saw of this description, about 3 ft. 6 in. in diameter, driven by a 4-horse power, was found to move through Carrara marble at the rate of about 2½ inches per minute, and through Normandy granite at the rate of nearly an inch in the same time; and the cost of cutting was scarcely one-sixth of that with the ordinary method.—*Scientific Review.*

STONE-CUTTING MACHINE.

For some time past machinery has been rather extensively used in the slate quarries of Wales, in cutting the rough material into slabs. These machines, the invention of Mr. George Hunter, of Carnarvon, have been fitted up for the Tyne Harbour Works. The Newcastle Machine is of the normal type, which consists essentially of two saw-blades mounted on a transverse shaft; and a traversing bed, much resembling that of a planing-machine in its action, on which the block of stone or slate to be cut is fixed. The machine is fitted with two 7-ft. blades of ¾-in. steel-plate. The tools are set with a twist to right and left alternately; they cut 1¼ in. wide, at the rate of about 3½ in. per minute. There are forty-four sets of tools, at a 6-in. pitch, in each blade, moving at the rate of 44 ft. per minute. The shaft is 12½ in. diameter, of cast iron, and 9 ft. long between standards. The stone is magnesian lime, and the rough blocks, as placed on the table, weigh up to seven or eight tons. The estimated horse-power consumed is between two and three. A second machine is a two-bladed saw, each saw 13 ft. diameter. Each blade will carry sixty-eight tool-holders, the tools set singly and in pairs alternately. The larger number of the saws employed for cutting slate in North Wales have two blades, but several have been mounted with three and four blades, with 16 ft. between the standards.

PATENT TUNNELLING MACHINERY.

Mr. Doering has exhibited in the York-road, Lambeth, some "Patent Tunnelling and Shaft-sinking Machinery," which has attracted considerable notice. What you really see is "a small stone-drilling engine placed upon an iron cradle, which is pivoted on the end of a horizontal arm. A cast-iron piece, consisting of two sockets placed and fixed rigidly at right angles to one another, connects this arm with a vertical column, which is supported on a wrought-iron frame on wheels. This construction enables the drilling engine to be moved and placed so as to drill a hole in any direction." This is the inventor's description of a machine the extreme compactness and lightness of which impress you at first sight. The drilling engine, indeed, weighs no more than 105 lb., and the frame in which it is set is correspondingly simple and portable. This advantage, considering the circumstances, and the place of working, is of great and obvious importance. The engine is worked by means of compressed air, and the drill, when fixed in its socket, has both a forward and a revolving motion. The point of hardened steel is driven like a battering ram against the surface of the rock with extreme force and rapidity, until a hole is made of sufficient depth for blasting. A block of granite was experimented upon, and when once the hole was rounded, a depth of six inches was scooped out of this most stubborn material in five minutes. Pulverization is assisted by a continuous jet of water directed into the hole, and the hole itself may be driven not only horizontally but at any angle—a point of great importance in blasting operations. These drilling engines are in daily use at the zinc mines of the Vielle Montagne at Moresnet, near Aix-la-Chapelle: the rate of advance with only one engine in a drift six feet high is said to be two and a half times what it formerly was by hand labour in the same kind of ground, while the expense of driving per mètre has been reduced from 175f. to 95f. Less powder is also wanted, and the cost of sharpening tools is less in engine than in hand-labour. On the other hand must be reckoned the repair of engines, which, with such a movement, must needs be considerable, and is, in fact, set down at 12f. 25c. per mètre, the total result being a cost of 120f. 66c. per mètre for engine-labour, against 194f. 88c. per mètre for hand-labour. The engine differs in some important particulars from that employed in the Mont Cenis excavations.

PROBABLE EXHAUSTION OF COAL.

Prof. W. S. Jeavons, in a paper read by him to the Manchester Scientific Students' Association, states the consumption of Coal at the present time may practically be stated at 100 millions of tons annually. Within less than 60 years it increased sevenfold, and the increase of the population and wealth has been proportionate. He thought the geometrical method of calculation was the only practical way of expressing the rate of progress. The question was, whether this rate of increase would continue, because if it did there was no doubt the consumption of coal would outstrip all reasonable bounds. They had not yet got to the end of things; they had not made all the requisite railways; they had only seen the beginning of steam navigation; in twenty years hence steam-ploughing would probably be the rule, and in their water supply, in the pumping of the sewage of towns, and in twenty other different ways, steam and coal would come into use. Nothing but a rise in price would bring any serious check. The result of Mr. Hull's calculations is, that there is within 4,000 ft. depth an amount of 83,000 millions of tons; but no one is so absurd as to suppose that we shall ever get to that depth. Mr. Vivian, in his speech in Parliament on the subject, had said that there was no difficulty arising from temperature or pressure; but in the Dukinfield mine, which is the deepest perhaps in England, the pressure makes itself felt in what is called a "creep," and the same is the case at Monkwearmouth. At the latter place the temperature of the rock is 80 degrees, and the atmosphere is 84 degrees, and occasionally higher. Mr. Vivian had given an erroneous idea about the cost of sinking, which, instead of a penny a ton, is, calculating the interest and the number of years taken to bring a mine into working order, more like very many pennies. America has the largest area of coal of any other country; and the moment England begins to retreat, the produce in America and other countries will increase, and pass us in the race of competition.

PRESSURE-GAUGE.—PYROMETER.

MR. E. A. COWPER has exhibited to the Institution of Civil Engineers a very delicate Pressure-Gauge for ascertaining very low pressures and small differences in pressures, the scale commencing at 1-100th of an inch of water. This instrument consists simply of a very flexible diaphragm, having one square foot of area on which the pressure acts. The amount of pressure is ascertained by weights applied on a lever which keeps the diaphragm in place. Mr. Cowper also showed a pyrometer for high temperatures, which is used for taking the temperature of a hot-blast of 1,150 deg. Fah., from Cowper's hot-blast stoves for blast furnaces. It consists of a copper mug or measure, the body of which is about an inch thick and is hollow, fitted inside with an indicator and sliding scale. A piece of copper is adjusted so that its specific heat shall be as 1 to 50 to a pint of water. The copper is heated in the hot-blast and dropped into the water, when the rise in the temperature of the water is read off the sliding-scale, the zero of which has been previously adjusted to the temperature of the water.

LIQUID FUEL.

TRIAL has been made in Russia by Captain Schepakovski, of the Military School at St. Petersburg, of a furnace for burning fluid hydrocarbons. If petroleum is ever to be used commercially as steam-fuel, it is probable that some such arrangement as that proposed by Captain Schepakovski will be employed for burning it. The principle of his apparatus is very simple, and is one with which we are just now very familiar, owing to the recent introduction of the "vaporizer." This little instrument consists of two tubes placed at right angles to each other with the extremities in contact. One of these tubes is placed in the liquid to be "vaporized," and air is forced through the other, which causes an upward current through the first tube. The liquid ascends; and, on arriving at the extremity of the tube, is dispersed in finely-divided spray. It is upon this principle that the improved furnace is based. The boat in which the boiler was fixed was 24 ft. long and 5 ft. wide, and was fitted with a steam-engine of two-horse power, by the aid of which a speed of six knots per hour was obtained, the quantity of turpentine consumed being three pounds per horse-power per hour. The boiler was heated by four jets, the turpentine being contained in a reservoir at the bows. It is stated that the heat obtained by a lamp constructed on this principle is enormous—sufficient to melt steel. This has actually been shown by the inventor in a lecture, in the course of which a fragment of copper weighing three-quarters of an ounce was melted by a lamp burning between two and five pounds of turpentine per hour. The flame was about 2 ft. in length, and was of a yellowish-white colour. The noise was like that produced by steam escaping from a boiler. The application of the lamp to the superficial charring of wood for preservative purposes was also exhibited.

Oil of turpentine is composed exclusively of carbon and hydrogen, in the proportion of five atoms of the former to four of the latter; and a pound of this substance would contain thirty parts by weight of carbon to four parts of hydrogen. When it is burnt under the ordinary conditions, only a small quantity of this carbon is employed in the formation of heat; another part is consumed in the production of light, and the remainder escapes unburnt as smoke. In the apparatus which we have noticed, the turpentine, being in a highly divided state, is placed under the most favourable conditions for complete combustion, the supply of oxygen being sufficient to consume the whole of the carbon, very little of which is wasted in the formation of either light or smoke.

We have purposely omitted all considerations of cost, and it may fairly be doubted whether the substitution of petroleum, or any other fluid hydro-carbon, for coal, will be attended with any great economy. M. Schepakovski's experiments appear to have been made exclusively with turpentine, which is, of course, not so expensive an article in Russia as in this country.—*Builder.*

PETROLEUM FOR MARINE ENGINES.

A Parliamentary paper gives an account of the results of experiments made at Woolwich Dockyard with the view of testing the value of Petroleum and Shale Oil as substitutes for Coal in raising steam in marine boilers. The experiments were conducted by Mr. Richardson, who had proposed a plan of employing oil instead of coal. The Report of the results is not of a very decisive character, but it shows that the value of oils for the purpose in view varies considerably.

The Report concludes that if results as favourable as three mentioned can be obtained under ordinary circumstances, it would appear that 1 lb. of oil will evaporate about double the weight of water which 1 lb. of coal burnt in the ordinary way would evaporate; but at the same time the greater cost of oil (from 10*l.* to 23*l.* per ton) must be taken into consideration. If, however, a great reduction were to take place in the price of the oils, "probably, under some circumstances, they might be advantageously used instead of coal. The experiments, therefore, as far as they have gone, may be regarded as of considerable value, in showing the great evaporative power of these oils, and the practicability of burning them according to Mr. Richardson's plan." Mr. Richardson writes to the *Times*:—

"The experiments at Woolwich were necessarily commenced with the best and more expensive petroleums. Nothing was known of their properties as fuels; the result has proved, that those which contain spirit and burning oil are not so well suited for fuel as those from which they have been extracted; but until a method was arrived at of getting rid of the smoke, nó others could be used. The smoke was mastered by simply decomposing a little water vapour, carbonising, and burning the gases. The heavy oils, as they are termed—those from which the spirit and burning oil have been extracted—are about the consistency of gas-tar. Their market price is at present 5*l.* per ton. . . . . When we remember that gas-tar is the same as the heavy oil, only in a more concentrated form, and that it can be obtained in any quantity at 18*s.* per ton, cheapness would be the result of an enlarged manufacture."

In Canada there are vast deposits of asphaltum, or mineral pitch, which the inhabitants call gum-beds. Perhaps these could be made available in Canada for engines. A cubic foot of this asphaltum, it is said, represents the effusion of 60 to 80 cubic feet of lubricating oil, and from 100 to 120 feet of illuminating oil. Some of the best oil-wells in Canada are sunk on or near these gum-beds.—*Mechanics' Magazine.*

SMOKE CONSUMPTION.

A NEW invention for Consuming Smoke and economising fuel has been applied to the steam-engine furnaces at several large works in Sheffield, with very remarkable results. The novelty consists in supplying the furnace with hot instead of cold air for combustion, and feeding the boiler with boiling instead of cold water. The air is heated by being drawn through flues along each side of the boiler, and it passes from the flues into the furnace through small perforations in the brickwork forming the sides of the furnace. It is thus distributed evenly over the whole surface of the fire, causing such complete combustion, that, with proper care, no smoke is emitted even after firing, beyond occasionally a few light puffs. It is a necessary part of the plan that the furnace-door should fit well and be opened only for firing. This is one part of the invention; the other provides for the heating of the water before it reaches the boiler. This object is accomplished by conducting the waste steam from the boiler into a sort of cistern (called a 'heater') having a series of pipes, like those of a tubular boiler, but with more space between. The water winds through these pipes on its way from the tank to the boiler, and is heated to boiling point by the action of the waste steam on the pipes. The result of the combined processes is that full steam-power can be maintained with half the ordinary quantity of fuel and labour on the part of the fireman, and the smoke is effectually consumed. The invention, with slight modifications, is considered to be specially applicable for steamships, as at sea it would have the additional advantage of providing, by the condensation of steam in the heater, sufficient saltless water for the use of the crew. The two processes described are self-acting, and the invention is so simple that it can be applied to any kind of boiler or furnace at a comparatively small cost. The inventor is Mr. Prideaux, of the King's Head Hotel, Sheffield.

STEAM FIRE-ENGINE.

An interesting trial has been made at Saltaire with two of Messrs. Merryweather and Sons' patent long-stroke Steam Fire Engines. One of these engines had a single steam cylinder of 8 in. diameter, and a horizontal double-acting pump of 6 in. diameter, with 18 in. stroke of piston, being on the same principle and of the same size as the engine *Der Rhein* which gained for these makers the first prize at the last competition of fire engines, being that held at Cologne in 1865. The other engine had double cylinders each 6¾ in. diameter, and two double-acting pumps, each 5 in. diameter, and 18 in. stroke of piston, being of the same construction as their first prize engine *Sutherland* at the Crystal Palace competition. The double cylinder engine raised 50 lb. steam pressure from the time of lighting the fire in 9 min., and got to work in another minute, when, working through 160 ft. of delivery hose and a 1½ in. nozzle, it projected a continuous stream of water from 10 ft. to 15 ft. over a shaft 165 ft. high. When tried for range a 1¼ in. stream reached a measured distance of 233 ft. from the nozzle, and a fair body of water was projected to 219 ft. distant; through a 1½ in. nozzle a distance of 169 ft. was reached. The single cylinder engine took rather longer to raise steam, solely on account of using a very inferior coal (the boilers in both engines are of the same construction). This engine also projected a 1¼ in. stream fairly over the shaft some 16 ft.: the pressure on the pumps of both engines reached 135 lb., the average steam pressure being 120 lb. per square inch. The trials were considered highly satisfactory by those present, as both engines worked very steadily and maintained steam easily, working without vibration or oscillation, and being attended only by one engineer and one of the Corporation of Bradford firemen as a stoker.—*Mechanics' Magazine.*

FIRE ALARUM.

We find in the *Union Médicale* a paper by Dr. Duffay, on a curious and useful invention, due to the ingenuity of a celebrated ex-conjuror, M. Robert Houdin. The object in view is to give the Alarm of Fire at the very commencement of the threatened catastrophe, and the following description will show how this is accomplished. Suppose a copper lamina and a steel one to be soldered together by their surfaces, so as to form a single blade, copper on one side and steel on the other. Let it be fixed vertically by one of its extremities to a board, without however quite touching it, in order to avoid all friction. The arrangement will be best understood by supposing a knife to be brought close to the board as if with the intention of cutting it through. Now suppose a metal knob to be fixed on the board, on the steel side of the blade, and at a short distance from it. This knob is connected with one of the poles of a voltaic battery, the other pole of which communicates with the screw which secures the fixed extremity of the blade, and with one of those bells or alarums which we see used in the telegraph-offices to prepare the clerks for the reception of a message. Now let the blade be warmed: as the dilation of copper by heat is greater than that of steel, it follows that the blade will be bent, the concave side being the steel one; and if the heat applied be sufficient, a contact will be effected between the blade and the knob. No sooner does this take place than the bell begins to ring, and continues doing so until the contact is interrupted. A very small degree of heat will be sufficient to produce the requisite curvature of the blade; even a burning cigar will do so at a distance of about three inches. This facility might in many cases prove rather a drawback, were it not that the sensitiveness of the apparatus may be diminished at pleasure by increasing the distance of the knob from the blade.—*Galignani's Messenger.*

A FIRE-DAMP INDICATOR.

At the Society of Arts, recently, Mr. Jabez Hogg, F.L.S., has read a paper on "The Perils of Mining and Means for Preventing them," his chief purpose being to bring under notice a Fire-damp Indicator by Mr. G. F. Ansell, of the Royal Mint.

After reviewing the subject of mining "accidents," and showing the necessity still for means of preventing them, he proceeded to speak of Mr. Ansell's indicator, whereby, said Mr. Hogg, he is able to detect the smallest appreciable quantity of fire-damp in a mine. As in the case of the safety-lamp, Ansell's fire-damp indicator is the practical application of a natural law, that of diffusion. Mr. Ansell practically applies this law to the detection of fire-damp; and since his indicator enables him to ascertain the exact percentage of this or other deleterious gases, the application is of the very highest importance and value, not only for coal and metal mines, but wherever subterranean works of any kind have to be carried on, for it as readily indicates the presence of the deadly choke-damp if in a poisonous amount. It is also capable of being made equally useful for the detection of coal-gas in houses and large buildings, as theatres, railway tunnels, and the proposed subways in our streets; or in the holds of ships, where foul air or fire-damp often collects.

The instrument is formed, in the first place, of a glass flask six inches in height and two in diameter. Its top is tightly covered by a piece of common red tile, and from its bottom goes a narrow tube, which, being bent upwards, rises to double the height of the flask itself. Mercury is lying in the bottom of the flask, and, of course, to the same level in the tube also. In the upper part of the narrow tube are the projecting ends of two isolated wires, connected with a small galvanic battery. This forms the whole apparatus, and we may suppose that the flask is placed in a part of the mine where some men are at work, while the wires can be extended to the top of the pit, and there be connected with a battery and bell. If, while the men are working, a small or large quantity of gas be suddenly disturbed, some portion of it will percolate through the tile and gather in the flask with remarkable rapidity. There it will press the common air upon the mercury, and induce it to rise in the narrow tube until it reaches the wires. Immediately the mercury touches them the galvanic current will be complete, and the bell will be set ringing. This warning will be given in less than two seconds from the time the gas makes its appearance; and another instrument, designed upon the same principle, will give warning of a gradual accumulation of gas when it had become dangerous. Mr. Ansell also shows an instrument a little larger than a watch, and constituted upon the principle of the common barometer, which the mine-viewer can take in his hand; and if in the course of his passage through the mine he comes upon any place where the atmosphere is charged with even one per cent. of gas, the instrument will register it.

MANUFACTURE OF LUCIFER MATCHES.

One of the most perfect Lucifer Match Manufactories in the world is supposed to be that at Frankfort, N.Y., noted for some extraordinary machinery, the invention of Mr. Gates. At this establishment 720,000 ft. of pine, of the best quality, are used annually for the matches, and 400,000 ft. of bass-wood for cases.

The sulphur used annually for the matches is 400 barrels, and the phosphorus is 9,600 lb. The machines run night and day, and 800 hands are employed at the works. It takes 500 lb. of paper per day to make the light small boxes for holding the matches, and four tons of pasteboard per week for the larger boxes; 66 lb. of flour per day is used for paste, and the penny stamp required by Government on the boxes amounts to the snug little sum of 1,440 dollars per day. There are four machines in use for cutting, dipping, and delivering the matches. The 2 in. pine-plank is sawed up the length of the match, which is 2¼ in. These go into the machine for cutting, where, at every stroke, twelve matches are cut, and by the succeeding stroke pushed into slats arranged on a double chain 150 ft. long, which carries them to the sulphur vat, and from thence to the phosphorus vat, and thus across the room and back, returning them at a point just in front of the cutting machine, and where they are delivered in their natural order, and are gathered up by a boy into trays, and sent to the packing-room. Thus 1,000 gross, or 144,000 small boxes of matches, are made per day. The machines for making the small thin paper boxes and their covers are quite as wonderful and ingeniously contrived as those that make the matches. A long coil of paper, as wide as the box is long, revolves on a wheel, one end being in the machine. It first passes through rollers, where the printing is done, from thence to the paste boxes, where the sides and ends only are pasted; from thence to the folding apparatus, where the ends are nicely folded, and the whole box is pasted together and drops into a basket. A similar machine is at work at the covers, and thus 144,000 boxes per day are manufactured.—*Mechanics' Magazine.*

GUTTA PERCHA CEMENT.

A good Gutta-percha Cement is made by dissolving gutta-percha in chloroform in quantity to make a fluid of honey-like consistence. When spread it will dry in a few moments. Heat the surfaces at a fire or gas flame until softened, and apply them together. Small patches of leather can be thus cemented on boots, &c., so as almost to defy detection, and some shoemakers employ it with great success for this purpose. It is waterproof, and will answer almost anywhere unless exposed to heat, which softens it.

MECHANICAL MOTION AND HEAT.

A remarkable instance of the conversion of Mechanical Motion into Heat is recorded in the *Proceedings of the American Academy of Arts and Sciences* (Boston). A turbine working in a race led from the Merrimac river, and supplying the motive power to one of the Lowell cotton factories, was observed to be irregular in its motion. On examination it appeared that the "steady pin," at the lower end of the shaft, made of steel two and a half inches diameter, and working in a box of case-hardened iron, was actually fused, although it had been constantly plunged in the race, through which seventy-five cubic feet of water rushed every second—4,500 feet per minute. The pin and portions of the iron box were exhibited at a meeting of the Academy, and on each the signs of fusion were clearly apparent. The moving power of a turbine is known to be great; but here we see it converted into heat, which, in defiance of the rapid stream of water, rose to the temperature of the welding point of iron. That heat is but a mode of motion is a question that has worthily occupied the attention of Dr. Joule and other mechanical philosophers, and to them we commend this new and striking illustration.

IMPROVED MOTIVE POWER FROM GAS.

A COMPACT Gas-engine, the invention of M. Pierre Hugon, of Paris, is protected by twelve patents, dating from 1858, with which a series of careful experiments has been conducted by Professor Cazin, of the Versailles Lyceum, with very satisfactory results. The *Mining Journal* states that the cylinder of the new machine is vertical, and that a rod jointed to the shaft works a bellows, which draws the gas from the ordinary supply pipes, and forces it into the cylinder; here it is mixed with the necessary quantity of air to form an explosive compound, a minute quantity of water being supplied within the cylinder to ensure the necessary degree of moisture to prevent the hardening of the oil used for lubrication. The ignition of the explosive mixture takes place alternately above and below the piston, and is effected by an ingenious form of slide-valve carrying suitable gas-burners, which are lighted at each half-stroke by an exterior burner continuously kept burning. The cylinder is surrounded by a water-jacket, through which cold water is continually circulated. The explosive mixture used consists of about 1 part gas to 9 parts air, and the average of two experimental tests, each of one hour duration, made by Professor Cazin on December 6 and December 8 respectively, showed the gas used in the cylinder to be 171 cubic feet; number of revolutions of shaft, 3,313; weight on break, 15 kilos.; length of break-lever, 2 mètres; diameter of cylinder, 13 in. nearly; stroke, 11 8-10 in. The power of the machine was found to be 2½ horse-power nearly, and the gas used per horse-power per hour 74 cubic feet. It is claimed that M. Hugon's is the only gas engine that regularly and uninterruptedly works up to its nominal power: and it is maintained that the ignition of the explosive mixture by a gas jet instead of by electricity is decidedly advantageous, inasmuch as electricity is a force too complicated and too delicate for the every-day use of a manufactory or workshop. Gas engines are, undoubtedly, the best motors extant for obtaining small power—from ½ to 3 horse—without the necessity of the continual outlay which the use of steam would entail. No expense whatever is incurred whilst the machine is idle, and the full power is available at any moment by simply lighting the gas, whilst its stoppage is effected with equal facility by turning it out.—*Mechanics' Magazine.*

NEW GAS-BURNER.

A NEW Gas-burner, which possesses important advantages over the ordinary metallic kind, has been introduced by Messrs. Armstrong and Hogg, gas engineers, Edinburgh. The nib of the burner is composed of "patent adamas," a siliceous substance, which is not liable to corrosion or oxidation; and the result of this quality is that the flame is always steady and the gas thoroughly consumed. The adamas is quite unaffected by any degree of heat to which it may be subjected in the burner form, and is so durable that burners tipped with it will last for many years.

PHOTOMETER FOR GAS-BURNING.

MR. SUGG, the gas engineer, has exhibited at the Conversazione of the Institution of the Civil Engineers, a jet Photometer for registering the illuminating power of gas-burners, upon the principle which has for some time past been adopted by gas companies. In this apparatus there is a delicate arrangement for maintaining a constant pressure, and through this a small jet is supplied. The whole is enclosed in a case in which perfect ventilation is secured without the fear of disturbance to the flame, by which erroneous results would accrue. The case has a glass front, on which is a graduated scale; there is also a similar arrangement at the back, so that the height of the flame can be accurately ascertained. For registering variations in the height of the flame, the light is admitted through a slit on to a piece of sensitised paper, to which a transverse motion is imparted in a photographic camera. A continuous image is thus secured, the varying height of the flame being indicated by the height of the image at different points. The principle of this photometer is based upon the discovery made by Mr. George Lowe, that if a jet be supplied with gas the pressure upon which remains constant, any change in the illuminating power of the gas will vary the height of the flame.

THE HOUSES OF PARLIAMENT.

DR. PERCY'S Report on the Warming, Ventilating and Lighting of the Houses of Parliament has just been published. It is clear and concise, in which it exhibits the essentials of a public document. The arrangements for ventilation appear to be as perfect as the present state of mechanical science will admit of; and if honourable members complain, it is because, as Dr. Percy shows, they take their own feelings as the standard, instead of regarding the laws of Nature. With an unlimited supply of air, Parliament should never be drowsy. On the night that the Electoral Franchise Bill was introduced, about 1,500,000 cubic feet of air passed through the House of Commons every hour, heated to a comfortable temperature. There are hundreds of air-courses throughout the building, and air-valves, and huge horizontal smoke-flues, with hundreds of chimneys, besides fifteen miles of steam-pipes, with about 1,200 stop-cocks and valves, and "a multitude of holes and crannies as intricate and tortuous as the windings of a rabbit-warren." The consumption of gas, including the entire building, is 12,000,000 cubic feet annually, the cost of which amounts to 3,500*l*.—*Athenæum*.

In the *Lancet* it is remarked:—"Whenever there may be doubt as to the effectiveness of the ventilation, let those whose complaints tend to its augmentation be listened to rather than those who would diminish the supply of air, for it is not possible to over-estimate the beneficial influence of efficient ventilation on the health of men. As the reporter states, 'Of all sanitary conditions, not one is more conducive to health than a copious supply of fresh air.' But what, it may be asked, is sufficient? It is essential that each individual should receive at least 1,600 cubic feet of fresh air per hour, or 20 cubic feet per minute. However, the best authorities on ventilation agree in opinion that it is desirable to supply about 2,000 cubic feet to each man per hour, or 33 per minute. Dr. Reid regarded 10 cubic feet per minute as generally sufficient, but occasionally supplied 60 cubic feet per minute. Since the Report before us was presented to the House, it was found on the night when leave was asked to bring in the Electoral Franchise Bill that about 1,500,000 cubic feet, or between 9,000,000 and 10,000,000 gallons of fresh air passed through the House of Commons every hour."

The cost has been paid of securing the Houses of Parliament from danger of fire. In April, 1865, Mr. Barry drew attention to the wooden fittings placed beneath the roof (which is itself incombustible), to aid in the ventilation of the House; also to the proximity of the gas-burners to the ribs of the ceiling. The high temperature caused by the method of lighting added to the peril. In August 1865, Mr. Imray undertook to execute works (substituting metal for wood, or covering the latter with metal, with other arrangements) which should render the roof fire-proof. For this useful work he received the sum of 1,400*l*. (the time employed by him was four months), and such a sum has seldom been laid out to more useful purpose.

THE CYCLOSCOPE.

Mr. Humphrey has exhibited and explained to the Institution of Civil Engineers an instrument called the Cycloscope, for setting out railway or other curves without the aid of the transit theodolite, &c. Externally, it somewhat resembles a box sextant. It is composed of two essential parts only, viz. two plane mirrors, one of which is silvered over the whole of its surface, and the other over one-half of its surface. By a law of physical optics, which is called either combined or successive reflections, a series of images will be formed in the half mirror which are rendered available to set out any curve of any given radius, by applying the eye to an eye-hole in the back of the whole mirror, and at the same time setting the two mirrors at an angle to one another equal to the required tangential angle. Then the several successive reflected images of a ranging rod, for instance, are seen to lie upon the circumference of a mathematically true circle. The curve is then readily set out in the field by simply placing other ranging rods in line with these several images. This can be done by looking through the unsilvered half of the half mirror, and planting the rods opposite to and overlapping the successive reflections. No error can arise in the manipulation, and the whole process of setting out a true curve is shortened and simplified. After setting the mirrors to the requisite tangential angle, no further adjustment or support is needed than can be afforded by the top of a ranging rod placed at the commencement of the curve, and shifted occasionally to any stake on the curve that the limits of distinct vision may require.

PNEUMATIC PROPULSION.

M. Bergeron, the manager of the Swiss Western Railway, has described to the British Association "A System of Pneumatic Propulsion," which he proposes as adapted for surmounting steep gradients and sharp curves. His proposition is to propel the carriages through a tube by means of a column of air, and not to use exhaustion. This column of air he derives from the gradual sinking of a large bell, or succession of bells, after the manner of a gasholder. The raising of the bells will be effected by means of the direct action of hydraulic power from an elevated head, where such is available; and in any case the power, whether water or steam, used for raising the bell is only auxiliary, as the ascending carriages will drive the air before them, and thus raise the bell a certain portion of the necessary elevation. M. Bergeron is about to construct a short line on this system at Lausanne for connecting that town with the terminus of the present railway there. The tube is to be constructed of concrete, the materials for which can be obtained at a low cost.

RAILWAY INVENTIONS.

At the Conversazione of the Institution of Civil Engineers* have been exhibited one or two new features in the much-vexed question of Permanent Way. Mr. Wright sent a model of his excellent, though expensive Bed-plate Sleeperage system, which certainly possesses many and great advantages, but which we fear

* Upon this occasion, the President (Mr. Fowler) narrowed his list of invitations so as considerably to reduce the number of his guests, and enable them better to appreciate the merits of the models and other articles exhibited, by the additional space afforded to the company. The hospitalities of our Scientific Reunions appear to be serious items of expense; they vary with the views of the *savans* filling the presidential chair.

will never come into extensive use on account of its great first cost. Messrs. Livesay and Edwards exhibited a modification of Mr. Greaves's well-known cast-iron Pot-sleeper, so much in use in India and Egypt. The sleeper is oval in plan, and it has three jaws cast on it, so that the rail is well held in place. The key i of cast-iron and is serrated, corresponding serrations being cast on one of the jaws of the sleeper. Mr. Griffin's sleeper is of the same family as the last, only it is cast with corrugations; the rail is also held with a ratchet-key. This system of holding the key in place by means of ratchets or serrations, which was introduced by Mr. Ordish in his elastic cast-iron chair, appears to be now freely adopted by permanent way inventors. We observed a model of Clark's radial Axle-box, which will roll freely round curves of 60ft. radius. There are three pairs of wheels connected on the outside by an arrangement of rods and hinges. The centre pair of wheels is capable of considerable lateral motion, which is displayed directly the leading wheels enter upon a curved piece of line. It is ingenious, but hardly looks practical, and will not compare favourably with Mr. Bridges Adams's simple arrangement for effecting the same object. In Mr. George Smith's Bogie Engine the novelty consists in an arrangement of segmental-headed pins or bolts attached to the framings of the engine and bogie, and so constructed as to allow of a true motion round the centre, and admitting also of a compound transverse and circular motion by means of slots made in the slides. The engine and bogie frames are always in contact sliding upon each other, and the weight is equally distributed amongst the wheels by means of a system of compensating levers connected to the springs. Mr. Skinner contributed a model of his patent Locking Gear for Railway Signals as erected on the Great Western Railway.—*Abridged from the Mechanics' Magazine.*

LIGHT RAILWAYS.

At the Institution of Civil Engineers, a suggestive paper on "Light Railways in Norway, India, and Queensland," by Mr. C. D. Fox, has been read. By the term "light railway," the author states that he had in view such as, either being branches from existing trunk lines, or being intended for districts requiring the development of their traffic, might be constructed in a substantial manner, but with every part only of sufficient strength to carry loads represented by the rule that no pair of wheels should have to bear more than six tons. This would enable these lines to take the rolling stock of all other railways of similar gauge, with the exception of the locomotives.

The railway system of Norway was, it appeared, being constructed on the light principle, with a gauge of 3 ft. 6 in., under the direction of M. Carl Pihl, the State engineer. Two lines had already been completed; the one, from Grundsett to Hamar, a distance of twenty-four English miles, at a cost of 3,000*l.* per mile, including rolling stock and stations; and the other, from

Trondhjem to Storem, a distance of thirty English miles, at a cost of 6,000*l.* per mile, including also rolling stock and stations; but in the latter case the country was more difficult, the works generally were heavy, so that steep gradients and sharp curves were unavoidable. The details were given of the locomotive and carriage stock; and it was observed, that these lines, which ran through thinly-populated districts, already more than paid their expenses; and that the results of their working had been so satisfactory that this system was being extended.

In India, a line from the Arconum junction of the Madras Railway to the town of Conjeveram, nineteen miles in length, and on the same gauge of 3 ft. 6 in., has been at work for eighteen months. This had been constructed for 3,500*l.* per mile, including telegraph, stations, and rolling stock; and although the traffic did not require a greater working speed than from twelve to fifteen miles per hour, the trains had at times been run, with perfect safety, at upwards of forty miles per hour, including toppages.

For the Government railways of the colony of Queensland it was decided, after much discussion, to adopt a gauge of 3 ft. 6 in. Of the Southern and Western Railway 50 miles had already been opened, while 124 miles were in course of construction, and 200 miles under survey. Some account was then given of the character of the permanent way, and it was stated that these lines might be constructed under difficult circumstances for between 11,000*l.* and 12,000*l.* a mile, and under ordinary circumstances for 6,000*l.* a mile, including stock and appliances of all kinds.

The Great Northern Railway of Queensland was then noticed. And in conclusion, the author repeated that, in his opinion, the basis of the light railway system was the reducing of the weight upon every—even an engine—wheel in the train to three tons, the limitation of the speed to twenty-five miles an hour, and the adaptation of every detail to this data.

STEEL RAILS.

Mr. Price Williams, in a paper read by him to the Institution of Civil Engineers, states that the introduction of Steel Rails, manufactured chiefly by what was known as the Bessemer process, and the satisfactory nature of the results obtained, encourages the belief that in this material has at length been obtained what was alone wanting to give something like real permanency to that which in name alone had hitherto deserved the title of permanent way. Two steel rails laid in May, 1862, at the Chalk Farm Bridge, on the London and North-Western Railway, side by side with two ordinary iron rails, after outlasting sixteen faces of the iron rails, were taken up in August last, and the one face only which had been exposed, during more than three years, to the traffic of 9,550,000 engines, trucks, &c., and 95,577,240 tons, although evenly worn to the extent of a little more than a quarter of an inch, still appeared to be capable of enduring much more work. A piece of one of these rails was exhibited, and another piece had been tested, by Mr. Kirkaldy's machine, the results being recorded in tables and diagrams, showing the comparative strength of steel, steel-topped, and iron rails of different sections.

The general adoption of steel rails on main lines, where the traffic is of the heavy description referred to, would, in the opinion of the author, not only prove 50 per cent. cheaper in the end, but, what is of infinitely greater importance, would, through the less frequent breaking up of the road, materially add to the safety of the travelling public.

ELECTRICAL RAILWAY COMMUNICATION.

A SYSTEM of Electrical Communication between passengers and guards, and between guards and drivers, is now used in the mail and tidal trains of the South-Eastern Railway. The passenger compartments of the carriages have on each side, near the roof of the carriage, a circular box, in the centre of which is a knob, which, on being pulled, rings the bells in the guards' vans, and on the outside throws out a small glass disc set in an iron rim. The guards see at once the compartment from which the alarm signal has been sent, and at their discretion they may at once either stop the train by signalling to the driver, or proceed to the next station. Passengers cannot restore the knob to its former place after it has been pulled out, nor replace the indicator outside to its normal position. Electrical communication is maintained by wires passing under the eaves of the carriages, and between the carriages by spiral wires. The power employed is an electrical battery in the front and rear guards' vans, of 18 cells in each case.

RAILWAY SWITCH-BOX AND SIGNALS.

AT the Conversazione of the Institution of Civil Engineers there has been exhibited Mr. Deas's Switch-Box and Handle, which consist of only four parts, instead of about eighteen, as in the ordinary switch-box arrangement. A tubular casting has a bed-plate attached, which is embedded in the ballast; on the upper side are jaws for receiving the pin of the switch lever. The balance weight is cast on the switch lever, which has an eye at its lower end into which the switch rod hooks. This forms a very simple and satisfactory arrangement, which has been working successfully for some time past on several lines of railway. It certainly will have the effect of preventing trains leaving the rails at switches in consequence of weights dropping off or being frozen in the ordinary switch boxes, upon which it is a decided improvement. The details of Mr. Deas's system will be found illustrated in the *Mechanics' Magazine*, to which journal we are indebted for this report,

Messrs. Hogarth and Matthews sent Sparre's patent Signalling

Apparatus for bell ringing, engine telegraphing, and instant communication within any distance up to 1,200 yards. The signals are transmitted by means of a column of compressed air contained in a pipe, the bore of which is varied according to the distance; a bore of $\frac{1}{8}$ in. to $\frac{3}{8}$ in. being sufficient for transmitting signals 1,200 yards. The column of air is compressed and forced against an elastic airtight diaphragm in the receiving apparatus by means of a cylinder in caoutchouc, adapted to the extremity of the transmitting apparatus. At each compression the elastic diaphragm is raised and resumes its former shape on the cessation of the pressure. Advantage is taken of this alternate elevation and depression of the diaphragm for the transmission of signals. This system has been adopted for signalling purposes in the French navy, where it is stated to have met the approval of the Government. It is well adapted for transmitting signals on board ship between the commander and the steersman or the engine-room.

RAILWAY PASSENGERS' SIGNALS.

Mr. Howell, of the Peninsular and Oriental Company, has devised a Railway Signal, which is purely a pneumatic one. Each carriage is supplied with a length of elastic airtight tubing, which runs under it longitudinally, the ends of which are joined and made secure when the carriages are coupled up by means of a simple screw joint, which locks by the sixth of a turn. From this main tube, thus made to run the whole length of the train, branches are brought through the floor into each compartment, terminating in a small box having an airtight lid for the main tube, and all its branches are maintained in an almost perfect vacuum by being connected with a steam pipe of the engine itself, which keeps the air exhausted. Thus, on the first symptom of danger or alarm, the passenger has but to pull a string, the airtight lid of the box is opened, and on the pneumatic despatch principle, the ball is driven through the tube into a receptacle in the guard's van next to the engine, passing into which it liberates a detent that fires a cap, and instantly calls the attention of the guard to it. By a very simple contrivance the opening of any of the lids of the airtight boxes opens also a small steam whistle on the engine, thus warning the driver of the guard having received a danger signal from a passenger, and giving him notice to be ready to stand by when the guard's signal comes, and instantly stop his engine, or even reverse it. Every ball placed in each airtight box of each compartment bears on it the number of the carriage to which it belongs, with its class, so that the guard, if careful about observing the make-up of his train, can give a pretty good guess as to the part it comes from, and possibly even the nature of the danger it intimates.—*From the Times.*

GAS-LIGHTING IN RAILWAY CARRIAGES.

Some time since, Mr. Dalziel, of Deptford, suggested that each carriage should be furnished with an iron reservoir or holder to contain gas, which should be forced into it under pressure. He devised also a simple compensating and automatic valve for equalising the amount of gas given out for feeding the various burners. These plans have been realised and tested on the South-Eastern Railway with the most gratifying results.

The Great Northern Railway Company, desirous also of effecting changes in the same direction, and of testing Mr. Dalziel's system of lighting in their long and fast trains, have borrowed for the purpose a South-Eastern experimental carriage. This carriage, with its holder and apparatus complete, has been attached to a Manchester express train at the King's Cross Station. The holder was charged with what was deemed a sufficient quantity of gas for the supply of three burners during the double journey. The gas was turned on at 4.40 P.M. by means of a stop-cock, and the train started at the time above mentioned. The burners continued to emit a brilliant and uniform light up to 10.20 P.M. on the same night, when the train reached its destination and the gas was turned off by means of the same stopcock. On the following morning at 11.30 A.M. the gas was again lighted, and the carriage then proceeded with the train to London, where it arrived at 6 P.M. The burners had thus been alight for twelve hours and ten minutes; notwithstanding this, there yet remained a sufficient supply in the receiver for two hours' further consumption. The officials appointed for watching the progress of the experiment report that no uncertainty or flickering of the lights was observable, no matter what the speed of the train or the sharpness of the curves round which it passed. The holder, in this case, consisted of a boiler-like vessel of wrought iron, 1 ft. 6 in. in diameter, and 9 ft. 6 in. long, and which was fastened below the floor of the carriage, and was thus invisible to the passengers. The automatic valve is a valuable and important feature in the contrivance, for the gradual exudation of the gas involves a constantly varying pressure within the holder, and unless this were provided for and counteracted effectually it is easy to understand that no such thing as uniformity of light would be obtained. The pressure employed in charging the holder was equal to 120 lb. on the square inch.—*Mechanics' Magazine.*

THE RAILWAY IN LONDON.

The Railway Traffic in London begins to make some show in the annual returns. In the year 1865, the Metropolitan line carried 15,021,275 passengers; the North London, 9,172,319; the Blackwall, 4,286,159 of "local" passengers. The figures do not include the 6,000 or 7,000 periodical ticket-holders, as the number of their journeys is not known. These 28,000,000 of London passengers, travelling along 22 miles of railway, were more by several millions than all the passengers upon the 1,274 miles of the great and prosperous London and North-Western; and more by several millions than all the passengers upon the 1,900 miles of two other great and prosperous lines, the Midland and the North-Eastern. Another year has now made an addition to London railways—the Cannon Street and Charing Cross line is open, and the Metropolitan runs into Moorgate Street. Even in 1865, passengers by railway in the metropolis were far more than 28,000,000; that number takes no account, there being no return, of the millions who use the suburban portions of the long railways, whether main line or branches—a class especially large on the south side of the metropolis, where railways carry their passengers into and from the very heart of London. We do not pretend to estimate the London railway traffic of a few years hence, when the inner circle shall be complete, and when people may take the rail through the Thames Tunnel. It is enough that London railways will make the progress of London possible.—*Times*, Jan. 3, 1867.

VICTORIA RAILWAY BRIDGE OVER THE THAMES.

THIS new Bridge over the Thames at Battersea, which is 912 ft. long and 132 ft. wide—being the widest railway bridge in the world—consists of four river spans of 175 ft. in the clear and two land spans of 65 ft and 70 ft. respectively. The spans and rise are the same as those of the original bridge, hitherto used jointly by the two bodies for which the present work has been undertaken—the London, Chatham, and Dover, and the London, Brighton, and South Coast Railway Companies—but the foundations and ironwork are perfectly distinct. The great additions made to the capabilities of the two companies will be easily understood when it is stated that the bridge will hold two mixed gauge and two narrow gauge lines for the London, Chatham, and Dover; and one for the London, Brighton, and South Coast. Besides, the space of 33 ft. 6 in. by the up and down platforms is at present so arranged that it will be available by a small additional expenditure for three more narrow gauge lines; so that altogether, with those already existing on the old bridge, there will be ten separate means of access to the Victoria station, each having a distinct and independent approach. The bridge forms the key to the intricate network of high-level lines at Battersea, which is now nearly completed, and will doubtless obviate the difficulties which have now for some time impeded the working of the traffic of the companies by whom it has been built. The details of the structure are so numerous that it is impossible to notice them one by one, but there are some peculiar features connected with it which deserve special mention. For instance, the 32-arch ribs in the four spans are so arranged as to act as cantilevers, while the horizontal girder connected with them by spandrils is riveted up, and thus forms one continuous girder from end to end of the bridge, which, as has been stated, is 912 ft.

in length. Again, the ribs abut on cast-iron skewbacks, from which, on the piers, cast-iron standards are carried up to support the horizontal girder; so that the bridge is, in fact, an uninterrupted structure of iron, without intervention of masonry or brickwork of any kind. The cylinders beneath have been filled with concrete in cement and brickwork, loaded with pig-iron, so as to equal the weight of the superstructure when occupied with locomotives—being in the case of the cylinders next the old bridge as much as 1,260, while in the remaining ones it was 1,000 tons. It may be added that the greatest settlement in any part of this section of the great structure was not more than $\frac{7}{8}$ of an inch. The works connected with the bridge on the south side of the river are chiefly lofty viaducts and represent a total length of ten miles of double lines.

THE CANNON STREET RAILWAY STATION.

ANOTHER most important link in the network of railway lines which now traverse the metropolis in all directions has been completed and formally opened. This was the magnificent Station and Bridge which makes its junction with the Charing Cross line near the Borough Market; and, turning off from that point, crosses the river near London Bridge and terminates about the centre of Cannon-street. As might be expected, this little completing loop has been uncommonly costly; but it is also expected to be unusually remunerative, for the station has been built on a scale which supposes a passenger traffic of no less than 20,000,000*l.* annually.

Except in the bridge and the building of the Cannon-street Station, no very great expense has been incurred; but both the works we have named have, of course, been very heavy items in the bill of costs. The bridge is, for a railway bridge, singularly graceful. Unlike the bridge at Charing Cross, where Mr. Hawkshaw had to make his designs fit in with previous work, to use abutments not suited to his outlines, and, above all, to provide a footbridge, which spoilt the whole effect, the bridge at Cannon-street has been executed entirely in accordance with the first conception. Its piers, which have been built on the cylinder principle, have been taken far below the bed of the river, and ordinary girders of wrought-iron between these piers carry the roadway, which is laid for five lines of rails. A handsome ornamental balustrade on each side gives a peculiar appearance of grace and lightness to the whole.

The station to which this bridge leads is one of the loftiest and most convenient in the kingdom. Its arched roof is wider in a single span and longer in extent than the roof of any other building in London. It is nearly 40 ft. wider and nearly 100 ft. longer than even the Charing Cross Station.

At the signal-box at the entrance to Cannon-street Station there are no less than 60 semaphore arms at the different points. Next to the signal levers at the Clapham junction, where, it is said, one may change carriages for any part of the world, there is nothing like the signal station at Cannon-street. It extends from one side of the bridge to the other. It has a range of no less than 67 levers. Those for distance signals are coloured yellow, red for the in-trains on the east line, blue for those going out, and black for the "points." Each lever is numbered on the face and on the top, and the work of all is further indicated by the lettering on the brass plate which is placed along the front of the lever frame.

This railway was opened on the 1st of September, when the working of the line was so inoperative that it was "blocked" almost continuously throughout the day. But, on January 5, 1867, the *Times* bore this emphatic testimony to improvement:—"The traffic on the Metropolitan Railway continues on a most extraordinary scale, and the facilities by the South-Eastern line from Cannon-street to Charing Cross, which is now extremely well arranged, have been invaluable. But for the services of these two lines the greater part of the business of London during the past three days must have been suspended."

CLIMBING LOCOMOTIVES—MONT CENIS RAILWAY.

MR. J. B. FELL has read to the British Association a lengthy paper on Locomotive Engines and Carriages on the centre-rail system for working on steep gradients and sharp curves, as employed on the Mont Cenis Summit Railway, of which the following is an abstract. The use of the centre rail was first thought of by Messrs. Vignolles and Ericsson, in 1830, and proposed to be applied to the inclines on the Manchester and Liverpool Railway, but it was not put into operation. In ignorance of what was then done, Baron Seguin, in France, Mr. Fell, and others, also applied their minds to a solution of the problem of constructing railways over steep gradients. It was not till Mr. Brassey and Mr. Fell built a centre-rail engine, and laid down a length of line on that plan on the Cromford and High Peak Railway, for experimental purposes, in 1863, that the system was put into practical operation; the experiments being entered into in order to satisfy the Italian Government as to the feasibility of laying down a line on a similar principle over one of the Alpine passes. The mean gradient of the first 24 miles of line from St. Michael to Lauslebergis 1 in 60, with a maximum gradient of 1 in 12; in the other 24 miles the mean is 1 in 17, and over the whole length there are at intervals curves of 2 chains' radius. The line rises to an elevation of 7,000 ft., and is exposed in places to avalanches and heavy snow-drifts, where it will be suitably protected. The system of locomotion adopted was that of a third or traction rail, on which adhesion could be obtained by horizontal wheels, worked by the engine in conjunction with or independently of the ordinary driving-wheels, which admitted of the weight of the engine being reduced to a minimum; while the pressure upon the middle rail could be carried to any required amount, and gradients of 1 in 12 worked with as much certainty and safety as those of

1 in 100. The centre rail also furnishes the means of applying most powerful brakes for controlling the descent of the trains, and greatly diminishes the frictional resistance in passing round sharp curves. Besides this, the centre rail renders it almost impossible for the train to leave the rails.

The first experiments were made on the Cromford and High Peak Railway, from September, 1863, to February, 1864. The weight of the engine and load was from 16 tons to 17 tons. It never failed to take loads of from 16 tons to 24 tons up gradients of 1 in 12, or in working round curves of 2½ chains' radius on that incline, the brakes having perfect control over the train on the ascent. Certain improvements suggested themselves—the boiler power was insufficient, the inner machinery too crowded and inaccessible, and the connecting rods, working at too great an angle, by an irregular impulsive movement diminished the adhesion of the horizontal wheels. The improvements were made, and further experiments conducted, with special reference to the requirements of the Italian Government, which included three trains a-day each way; the mail train to perform the journey at an average rate of twelve miles an hour, including stoppages, the speed up the steepest incline being 7½ miles an hour, while the gross weight of the train was to be 16 tons. The mixed and goods trains were to carry 40 tons and 48 tons, each with two engines. The traffic on these trains represented a return of 100,000*l.* annually.

The paper described the official trials in Italy in the presence of the representatives of the English, Italian, Russian, and Austrian Governments. The result of the trials exceeded the estimate, both as to speed and weight of the trains; and Captain Tyler, who represented the Board of Trade, reported that "this scheme for crossing the Mont Cenis is, in my opinion, practicable, both mechanically and commercially;" and similar favourable reports were quoted from the French Royal Commissioner, while it was stated that those of the Italian, Russian, and Austrian Commissioners were equally favourable and conclusive. The French and Italian Governments granted concessions, authorising railways on the Imperial postal road over the Mont Cenis, with a width of about 13 English feet, and a company has since been formed to carry out the undertaking, and the line is expected to be opened in April or May, 1867. Attention was directed at some length to the conditions essential to the success of the system, the first of which was the employment of different types of engine according to the heaviness of the gradients. The carriages as well as the engines are each furnished with four horizontal wheels, which have flanges underlapping the centre rail—these act both as guide and safety wheels, preventing the carriages from leaving the rails; and, by guiding them round the curves, greatly diminish the frictional resistance and the tractive power required, thereby rendering it easy to reduce the weight of the engine to that which was necessary for producing and carrying the power required for the traction of the train. The economy of weight has been effected.

by a simpler arrangement of the machinery, and by using an improved quantity of material. In mountain lines ice and snow might be cleared off by cutters attached to the engine; and in seasons of mist new machinery could be probably contrived for removing that almost imperceptible film of mist which diminishes the adhesion to nearly the same extent as ice. About 8 or 9 miles of the line will be constructed in galleries — some of masonry and some of wood.

SELF-WINDING CLOCK.

MR. G. HORSTMANN, in the *Horological Journal*, describes a Self-winding Clock, of his invention, the principle of which is the expansion and contraction of fluids, consequent upon the natural changes of temperature of our atmosphere. There is first employed in this machine a vessel containing naphtha, or any other expansive fluid, which is placed at the top of the case, or in any convenient position in which it can be affected by the changes in the atmosphere. A thin piece of metal tubing connects this vessel or reservoir with a cylinder inside the case of the clock, both of which contain the aforesaid fluid; the former being of course full, and the latter filled only to such distance as to allow a piston to act in all different degrees of temperature throughout the year. The piston rod, by means of a chain, is then brought in connection with the winding part of the clock, this winding part being perfectly independent of the movement; by which contrivance a perfect maintaining power is obtained. Instead of a line an endless chain is employed for support of the weight, constructed of perforated watch-spring wire in one length, which reduces the weight of chain to one quarter of an ounce. The regulating screw for pendulum passes through the top of the case and through an airtight stuffing-box, by which means great accuracy can be obtained in regulating, without opening or in any way interfering with the case. The altering of the hands is also effected in the same manner by a pinion with long arbor connected with the motion work. The whole is enclosed in an *airtight* case, eventually (if required) to be replaced by an exhausted air case: this will of course materially reduce the pressure on all the going parts of the clock, especially the pendulum, which will then oscillate with much greater regularity.

ELECTRO-MAGNETIC CLOCK.

AN application of Electro-magnetism as a motive power for Clock-work has been made by Mr. Bright, of Leamington. The pendulum, the bob or ball of which consists of an electro-magnetic coil, is made to oscillate by means of a feeble current of electricity, thus beating true seconds, with a train of wheels only. One of the advantages of the system is said to be, that a number of clocks, in different parts, or even in different houses, can be connected together by a single wire, and the whole number will indicate the same time to a second. The clocks are of the simplest construction, and never need winding up. No acid battery is used. Mr. Bright has patented the plan; but the simultaneous movement of clocks by electrical means is not new.—*Mechanics' Magazine.*

WINDING ENGINES.

MR. J. DAGLISH has read to the British Association a paper "On the Counterbalancing of Winding Engines." It will be readily apparent, on a consideration of the subject, that the working strain on any winding engines not fitted up with some counterbalancing apparatus must vary greatly at different stages of the winding; and this is especially the case in deep pits, where the weight of the rope itself frequently exceeds that of the load to be drawn. This seems so self-evident that attention need hardly be drawn to it; and yet, although in the northern coal district the system of regulating the load on the engine by counterbalancing apparatus is widely adopted, in other parts of England it is the exception instead of the rule. The author gave a description of the counterbalances now in use, and reviewed the action of the different systems, more especially that of the most usual method of counterbalancing weights descending on a staple.

THE CHRONOGRAPH.

THIS instrument, the invention of Mr. Benson, has now come to be regarded as an authority in all matters where it is essential to obtain the rate of speed with perfect accuracy. It consists of an ordinary quick train lever movement, on a scale sufficiently large to carry the hands for an 8 in. dial; and with the addition of a long seconds-hand, which traverses the dial, instead of being, as usual, just above the figure VI. The peculiarity of the Chronograph consists in this seconds-hand and the mechanism connected with it. The hand itself is double, or formed of two distinct hands, one lying over the other. The lower one, at its extreme end, is furnished with a small cup, or reservoir, with a minute orifice at the bottom. The corresponding extremity of the upper hand is bent over so as to rest exactly over this puncture; and, the reservoir having been filled with ink of a thickness between ordinary writing fluid and printer's ink, the chronograph is ready for action. The operator, who holds tightly grasped in his hand a stout string connected with the mechanism peculiar to this instrument, in taking the time at a race, keeps a steady look-out for the fall of the starter's flag. Simultaneously, therefore, with the start of the race, the string he holds is pulled by him; and at the same moment, the upper hand dips down through the reservoir in the lower, and leaves a little dot or speck of ink upon the dial. This is repeated as the horses pass the winning-post, so that a lasting and indisputable record is afforded by the

There has been exhibited to the Institution of Civil Engineers Fenby's patent Adytic-retainer Lock, in which the levers controlling the movements of the bolt are out of the reach of any instrument. The key is made in two parts, each part being inserted in the lock through a separate aperture. The works are protected from the action of any picklock, and the whole forms one of the safest and most complete fastenings. Messrs. Whitfield and Sons, of Birmingham, have tested Mr. Fenby's adytic lock and permutating machine in the following manner:—Messrs. Whitfield took a lock from stock, and sent a written direction to the workman in charge of the machine, to cut a check for it, merely sending him the register of the lock, C501A8, having no other communication with him, nor did he see the lock. In a few minutes he sent the check which he had cut, and it opened the lock the first time it was put in. The arrangement of the six levers was then altered thus, 1 2 3 5 6 4, and a written direction again sent to the workman to cut a check to this new combination of the levers. A few minutes sufficed to cut this check, which opened the lock the first time it was applied. In order to satisfy themselves by a further test, Messrs. Whitfield again altered the arrangement of the levers, this time placing them in this order, 3 2 1 4 6 5, and sent a direction to the workman to cut a check to this arrangement of levers. In a short time the check was sent, and with it the lock was unlocked the first time it was applied. It is certainly gratifying to find that what Mr. Fenby has laid down in theory should be found so practicable, and this trial proves the value of the lock and the machine for cutting the keys or checks.

The Needle Lock is simple in its construction, as it is composed of neither more nor less than steel wires—call them needles, if you like—strung together on two stumps attached to the running bolt upon which they revolve, and they require to be lifted by the key to a position to admit of their being passed through certain holes in a plate of brass, and thus passing, carry the running bolt with them, which carries the real bolt. The needles move obliquely, perpendicularly, laterally, and indeed in any direction: hence the difficulty in raising all the needles with an instrument simultaneously to their required positions to run through their own apertures, and escape the many traps set for them in the shape of a number of holes pierced nearly half-way through the fence-plate of the exact size to fit the needles. In the more expensive latches, as we have only been describing the cheapest one, there are protectors and detectors. The invention certainly seems to deserve trial.—*Ibid.*

WOOD PRESERVING.

The process of Preserving Wood from decay, invented by Mr. L. S. Robbins, of New York, is as follows:—It consists in first removing the surface moisture from the wood, and then charging and saturating it with hot oleaginous vapours and compounds. It is pointed out that albumen is the constituent in wood which first decomposes; and herein the process of decay and putrefaction commences, and it proceeds until the woody tissue is destroyed. But the albumen in the sap is coagulated by the application of heat, and also by the antiseptic power of creosote, which the oleaginous vapours deposit in the cellular tissue. Coagulated albumen is insoluble in water, and hence it is not likely to be changed by exposure to a humid atmosphere. As the Robbins process applies the preserving material in the form of vapour, the wood is left clean, and after a few hours' exposure to the air it is said to be fit to be handled for any purposes in which elegant workmanship is required. Neither science nor extraordinary skill is required in conducting the process, and the treatment under the patent is said to involve only a trifling expense.

ARTIFICIAL WOOD.

An important branch of industry has recently sprung up in Rhenish Prussia. It consists in the manufacture of various articles from refuse wood and saw-dust, which are agglomerated by a cement, the exact nature of which is not stated, and then pressed in moulds, so as to form covers for photographic albums, small picture-frames, rosettes, and other ornaments for the use of cabinet-makers, &c. For the last-mentioned articles the composition is stained to imitate ebony, mahogany, walnut, and other woods. The composition, or "scifarine," as it is called, may be sawn, cut, drilled, attached together by glue, and bent on hot plates. It may be polished with oil or French polish, and may be varnished and gilt. A similar composition was manufactured in France a few years ago by mixing fine saw-dust with blood, and submitting it to the action of an hydraulic press. —*Builder.*

WINDOW-SASH SLIP.

A contrivance has been recently patented by Messrs. Marygold and Fitzjohn, of Shoe-lane, with the view of obviating the inconvenience and danger incidental to window-cleaning. The arrangement admits of the two window-sashes, the upper and the lower, receiving a double motion, one vertical, and the other of rotation about pivots fixed in the sash-frame, right and left, in the horizontal line through its centre. The sash-weights, sash-lines, and pulleys are dispensed with, and the up-and-down motion is obtained by a rack and pinion. The spindles of the pinions are fixed in the side-frames, and the racks are fitted into sliding pieces of deal or mahogany which support the pivots; the whole of this apparatus constituting the "Patent Window-sash Slip." As the pinion gears into the teeth of the racks, and is placed between them, the vertical motion of the sashes is always contrary. If the lower sash be raised, the upper one immediately descends through an equal space, and *vice versâ*—an arrangement of rather doubtful advantage as regards ventilation; and the weights of the two sashes being very nearly equal, the hand has only to supply the small amount of pressure necessary to overcome friction in the frame. To clean windows constructed on this principle, it is only necessary to swing them upon their pivots, so as to bring the external side of the panes within the room, lowering the upper one, if necessary, to bring it within reach.—*Builder.*

NEW COTTON-GIN.

AT the Royal Institution has been exhibited at work a new Cotton-gin for separating cotton fibre from the seed. This machine is constructed on an entirely new principle—viz., that of nipping the fibre in a positive manner close up to the seed at the time the separation of the seed is effected, the action being very similar to that of a finger and thumb opening to take in cotton, and closing in a powerful manner to hold it, so that no fibre can be broken. The result is, that the fibre is obtained, on an average, fully one-eighth of an inch longer than on the old system, and much more work is also done. This machine is the invention of Mr. E. A. Cowper, C.E., and has been named the "Lock-jaw Cotton-gin," from the manner in which the fibre is held fast in the jaws.

A NEW CHAMBER CLOSET.

A MODEL for a new Chamber Closet has been laid before the members of the Royal Scottish Society of Arts, by Mr. Alexander Ramsay, its inventor. Mr. Ramsay contends that the act of raising the handle of a watercloset unavoidably introduces into the house a quantity of foul air from the soil-pipes or drain, greater or smaller in quantity, and more or less noxious in its effects, according to the size and condition of the soil-pipes, drain, and apparatus with which the watercloset is connected. "From this evil, at least, the proposed chamber closet is free. The closet consists of two vessels, the upper one of which is covered by a valve, intended to be constantly closed, except when the closet is in use. This vessel is a sort of representative of the basin of a watercloset. Its lower end is also closed by a valve, which, when withdrawn, frees itself from and deposits the soil in the vessel under it. When that vessel is full, it is detached by moving it a couple of inches round, so as to undo the bayonet screw by which it is coupled to the lower part of the basin. When the full vessel is to be removed, it is covered with a lid, which is secured in its place by the bayonet screw. An empty vessel is then put in, and so on continuously. On the shoulder of these vessels there is a small tube terminating in a coupling screw, for the purpose of attaching a pipe to carry the gases generated in the vessel into the open air. The valves are nearly airtight, and may be made entirely so, and are opened and closed only when the closet is being used. The basin may be rinsed with water when it is thought necessary; but as far as possible, the contents of the lower vessel should not be subjected to dilution. The vessel itself being externally clean, its removal may be effected with less offence to sight or smell than is occasioned by the carrying of a housemaid's pail from one apartment to another." The excreta can thus be conveyed unmixed to the farmer's manure-strance.

NEW DISINFECTANT.

MM. Blanchard and Chateau, by mixing acid phosphate of iron and magnesia with nightsoil, have succeeded in fixing its volatile principles. Acid phosphate of magnesia and iron is cheap, and, moreover, an excellent disinfecting substance; and it appears, from the experiments which the city of Paris has made on a large scale, that, both as an agricultural and a sanitary agent, this phosphate will render great service to society.

APPLICATION OF SEWAGE.

The proper mode of applying Sewage to promote the fertility of land has, during the last two years, been exemplified at Croydon. In some cases it has been proposed to carry the sewage through drain-pipes beneath the surface of the soil; but by this means much of the effect is lost. The best mode of procedure is suitably to dilute the sewage, and then to keep the surface of the ground awash with it; and it will be proper simultaneously to introduce drain-pipes to take away the superfluous water after it has filtered through the soil, which water may again be used to dilute the sewage. It will be proper under this arrangement to divide the irrigated area into small squares of about 20 ft. each way by means of earthen embankments a few inches high, to prevent the sewage subsiding to one side of the field, from a declivity of the ground or from the action of the wind. This is the course that has been pursued from time immemorial in irrigating land in India, and it is as necessary here as there, if surface irrigation be adopted. At Croydon it was found that a field of unfruitful clay, not worth 18*s*. an acre, was made to produce, by the aid of the sewage, five or six crops of Italian rye-grass per annum, worth about 40*l*. per acre. The sewage, though foul when discharged over the land at the top of the field, becomes perfectly limpid and apparently pure when collected at the bottom.—*Illustrated London News.*

DEODORISING INDIA-RUBBER.

A NEW process, invented by Mr. S. Bourne, and described in the *Journal of the Society of Arts*, depends upon the still greater affinity possessed by charcoal, especially animal charcoal, for all kinds of odours, and its great capacity for the absorption of gases. The practical difficulty lies in so using the charcoal as not to injuriously affect the articles with which it may be brought in contact, and this has now been overcome by very simple means.

The articles, generally speaking, are laid in shelves or trays in a hot chamber, with a thin stratum of charcoal beneath and on top, and exposed to a temperature of from 120 to 180 degrees for from three to six hours; after which they are removed from the charcoal, having sustained no other alteration than the all-important one of being rendered devoid of smell and incapable of imparting any taste to liquids or other substances they may touch. Under proper management the most delicate textures can be thus dealt with without being impaired either in substance or appearance. The most convenient mode of applying heat is by hot water or steam surrounding the vessel or chamber in which they are placed. One very considerable advantage of this process is that, for a large number of vulcanised articles, it can be carried on in co-operation with the heating or curing by which the vulcanisation is affected, and they leave the chamber at once free from odour. It is equally applicable to India-rubber in sheet, spread fabrics, or the garments and other articles made therefrom when fully made up, such as the ordinary "Macintosh" clothing, air and water cushions, &c.—*Mechanics' Magazine.*

BRILLIANT MARBLED PAPERS.

IN the factories where albumenised photographic paper is made, a considerable quantity of paper is spoiled in the process, and it is then of but very little use. In Paris and Berlin this paper has always been washed as free as possible from the albumen, and then worked up into envelopes. Dr. Jacobson has found a new use for this paper; he proposes to stain it with aniline colours and to employ it for labels, covers of boxes, and general decorative purposes. By being splashed with concentrated alcoholic solutions of the various aniline colours, the waste of these coloured papers, according to the *Reader*, is now converted into Marbled Paper, of a much more beautiful appearance than what is produced by the old process, from the green-gold lustre which the films of these substances possess. The papers obtained by this method retain the gloss, the bright "satin" surface of the albumenised material, and are almost as brilliant by transmitted as by reflected light. They are said to be well adapted for shades, transparencies, paper lamps, and other means of decorative illumination.

POSTAGE STAMPS.

THE manufacture of these valuable little bits of paper is a Government monopoly in France as well as everywhere else, but is farmed out to a private contractor, who has his workshops in a back court of the Hôtel des Monnaies or Mint, where a million and a half of Postage Stamps are daily produced at a cost to the Government of 90c. per 1,000; so that in the case of the lowest description of stamps, of the value of 1c., the Government profit is 910c., or 9f. 10c. per 1,000. The same workshops also produce the postage stamps for the French colonies, the kingdom of Greece, the Republic of Guatemala, and any other foreign countries that choose to apply. The sheets used in this manufacture are first subjected to a preliminary process—viz., that of covering the whole surface with a sort of white transparent ink, an operation which is performed by means of cylinders. The object of this process is to prevent forgery, for, were anyone to attempt transferring the design to a lithographic stone, both the inks, the white and the coloured one, would stick to the stone, and nothing but a uniform coloured impression could be obtained. The composition of the white ink is a secret. In the press-room twelve powerful presses are constantly at work, the men having a number of colours spread out before them on marble slabs. But there is a portion of the operation which, after printing, is entirely effected by the hand; this consists in laying on certain specks of colour with the brush.

The last operation consists in pricking holes round each stamp by machinery. The sheets, when printed, are taken to another workshop, where they are cut into half-sheets, each containing 150 stamps. Five of these half-sheets are laid one upon the other, and strongly pressed together in a frame, an operation performed by two boys; the frame then passes under the pricking apparatus, and is thence brought back to the workmen's hands by a combination of pulleys. The bad stamps are now picked out, and the remainder sent to the General Post-office. The State having also the monopoly of playing cards, the manufacture connected with it is also partly conducted in the above-described workshops. The State causes a peculiar paper bearing a transparent figure of the eagle, to be manufactured at a special mill; at the postage stamps manufactory the types of the court cards and the ace of clubs are engraved by electricity; at the Imperial printing office these types are used to print on the sheets marked with the eagle; the paper in which the packs are wrapped up is stamped at the Hôtel du Timbre. Card manufacturers, therefore, are obliged to buy of Government the court cards, aces of clubs, wrappers, and paper on which to paint the low cards, which they do themselves. It is they who make up the packs for the retail dealers.—*Galignani's Messenger.*

PALMETTA PAPER.

A NEW vegetable fibrous substance, from which to manufacture paper, is a material obtained by treating the palmiet or prionium palmetta plant, which Mr. George Eveleigh, a surgeon, of Southampton, proposes to utilise in the following manner:—He takes the whole plant and macerates the same in water, with or without the aid of heat or steam, so as to thoroughly cleanse, soften, and loosen the fibre, which is then split up into thin strips by pressure or by circular or other knives. These strips are again soaked in water, or steamed, and allowed to ferment and bleach in the sun. He then passes the strips so produced with abundance of water between rollers, so as to remove as far as may be necessary all gum, resin, or other viscid or injurious matter; and again allows them to bleach and dry in the sun or by other heat, passing them again through rollers, if needful, so as to remove all moisture. They can then be packed and sent to the paper mills to be used as rags, straw, hempen, or flaxen material, and by the usual means for making pulp suitable for paper either alone or in conjunction with other materials. Mr. Eveleigh also obtains a substance more suitable for making the finer qualities of paper, by removing some portion of the outer coating of the stem and root of the plant. He then cuts or breaks up the stem and root—first longitudinally, then diagonally – by passing them with an abundance of water between pressing rollers. He then mixes the broken stuff with water, permitting it to ferment or not as may be desirable, and either extracts the small quantity of silica contained in the plant by soda and boiling under superheated steam, or dispenses with this operation, according to the quality of paper to be made from the pulp. The gum or resin of a caoutchouc nature which is contained in the plant is also extracted by increasing the pressure between the breaking rollers or by chemicals, excepting when making a substance for the coarser kinds of paper, in which case this gum adds materially to the strength and elasticity of the article produced. The stuff is then bleached by any of the ordinary processes, such, for example, as are used for bleaching straw, and reduced by machinery into a pulp, from which, when strained, paper can be made without admixture with any other material. The prepared substance may be used in no greater proportions than rags to make a pulp in combination with straw and other materials, which alone will not give a good paper. The fibrous substance thus obtained may be advantageously combined with rags, clay, straw, maize stalks, hempen materials, grasses, and any or several of the numerous substances now used by paper-makers.—*Mechanics' Magazine.*

SEA-WEED PAPER.

MM. Gegnon and Gaguage, chemists, of Paris, propose to apply generally marine vegetable substances for the manufacture of paper. The sea-weeds used are those known by the names of *fucus comosus* (*zostera maritima*), especially the varieties known as the fucus giganteus, or fucus comosus of the equator. It is found in the form of long glutinous coriaceous shreds or strips of a brownish-green colour and when dry it in form presents somewhat the appearance of tobacco. The sea-weed is washed, to deprive it of all impurities and slime, it is then further washed in any suitable alkaline, carbonated or oxidated and soapy solution marking 12 deg. Beaumé. This raw material is washed repeatedly until the water resulting from the washing remains perfectly clear, and is then submitted to the action of mills or crushing apparatus provided with water, which, in addition to the preceding operations, disengages all foreign matters from it. There then remains a cellular fibre similar to rags, which can be used in the manufacture of paper and cardboard.

The bamboo, which grows abundantly in most of the West India islands, has, we hear, been for some time past largely exported from Jamaica to New York in bales and bundles, for the purpose of being manufactured into paper, and has proved equally as valuable as rags. For shipment, it is crushed between the mill rollers, and, by screw pressing, packed into bales, as are now packed esparto and other bulky fibres.

Esparto grass is coming into general use in paper-making, and we learn that paper pulp from the esparto grass is now largely shipped from Carthagena to Belgium and England.

NEW MANUFACTURE OF FLOOR-CLOTHS.

Dr. John B. Wood, of Broughton, Manchester, has patented an improved description of Floor-cloth, which he proposes to manufacture in the following way. He takes buffalo or other untanned hides, previously macerated in water, the temperature of which should not exceed eighty degrees of Fahr., the water being slightly acidulated with hydrochloric acid; using, for this purpose, about one part of the commercial acid to a thousand parts of water. The shreds or strips of hides should be allowed to remain in this water for the period of one or two days, or until the texture of the hides is sufficiently softened. The hides or shreds are then removed from the bath in which they were immersed, and subsequently put into a rag-engine or other suitable machine, in which they are macerated or bruised in combination with a sufficient quantity of water, until the whole shall be reduced into one uniform fluid fibrous mass; this is afterwards to be mixed with cotton, cotton waste, linen, or linen waste, linsey, linsey rags, animal hair, or other fibrous materials, until the whele becomes equally blended throughout. The combination preferred is as follows, namely, about thirty parts of the pulped hide combined with thirty parts of linsey rags reduced to a pulp, and forty parts of animal hair ground up extremely short and fine in the rag-engine or other suitable machine. The pulped hide may, however, be mixed in other proportions than those above given with fibrous materials; the liquid fibrous pulp thus obtained is afterwards placed in a vat, in which it is kept constantly in motion, from which the flow is regulated as required on to the wire of a machine similar in most respects to that for making paper; but inasmuch as the amount of pulp requisite to be upon the wire at any given time is considerable, it is preferred, in order to prevent the too rapid separation of the water from the pulp, and to ensure an equal diffusion of the pulp over the whole surface of the wire, to use a wire which shall run on or more or less under the surface of water contained in a tank or cistern equal in breadth to the wire of the machine; so that, at all times, the upper surface of the wire shall be more or less covered with a stratum of water. The length of the tank may be about 4 ft. or 5 ft., but this may be considerably varied; by this arrangement of the wire the pulp, as it flows from the vat, cannot immediately part with any of its water, so that its perfect fluidity is maintained, and its equal diffusion over the surface of the wire effectually secured. The wire, during the whole of the time, travels forward at a comparatively very slow rate, the combination and thorough intermixture of the fibres being at the same time effected by the lateral shake given, as in an ordinary paper mill. This having been done, the wire travels onwards, leaving the surface of the water in the tank, and thus immediately allowing the greatest bulk of water contained in the pulp at once to escape. The more complete separation of the water is afterwards effected by the application of vacuum-boxes and air-pumps, as now done in a paper machine, aided by the compression of one or more pairs of wire rollers or other rolls. By this time the pulp is sufficiently consistent to permit of its being passed through a series of couch rolls covered with felt, the number of which may be more or less as required, until the whole or nearly the whole of the water which the cloth contains is removed; the fabric is then to be passed over one or more large jacketed cylinders, moderately heated by steam, in a similar manner to that employed in the manufacture of paper.

The cloth thus made or produced may be finished in different ways, either in imitation of and as a substitute for the common oil floorcloth, or a substitute for kamptulicon.—*Mechanics' Magazine, abridged.*

FRESH MEAT FROM SOUTH AMERICA.

Lord Stanley has received from Buenos Ayres a Report on the various methods used in the country there to Preserve Meat in an effectual manner for transportation to Europe. Mr. Ford gives a full account of the native system of curing meat, then of Morgan's process for doing so by injecting a preparation through the circulatory system of the newly-killed animal, and next of Liebig's process for producing the *extractum carnis*. Finally, he gives an interesting account of an invention for transporting meat in a perfectly wholesome condition, and as fresh as when killed. The following is Mr. Ford's account of the new process, called "Sloper's process," lately patented by Messrs. M'Call and Sloper. The patent has been conceded for the whole of South America to Messrs. E. Paris and B. S. Sloper. These patentees profess to be able to preserve meat in its fresh and raw state, which is to arrive in England or elsewhere, in the exact condition as butchers' meat just killed, and be able to dispose of it at the rate of *4d.* to *5d.* per lb.; and that, moreover, when taken out of the airtight tins in which it is to be packed, and on being exposed in the air, it will keep twice as long as ordinary butchers' meat. The curing process is simple, and is based on the destruction of oxygen from the vessel in which the meat is packed. All bone is extracted from the meat, but the fat is left. From the tins in which it is placed the air is exhausted by means of water forced in at the bottom, which, when it reaches the top, is allowed to redescend and run off, and the vacuum thus left is filled from above by a certain gas, the composition of which is kept a profound secret. The two holes at top and bottom are carefully soldered down, and the meat is then ready for exportation. The only risk it runs is from leakage, the smallest opening in the tin case proving destructive, by allowing the gas to escape and the air to get in. Messrs. Paris and Sloper, on their arrival at Buenos Ayres, gave an entertainment to the Vice-President of the Argentine Republic, to the members of the Government, and other gentlemen, with a view to their tasting some samples of beef they had brought out with them from England, and which they had cured six months previously. The tins on being opened were found to contain joints in first-rate condition, and, on their being cooked, no difference could be detected from freshly-killed meat.

At a meeting at the London Tavern, to test the River Plate meat preserved in a fresh state by the patent process of Messrs. Paris and Sloper, there was a large attendance of merchants and others interested in the trade of the Argentine Republic and the Republic of Uruguay, and resolutions were unanimously passed expressing satisfaction at the samples submitted and confidence in the results of the invention.

EXTRACT OF MEAT.

With regard to Liebig's Extract of Meat Company, the machinery, &c., for enlarging the establishment at Fray Bentos, and for erecting another in the Argentine province of Entre Rios, has been completed and sent out. The outlay for the new manufactories will be less than was anticipated; while, on the other hand, the sheep and lands transferred to the company by the Sociedad de Fray Bentos are found to be rather in excess of the original representations. In 1867, the production, it is believed, may amount to 500,000 or 600,000 lb. Meanwhile, the manager of the depôt at Antwerp gives "the most assuring accounts of the increasing demand for the meat, not only in Europe, but elsewhere."

Natural Philosophy.

EVIDENCES OF CONTINUITY IN THE UNIVERSE.

PROFESSOR GROVE, as President of the British Association, which met at Nottingham in August last, remarked that "One word would give the key to his discourse; that word was Continuity. The more they investigated, the more they found that in existing phenomena graduation from the like to the seemingly unlike prevailed, and that in the changes which took place in time, gradual progress was, and apparently must be, the course of nature." In applying that view to the recent progress of some of the more prominent branches of science, Professor Grove remarked there was another class of observations, quite new in its importance, which had formed a special subject of contribution to the Reports of the Association—he alluded to those on meteorites, at which their lamented member, Professor Baden Powell, assiduously laboured. "If," he might add, "the same scrutiny were applied to other parts of the heavens as to the zone between Mars and Jupiter, it would be no far-fetched speculation to suppose that between the asteroids or bodies of a smaller size than what were known as the ancient planets, of which instead of seven we now counted 88, and the meteorites, bodies of intermediate size existed, until the space occupied by our solar system became filled up with planetary bodies, varying in size from that of Jupiter—1,240 times larger in volume than the earth—to that of a cannon ball or even a pistol bullet. Another half century would, not improbably, enable us to ascertain that the now seemingly vacant inter-planetary spaces were occupied by smaller bodies still, which had hitherto escaped notice, just as the asteroids had done until the time of Olbers and Piazzi. But the evidence of continuity, as pervading the universe, did not stop at telescopic observation; chymistry and physical optics furnished us with new proofs of its existence. Those meteoric bodies, which had from time to time come so far within the reach of the earth's attraction as to fall upon its surface, gave, on analysis, metals and oxides similar to those which belonged to the structure of the earth. M. Daubrée, too, as appeared from a series of papers which he had recently communicated to the French Academy, had succeeded in forming from terrestrial rocks substances very much resembling meteorites; so that a closer relationship, although by no means identity, had been established between the earth and those wanderers from remote regions. . . . .

Passing from extra-terrestrial theories to the narrower field of molecular physics, we found the doctrine of correlation of forces steadily making its way. In a practical point of view, the power of converting one mode of force into another was of the highest importance. At a moment when the prospective exhaustion of our coal-fields, somewhat prematurely, perhaps, occupied men's minds, there was much encouragement to be derived from the knowledge that we could at will produce heat by the expenditure of other forces. Some experiments in electricity, which had been made by Mr. Wilde and Mr. Holz, tended clearly to show that, by a mere formal disposition of matter, one force could be converted into another; and as we might, at no very distant day, need for the daily uses of mankind heat, light, and mechanical force, and find our present resources exhausted, the greater the extent to which we could invent new modes of conversion of forces the better the prospect we should have of supplying that want. It was but a month from that time that the greatest triumph of force conversion had been attained. The chemical action generated by a little salt water on a few pieces of zinc now enabled us to converse with inhabitants of the opposite hemisphere of this planet, and

'Put a girdle round about the earth in forty minutes.'"

. . . .

Professor Grove passed to the general question whether "what we termed Species were and had been rigidly limited, and had at numerous periods been created complete and unchangeable; or whether, in some mode or other, they have not gradually and indefinitely varied; and whether the changes due to the influence of surrounding circumstances, to efforts to accommodate themselves to surrounding changes, to what was called natural selection, or to the necessity of yielding to superior force in the struggle for existence, as maintained by our illustrious countryman Darwin, had not so modified organisms as to enable them to exist under changed conditions. The question whether, among the smallest and apparently the most elementary forms of organic life, the phenomenon of spontaneous generation obtained, had recently formed the subject of careful experiment and animated discussion in France; and the general opinion which was arrived at was, that, when such precautions were taken as to exclude from the substance submitted to experiment all possibility of germs from the atmosphere being introduced, no formation of organisms took place. The balance of experiment might, therefore, be fairly said to be against spontaneous generation. The progressive and more highly developed forms were, at all events, so far as the most enlarged experience went to show, generated by reproduction. Now, to suppose a zoophyte the progenitor of a mammal would, at first sight, appear to be an extravagant hypothesis; but the more the gaps between species were filled up by the discovery of intermediate varieties, the stronger became the argument for transmutation, and the weaker that for successive creations became. The former view, then, became more and more consistent with experience, the latter more discordant from it.

"Certain it was, that the more we observed the more we increased the subdivision of species; and, consequently, the number of those supposed creations to which he referred; so that the new creations became innumerable: yet of those we had no well authenticated instance, and in no other observed operation of nature had we seen such a want of continuity as would be evidenced by those frequent *per saltum* deviations from uniformity, each of which was a miracle. The doctrine of Cuvier —every day more and more borne out by observation—that each organ bore a definite relation to the whole of the individual, seemed to support the view of indefinite variation. If an animal sought its food or safety by climbing trees, its claws would become more prehensile, the muscles which acted on those claws must become more developed, and each portion of the frame would mould itself to its wants.

"Another series of facts, which presented an argument in favour of gradual succession, were the phases of resemblance to inferior orders which the embryo passed through in its development, and the relations shown in what was termed the metamorphosis of plants; facts difficult to be accounted for on the theory of frequent separate creations, but almost inevitable on that of gradual succession. There was, however, a difficulty in the way of tracing a given organism to its parent form, which, from our conventional mode of following up genealogies, was never regarded in its proper light. Where were we to look for the remote ancestor of a given form? Each one among them, supposing none of their progenitors to have intermarried with relatives, would have, at about the period of the Norman Conquest, upwards of a hundred million direct ancestors of that generation; and, if the intermediate ancestors were added, double that number. Let anyone assume that one of his ancestors at the time of the Conquest was a Moor, another a Celt, and a third a Laplander, and that those three were preserved while all the others were lost, he would never recognise either of them as his ancestor; he would only have the one hundredth-millionth of the blood of each of them, and, as far as they were concerned, there would be no perceptible sign of identity of race.

"The recent discoveries in palæontology showed that man existed on this planet at an epoch far anterior to that commonly assigned to him. The instruments connected with human remains, and indisputably the work of human hands, proved that to these remote periods the term civilisation could hardly be applied. A little step-by-step reasoning would convince the unprejudiced that what we called civilisation must have been a gradual process. If even new habit, and prejudice resulting therefrom, vested interests, &c., retarded for some time the general application of a new invention, what must have been the degree of retardation among the comparatively uneducated beings which then existed? He had, of course, been able to indicate only a few of the broad arguments on this most interesting subject; for detailed results, the works of Darwin, Hooker, Huxley, Carpenter, Lyell, and others must be examined. If he appeared to lean to the view that the successive changes in organic beings did not take place by sudden leaps, it was, he believed, from no want of impartial feeling. Perhaps the most convincing argument in favour of continuity which could be presented to a doubting mind would be the difficulty it would feel in representing to itself any *per saltum* act of nature. Who would not be astonished at beholding an oak-tree spring up in a day, and not from seed or shoot?

"If we were satisfied that Continuity was a law of nature, the true expression of the action of Almighty Power, then, though we might humbly confess our inability to explain why matter was impressed with this gradual tendency to structural formation, we should cease to look for special interventions of creative power in changes which were difficult to understand, because, being removed from us in time, their concomitants were lost; we should endeavour from the relics to evoke their history, and when we found a gap, not try to bridge it over with a miracle. Philosophy ought to have no likes or dislikes, truth was her only aim; but if a glow of admiration were permitted to a physical inquirer, to his mind a far more exquisite sense of the beautiful was conveyed by the orderly development, by the necessary inter-relation and inter-action of each element of the cosmos, and by the conviction that a bullet falling to the ground changes the dynamical conditions of the universe, than could be conveyed by mysteries, by convulsions, or by cataclysms. But the doctrine of continuity was not solely applicable to physical inquiries. The same modes of thought which led us to see continuity in the field of the microscope as in the universe, in infinity downwards as in infinity upwards, would lead us to see it in the history of our own race. Does not the worn hollow on the rock record the action of the tide, its stratified layers the slow deposition by which it was formed, the organic remains imbedded in it, the beings living at the times these layers were deposited, so that from a fragment of stone we can get the history of a period myriads of years ago? From a fragment of bronze we may get the history of our race at a period antecedent to tradition. As science advances, our power of reading this history improves and is extended. Saturn's ring may help us to a knowledge of how our solar system developed itself, for it as surely contains that history as the rock contains the record of its own formation. By patient investigation how much had we already learnt which the most civilised of ancient human races ignored! But how much more might we not expect to know?

"They assembled, ephemera as they were, had learnt by transmitted labour to weigh, as in a balance, other worlds larger and heavier than their own, to know the length of their days and years, to measure their enormous distance from the earth and from each other, to detect and accurately ascertain the influence they had on the movements of our world and on each other, and to discover the substance of which they were composed; might they not fairly hope that similar methods of research to those which had taught them so much might give our race further information until problems relating not only to remote worlds, but possibly to organic and sentient beings which may inhabit them, problems which it might now seem wildly visionary to enunciate, might be solved by progressive improvements in the modes of applying observation and experiment, induction and deduction?"

DIA-MAGNETIC FORCE.

An application of the Dia-magnetic Force, which was discovered by Professor Faraday in 1845, has been described by Mr. Cresson, at a meeting of the American Philosophical Society, Philadelphia. This force gives rise to a repellent action between a magnet and various bodies previously supposed to be destitute of magnetic relations. This property is found in vegetable, animal, and earthy substances. The new use of it consists in imparting inductive magnetism to the iron shell of a steam-boiler, by suspending within it a number of hardened steel permanent magnets. This has been found to effect the removal of sedimentary scales formed from the earthy salts held by the water, and to prevent the further deposit of crystalline scales, so that boilers using water highly charged with calcareous matters are cleansed from adhering scales in a few weeks, and kept clean.

MAGNETIC VARIATION.

The *Proceedings of the Royal Society*, No. 86, contains a paper by Lieutenant-General Sabine, P.R.S., on the lunar diurnal Variation of the Magnetic declination, and of the horizontal vertical components of the magnetic force, derived from seven years' Kew observations, and from comparison with observations in other parts of the world. The paper states that "a Magnetic Variation shown to be thus obviously dependent upon the moon's position relatively to the terrestrial meridian, and agreeing in its principal features in such various localities, is urged by the author as being ascribable, with great probability, to the direct magnetic action of the moon."

MAGNETISM IN IRON SHAVINGS.

M. Greiss has discovered a new source of magnetic iron in the Shavings of Iron and Steel, and especially the long spirals produced in turning on the lathe, which, he says, are highly magnetic, especially in the case of soft iron. This magnetism is permanent, and M. Greiss has observed that the south pole is always at the end which is first touched by the tool. This discovery may shed some new light on the curious phenomenon of vegetable spirals, although we should conceive these to be formed under the joint influence of the diamagnetic and the magnetic forces.

MAGNETISM OF SHIPS.

It is hoped that in due time a Manual will be prepared comprehending the results of recent Magnetical discoveries, and suitable for the guidance and instruction of persons engaged in the construction and navigation of iron ships. The Admiralty regulations and a series of suggested rules relative to the compasses of iron merchant-ships are given in an appendix; and, in notes respecting the compass, it is stated that the essential qualities of a good compass may be considered to embrace great sensibility and steadiness with simplicity of construction, by which it is understood "that the needle is freely to submit to the earth's magnetic force, with power sufficient to steadily obey that force under the varying motions of a ship, without the aid of friction or mechanical impediment; steadiness, or rather sluggishness, produced by the latter causes being obtained at the expense of accuracy." Details are given of the form and construction of a good compass.—*Illustrated London News.*

DEPOLARIZATION OF THE "NORTHUMBERLAND."

In reply to the article quoted from the *Athenæum*, at page 61, has appeared the following letter in that journal:—"It may be inferred from this statement, in connection with one of a similar nature made to the British Association, at Nottingham, in a paper by Mr. Evan Hopkins, C.E., 'On the Depolarization of Iron Ships to Prevent the Deviation of the Compass,' that, by the process alluded to, the magnetism acquired by an iron ship in building was, in the case of the *Northumberland*, so destroyed as to render the compasses on board that ship free, or nearly so, from error.

"As everything connected with the correction of the deviation of the compass is not only of scientific interest, but of vital practical importance to the mercantile as well as the royal marine, it is incumbent on those whose duties enable them to speak with certainty not to allow erroneous statements on this subject to pass without correction.

"The *Northumberland* having been built with her head nearly north, the compasses in the after-part of the ship had originally very large deviations. When the ship was taken to the Victoria Docks, she was, on the submission of this Department, placed in an opposite direction, or with her head nearly to the south, so as to decrease as far as possible the original deviations acquired in building. By careful observations made on the 21st of April last, immediately after she was placed in the docks, the maximum semi-circular deviation of two compasses, one on the front of the poop and the other on the quarter-deck, were respectively $54\frac{1}{4}°$ and $51°$; by equally careful observations made on the 10th of August, these deviations were $55\frac{3}{4}°$ and $46\frac{1}{2}°$.

"The operations of Mr. Evan Hopkins having been performed on the 4th of August, the above results show that, whatever local effect these operations may have had—as to which I have no evidence—no appreciable general effect was produced, and that the *Northumberland* has, in no sense of the word, been 'depolarized.'—Fredk. Jno. Evans, Staff-Commander R.N., in charge of Admiralty Magnetic Department."

METALLIC CONDUCTORS.

M. DUFOUR has published in the *Archives des Sciences* of Geneva, an account of his elaborate experiments on the secondary polarisation of Metallic Conductors placed in the soil. His experiments were made at Lausanne. One of his conductors was a plate of copper, 36 decimètres square, deposited in common vegetable earth, about 2·85 mètres deep. At a mètre from this was placed a plate of iron of the same size; the third conductor was formed of gas-pipes. Among the results obtained were the following:—Metallic conductors plunged into the earth, are polarised when they have been traversed by a current; the earth behaves entirely like an ordinary liquid conductor; the currents of polarisation are weakened nearly in proportion as the resistances employed increase; the polarisation is stronger when the current goes from the copper to the iron by the soil, &c.—*Illustrated London News.*

LIGHTNING CONDUCTORS.

M. PELTIER, son of the celebrated mathematician, has addressed a note to the Belgian Academy of Sciences on the question whether Lightning Conductors should be terminated by points or balls. If, says he, by the aid of conductors we hope to neutralise the electricity of a storm-cloud, there is no doubt points must be employed; but, if we wish to attract the lightning in order to conduct it into the common reservoir, there is still no doubt we must terminate the conductor by a ball. In conclusion, after commenting on experiments, he gives his opinion that lightning conductors owe very little of their preventive action to their points, and that they would have a very much greater preservative character if they terminated with a rounded surface.—*Ibid.*

PRACTICAL HYPSOMETRY.

MR. J. A. ELLIS has communicated to the British Association a paper, the object of which is to furnish a rule by which heights might be calculated from observations of the barometer and thermometer, with the same accuracy as by Laplace's complete formula (of which it is a mathematical transformation), but without any tables whatever, and therefore without the use of logarithms. The following local example will best illustrate the rule. On Wednesday, August 22nd, an aneroid barometer at the towing-path, Station Side, Nottingham, stood at 30·02, and at Mount Vernon at 29·82; the sum of these numbers is 59·84, and their difference 0·20; multiplying this difference by 52,400, we obtain 10,480·00, which, divided by the sum, or

59·84, gives the quotient 175, which requires to be corrected for temperature. The thermometer at each station was 65°; the sum of 65, 65 (the two temperatures), and 836, is 966, and this divided by 900 gives 1·073. Multiplying 175 by 1·073 to the nearest unit, we find 188, the number of feet in the difference of level.' If a mercurial barometer had been used, we must have diminished this result by two and one-third times the difference of the temperature of the mercury. This rule gives accurate results for all British heights, and, if only aneroid barometers are used, may be employed for all heights under 3,000 feet all over the world. Greater heights must be calculated in sections of about 3,000 feet each.

LONGITUDE BY GALVANIC SIGNALS.

PROFESSOR GRANT, of Glasgow, has communicated to the Royal Astronomical Society an account of the methods employed by him in the determination of the difference of Longitude between the observatories of Greenwich and Glasgow by Galvanic Signals, in which he was assisted by our Astronomer Royal, who placed all the resources of the Royal Observatory at his disposal, and also by the Electric and International Telegraph Company, who gave him the temporary use of a wire between the two places, and the aid of an engineer and other officers. He obtained definitely the following as the time of the passage of the current, 0·029 sec.

HEIGHT OF WAVES.

M. COUPVENT DES BOIS has presented a paper to the Paris Academy of Sciences on the Height of Waves on the surface of the principal oceans. From his observations it appears that, on the equatorial Pacific, the average altitude of waves diminishes in going westward, it being from three to four times greater in the vicinity of America than it is near Asia. 2. That in the equatorial Indian Ocean their average height is greater in the middle than towards its eastern and western borders. 3. That on the equatorial Atlantic the mean altitude of the waves increases from east to west, that is, in a sense contrary to that on the Pacific. 4. That this altitude is nearly the same in all latitudes, the average being about two mètres. 5. That this average falls to one mètre in those parts of the ocean that are more or less protected by land. 6. The highest waves were observed between New Holland and Adelia, between 50 deg. and 60 deg. latitude. Their average is more than double the general one, thus presenting a remarkable exception to rule 4. But greater anomalies are observable when the average velocity of the wind is compared with the altitude of the waves; nevertheless, the author is enabled to state that a wave two mètres in height corresponds to a wind moving at the rate of five mètres per second.—*Mechanics' Magazine.*

THE DIAMOND.

According to M. Goeppert, the Diamond is of Neptunian origin. It must at one time, he says, have been in a soft state, since on its exterior surface it often bears impressions of grains of sand and other crystals, and in its interior shows traces of plants. He considers the diamond to be the final product of the chemical decomposition of vegetable substances, and asserts that the fact that heat transforms the diamond into a graphitoid substance excludes the idea of a Plutonian origin.

YELLOW DIAMONDS.

M. Fremy has exhibited at the Paris Academy of Sciences a diamond with a yellowish tinge, worth 60,000f. M. Halphen, its owner, stated that a diamond of the same weight with a rosy tint, would have three times the value. He added, that he had accidentally discovered that this tint was acquired by submitting the diamond for a few hours to a high degree of heat, but, unfortunately, the colour lasted for a few hours only.

In regard to the change of colour in the above diamond, M. Gallardo Bastant, who has much studied the origin of precious stones, has communicated to the Academy his opinion as to the cause of this phenomenon. "The yellow diamond," he says, "is a compound of carbon and the fluoride of aluminium, and its yellow colour is changed into rose-colour. The same phenomenon is observed with the topaz, which is a compound of aluminium, silex, and fluoric acid, the yellow colour of which also changes to rose colour at an elevated temperature. This change of colour is due to the absorption of carbonic acid; and analysis shows traces of this gas."—*Illustrated London News.*

M. Chancourtois has presented an interesting memoir to the Paris Academy of Sciences on the production of Diamonds in nature. M. Chancourtois thinks that diamonds have resulted from an incomplete oxidation of carbides of hydrogen, just as the sulphur of the *Solftara* results from an incomplete oxidation of sulphuretted hydrogen, all of whose hydrogen is converted into water, while only a part of the sulphur is changed into sulphurous acid. It is by a similar process that petroleum has given rise to bitumen, and this again to graphite. "If," then, said the author, "a mixture of hydrocarbon gases and vapour of water be submitted to slow oxidation, diamonds may possibly be obtained." It is even possible, he observes, that "the tubes which convey common coal gas along the streets may contain such artificial diamonds in abundance." Let us take another view of the matter. Diamonds, as we have before said, could readily be produced if we had a solvent of carbon. Might not that very interesting and curious fluid from two solids—sulphide of carbon—under galvanic influence, dissolve a certain additional quantity of carbon, which, on the gradual withdrawal of the galvanic action, might be deposited from the sulphide in a crystallised or diamond state?—*Builder.*

SPECTRUM ANALYSIS.

MR. WILLIAM HUGGINS, F.R.S., has examined the light both of the nucleus and of the coma of the small telescopic comet which was visible during a part of January last, and which is catalogued by the astronomers as "Comet I., 1866," by the aid of the Spectrum Apparatus with which he made his well-known observations on the spectra of the nebulæ. His observations have led him to the conclusions that the nucleus of that comet is self-luminous, and that it consists of gaseous matter in a state of incandescence; but that the coma is not self-luminous, and that the reflected light by which the coma was rendered visible to us was the light of the sun. The spectrum of the nucleus, like the spectra of several of the nebulæ previously examined by Mr. Huggins, consisted of but one bright line, corresponding in refrangibility with the brightest of the lines of nitrogen. The exact similarity between the spectrum of this comet and the spectra of the nebulæ in question implies the existence of some very close relation between cometary and nebulous matter, while the identity of the single line presented by these spectra with one of the nitrogen lines would seem to suggest the hypothesis that nitrogen is not an elementary substance, but a compound one, and that it is of some one of the several constituents which thus go to make up what we know as nitrogen that this nebulous and cometary matter consists. Mr. Huggins believes that cometary matter consists chiefly of nitrogen, or of a more elementary substance existing in nitrogen. Donati, after observing the spectrum of a comet in 1864, remarked that it resembled the spectra of some of the metals—which reminds us that in his lecture "On the Solidification of Gases," delivered some twenty years ago at the Royal Institution, Professor Faraday stated that in his opinion if nitrogen should ever be solidified it would prove to be a metal.—*Mechanics' Magazine.*

At the late meeting of the British Association, Mr. Huggins lectured "On the Results of Spectrum Analysis as applied to the Heavenly Bodies," a little formidable in point of sound, but the matter of the essay and the illustrations accompanying the lecture were of the most interesting character. The lecture occupied fully two hours in the delivery, being followed throughout with the closest attention. The new knowledge which has been gained from observations with the prism was thus summed up by the Professor himself:—1. All the brighter stars, at least, have a structure analogous to that of the sun. 2. The stars contain material elements common to the sun and earth. 3. The colours of the stars have their origin in the chymical constitution of the atmospheres which surround them. 4. The changes in brightness of some of the variable stars are attended with changes in the lines of absorption of their spectra. 5. The phenomena of the star in Corona appear to show that in this object at least great physical changes are in operation. 6. There exist in the heavens true nebulæ; these objects consist of luminous gas. 7. The material of comets is very similar to the matter of the gaseous nebulæ, and may be identical with it. 8. The bright points of the star-clusters may not be in all cases stars of the same order as the separate bright stars. Professor Huggins said it might be asked what cosmical theory of the origin and relations of the heavenly bodies did these new facts suggest? "It would be easy," he confessed, "to speculate, but it would not be philosophical to dogmatise, on a subject of which we know so very little. Our views of the universe are undergoing important changes; let us wait for more facts, with minds unfettered by any dogmatic theory, and therefore free to receive the obvious teaching, whatever it may be, of new observations. Star differs from star in glory; each nebula and each cluster has its own special features; doubtless in wisdom and for high and important purposes the Creator has made them all."

NEW SPECTROSCOPES.

Father Secchi, of Rome, has constructed a new Stellar Spectroscope, which may be very serviceable to amateur astronomers. It contains a cylindrical achromatic lens, intended to form a linear image of the star at the focus of the ordinary eyepiece of the telescope. Between the eyepiece and the cylindrical lens is placed a prism, as short as possible, with direct vision and without deviation, named Amich's prism, after its inventor. The spectra produced by this arrangement are very remarkable for the brilliancy of their tints and the sharpness of their bands.

The construction of a new Spectroscope is described by Mr. Josiah P. Cooke in the *American Journal of Science*, and illustrated by woodcuts. He states that a number of prisms are so arranged that the angle of minimum deviation for any ray may be measured and its position in the solar spectrum determined.

METALLIC SPECTACLES.

A curious discovery has been communicated to the Paris Academy of Sciences by M. Foucault, to the effect that the sun might be contemplated with impunity through a lens covered with silver leaf, the latter being just transparent enough to allow of the sun's disc being seen very clearly, though "shorn of its beams." The Academy subsequently received a communication from M. Melsens, in which he described a very useful application of M. Foucault's discovery. He states that about the beginning of last July he received an injury from the bursting of a balloon containing a solution of iodine and liquid sulphurous acid, whereby both his eyes were attacked with violent inflammation, which he got the better of by a bold treatment. Nevertheless, the cure was not so complete but that great weakness of the eyes remained (photophobia), so that light was painful to him. He then had recourse to the sort of spectacles used by engine-drivers on railways. These spectacles are provided with black glasses, and as these were still too transparent, M. Melsens put green ones over them. In this way they answered tolerably well, but the author ultimately used preservers with pale blue glasses, which he covered not chemically, but mechanically, with either gold or silver leaf, and this he found to answer best of all, the light so transmitted being exceedingly pleasant, especially in the case of gold leaf. The latter, when yellow, lets green light pass, when green (that is, alloyed with silver) the eye receives blue light. M. Melsens, therefore, thinks that persons labouring under the inconvenience of weak eyes will derive great relief from spectacles so prepared.—*Mechanics' Magazine.*

CRYSTALLINE GLASS.

An interesting paper on the Crystalline nature of Glass, by Dr. C. M. Wetherill, appears in the *American Journal of Science*, which contains an account of experiments made in the laboratory of the Smithsonian Institute, Washington; and refers to the researches of Faraday, Pelouze, Dumas, and other eminent chemists in respect to the qualities which may be produced in glass by admixture with various substances. Dr. Wetherill considers that the detection of the crystalline nature of glass demonstrates that we are as yet unacquainted with the true character of this complex substance; and he thinks that if we could succeed in producing at will an interlacement of long, fibrous, transparent crystals, a glass of superior flexibility and strength might be obtained.

COLOUR-DISEASE.

A remarkable paper on the doctrine of Colour-disease, by Dr. Edmund Rose, of Berlin, has appeared in the *Philosophical Magazine*. It is based upon investigations of cases produced by taking santonic acid or atropine, or by diseases of the liver or kidneys; and also of cases of congenital colour-disease, the so-called Daltonism. He forms of these cases two divisions—the colour-blind (those whose retina has lost sensibility for coloured light), and the colour-mistaken (those who confound one colour with another). In regard to the former he describes various experiments, especially some made with the spectra of potassium, sodium, and other metals, by himself and other persons. Some were found to be blind to red, others to blue, &c.; and with some the colour-blindness extended to half the spectrum. In the investigations made with the colour-mistaken he found a complete inversion of the three fundamental constituents of the perception of a colour—perception of purity, tone, and strength. In investigating such cases Dr. Rose employed an apparatus termed a colour-measurer, of which he gives a description, illustrated by a woodcut. In conclusion, he says that, among fifty-nine colour-diseased persons, he did not find any two who exhibited exactly the same sense of colour; and that it follows that Young's theory of colour, whether modified or not, is irreconcilable with this, for it only allows three kinds of colour-blindness—or, taking in the combinations, six.—*Illustrated London News.*

SOAP BUBBLES.

MR. BROUGHTON, the chemical assistant in the Royal Institution, has contributed some facts relating to the properties of Soap Bubbles formed of pure oleate of soda dissolved in fifty parts of distilled water mixed with two-thirds of its volume of pure glycerine—a method invented by M. Plateau, and well adapted for optical experiments. Mr. Broughton gives the calculations, which resulted in the determination of the thickness of the film to be the 28,000th of an inch. When viewed through a microscope the film exhibits chromatic phenomena of the utmost magnificence, difficult to describe.—*Ibid.*

DEFECTS IN THE POLARISCOPE.

MR. J. TRAILL TAYLOR, in a paper read to the British Association on "A Defect in the Demonstrating Polariscope, with a simple and effective remedy," states that having been engaged in some experiments with polarised light, projected on a screen by means of the oxyhydrogen lantern, he discovered that even the best instruments which were constructed were inefficient. None but the axial rays transmitted through the condensers were polarised, the main body of the luminous cone undergoing reflection from the polariser without being really polarised. He remedied this by intercepting the light with a flint concave lens before it reached the polariser, so that the whole mass of rays, being projected in a parallel direction, was completely polarised. On leaving the polariser, the rays were again converged, before passing through the crystal or other object to be exhibited, by a small achromatic lens, which thus acted as an achromatic condenser. It was stated that this arrangement effected a most important increase in the brilliancy of the object exhibited on the screen.

NEW MUSICAL INSTRUMENT.

A NOVEL and extraordinary Musical Instrument has been exhibited at the Royal Institution, and played upon by its inventor, M. Baudre, from Paris. It is about six feet long, and is composed of twenty-nine stones, principally flints, suspended by cords and arranged in a manner resembling two octaves and a half of a pianoforte, with the requisite semitones. Upon these stones M. Baudre performed various airs, with much precision and sweetness, giving effects different from those produced from any other instrument. M. Baudre stated that the collection of these stones, principally in the south of France, occupied five years.

CALORESCENCE.

THE *Philosophical Magazine* for May contains the first portion of Professor Tyndall's paper on Caloresence (the heat evolved by the invisible rays at the red end of the solar spectrum), with engravings which appeared as diagrams at his lecture at the Royal Institution. We give a translation of the motto from Lucretius (v. 610), suggested to the Professor by Sir Edmund Head, and which, the Professor says, "reads like divination":—"Perhaps, too, the sun, as he shines aloft with rosy lamp, has round about him much fire, with heats that are not visible; and thus the fire may be marked with no radiance, so that, fraught with heat, it increases to such a degree the stroke of the rays." Lucretius died 55 B.C.—*Illustrated London News.*

LUMINOUS WAVES.

PROFESSOR STEFAN describes his method of measuring the length of Luminous Waves by means of a column of quartz with polished faces parallel to the optic axis, by which he determined the wave length of Fraunhofer's line B to be the 6873 ten-millionths of a mètre. The results of his analytical investigation of the influence of internal friction in the air on the motion of sound show that friction increases the velocity of sound, and to a greater extent the higher the tone; yet, even for the highest tones, the increase is very small.—*Ibid.*

FLAME REACTIONS.

THE *Philosophical Magazine* contains an elaborate paper, by Professor R. Bunsen, on "Flame Reactions," which has been translated by Professor Roscoe, and illustrated by an engraving of the non-luminous gas-lamp employed in the experiments and the structure of the flame. Professor Bunsen gives details regarding the emission of light, the melting point, the volatility, the colouration of flame, and the reactions of the elements of a great variety of substances—including compounds of tellurium, selenium, antimony, and other metals, and also of sulphur compounds and mixtures of sulphur with the metals.

REFRACTION AND POLARISATION OF LIGHT.

M. PAUL DESAINS has communicated to the Paris Academy of Sciences some experiments which show a remarkable relation between refraction and the polarisation of light. The rotation impressed upon the plane of polarisation of the less refrangible red rays is less than the rotation impressed upon the more refrangible violet rays; and refraction and the rotation of the plane of polarisation therefore diminish and increase at the same time.

THE MICROSCOPE.

At a late meeting of the Queckett Microscopical Club, a very interesting paper was read by Mr. Lewis on some of the microscopic effects of the electric spark, detailing a number of experiments made by him between December, 1865, and the present time. They were suggested, in the first instance, by the circumstance of having placed a card which had been perforated by powerful induction sparks upon the stage of the microscope to examine the effect produced, when he was surprised to observe that all such holes as were clear were of pentagonal shape. In consequence of this observation, pieces of paper and card of various kinds were procured and perforated by sparks of various lengths from different induction circles, in all of which cases the pentagonal form of hole prevailed, and the same result was also found when discharge sparks from a Leyden jar charged with frictional electricity were employed. Subsequently a contrivance, which was described, enabled these experiments to be repeated upon the stage of the microscope. The effect of sparks upon paper chemically treated, the leaves of plants, mica, thin glass, film of eggs, &c., was described, from which it appeared that the perforations were generally five-sided, without regard either to the shape of the points between which the sparks were discharged or to the texture of the material perforated. The paper concluded by a few remarks to the effect that electricity thus brought under the microscope would be found to afford both amusement and instruction, whether in connection with the use of the micro-spectroscope or in observing the effects of electrolytic actions.—*Mechanics' Magazine.*

LUNAR PHYSICS.

M. Geoffroy, of Paris, asks, in an article in the *Moniteur*, what may be the utility of the moon with regard to our planet, and whether it is only there for the purpose of raising the waters of the ocean twice a day? To this he replies that, besides the great planets that are carried along a regular path around the sun, there exists an unlimited number of bodies of different sizes, moving through space in every direction, as the almost daily discovery of a vast number of asteroids proves. In his opinion the moon was once one of those erratic bodies, and, happening one day to get within the sphere of attraction of our planet, was forced to become our satellite, instead of continuing its own course. Hence the moon is but an accident. The earth had done without it before, and might do without it again. Venus is about the size of the earth, and goes regularly around the sun, although it has no satellite. Why should the earth need one? He continues to say, that our moon is of no use to us, because we might perfectly well do without oceanic and atmospheric tides; and the best eulogium he can pass on our satellite being that it is utterly useless, he goes further and declares that we owe it to the merest chance, it having been picked up, as it were, on the way; and as such a thing might happen again, the author sees no impossibility whatever in our getting some day another, and perhaps more moons still, added to our stock. M. Geoffroy is one of those who deny that the moon is inhabited—first, because the excessive cold there must prevent the possibility of any animal life; and, second, because the moon has no atmosphere.—*Mechanics' Magazine*.

Mr. J. P. Harrison has read to the British Association a paper "On the Heat attained by the Moon under Solar Radiation." On a view of the whole case at the present time, there would seem to be reason to believe that the sun's rays must penetrate the moon's crust to a depth that would prevent the possibility of her acquired heat being easily or speedily dissipated.

Mr. Croll has pointed out in successive papers, communicated to the *Philosophical Magazine*, that, inasmuch as the tidal wave generated by the moon's attraction produces heat by friction, which is dissipated in space, there must be a gradual loss of *vis viva* in the moon; and the moon and earth must, therefore, finally come together. Professor W. Thompson and Professor Airy have shown that, owing to the position of the tidal wave, the moon is drawn, not exactly in the direction of the earth's centre of gravity, but a little to the east of that centre, and, as a consequence, that her orbit is enlarged and her angular motion diminished. The tides, in fact, produce two distinct effects, the one to a certain extent neutralising the other. Nevertheless, as *vis viva* is consumed, and as this action will continue to go on through countless ages, the ultimate effect must be to bring the two bodies together.

Dr. Mann, in the *Athenæum*, writes:—"It may interest your readers to know at once that there is confirmation of Herr Schmidt's observation on the Lunar Crater *Linné* alluded to in the *Athenæum* of December 8, in connection with the labours of the Moon Committee of the British Association. On Thursday evening, December 13, I spent a couple of hours with Mr. Birt and Mr. Talmage at Mr. Gurney Barclay's Observatory at Leyton, examining the spot with Mr. Barclay's very fine telescope of ten inches aperture. During this time the moon was constantly covered by a fine veil of cloud; but Bessel and its shadows were very distinctly visible. No trace of Linné to be seen. Our impression was that Linné ought certainly to be visible under the circumstances, which allowed such very distinct observation of the neighbouring Bessel. I have this morning a note from Mr. Talmage, to inform me that after Mr. Birt and myself had left the Observatory, under the impression that all further chance of observation was gone, the clouds suddenly cleared quite away, giving him an unexceptionable opportunity of examination. He then found that a spot he had previously taken for Linné was Sulpicius Gallus, and that *no trace of Linné* was visible, but that where *it* should be there was a faint circular cloud-like spot ('*petit nuage blanchâtre*' of Herr Schmidt). Mr. Talmage was enabled carefully to verify the fact that the 'cloud' occupies the exact position that the crater Linné should hold."

The Report of the Lunar Committee of the British Association for Mapping the Surface of the Moon, notices that during the past year the Committee had met several times, and determined at the first meeting—in accordance with the remarks of the president, Professor Phillips, at Birmingham, where an outline map of 75 inches in diameter was exhibited—upon the construction of a map of 100 inches in diameter, photographs, if available, to be employed. The only photograph available for laying down positions was taken by Mr. Warren De La Rue, 1865, October 4. This has been enlarged to 10 inches in diameter, and employed for this purpose, as the measures taken from it are either without appreciable error, or require but a small correction. Mr. Birt has laid down during the past year, on one sheet, the whole of Quadrant IV. (meridians and parallels), 50 inches radius, and inserted Beer and Madler's 23 points of the first order. The greatest error in the position of these points is ·0008 of the moon's semi-diameter. The whole of the objects on a surface of 15° of longitude and 10° of latitude have been laid down on this sheet from the full-moon photograph, and several of them have been identified with objects seen conspicuously when near the terminator. A portion of this surface, 6° of longitude and 5° of latitude, is completed, and enlarged to 400 inches diameter. It contains 30 superficial degrees. On it are laid down the positions of 89 objects, from three independent sets of measures, made on three separate photographs, the magnitudes, which are given in the catalogue in seconds of an arc, being determined by a separate set of measures. Register: The whole of the 89 objects above mentioned have been inserted, and an abbreviated catalogue drawn up, with topographical and other notices, the full-moon aspect of the surface given, and a discussion of the lines of upheaval and depression appended. Taking into consideration the difficulty, arising from differing epochs of libration, of obtaining photographs suitable for the work, and the fact that the only photograph available for positions was taken since the last meeting of the Association, the completion of 30 superficial degrees of the map, an important step has been made in advancing the study of the physical aspect of the moon's surface.

By *L'Institut* (No. 1672) we learn that the photographic proofs of the moon taken during the eclipse of October 4, 1865, by different observers, present remarkable variations. MM. Wolf and Rayet, of the Observatory at Paris, with the great equatorial telescope of M. Foucault, have obtained results differing in several points from those of Dr. Warren De la Rue. Two of their proofs, taken between twenty-nine and thirty-eight minutes after the entry of the moon into the cone of the penumbra, did not show the least trace of this penumbra. In another proof, obtained at about eight minutes before the entry into the umbra, a very notable diminution of the chemical action of the moon was remarked in the region where the second contact was about to take place; but still the entire disc of the moon was visible. The last image obtained was at 11h. 35m. before the passing off of the umbra; after ten seconds, no image was obtained of that part of the moon covered by the umbra and a portion of the penumbra. It is asked, whether the remarkable clearness of the sky at the time may not have been the cause why the penumbra is not visible on the proofs obtained half an hour after its entry on the disc of the moon.

SOLAR PHYSICS.

M. GOLDSCHMIDT, the well-known painter and amateur astronomer, has sent a paper to the *Cosmos* on the physical constitution of the Sun. His hypothesis differs materially from those hitherto admitted, the sun's spots having been generally considered owing to disturbances on the surface of the photosphere, or else to upward and downward currents going from the centre to the surface and conversely. M. Goldschmidt, on the contrary, endeavours to explain the phenomenon on dynamic principles. He, in the first place, considers the proper motion of the solar globe in space: it being now well ascertained that it describes some orbit which makes it move in the direction of the constellation of Hercules. Now, as the whole train of planets pertaining to our system follows the sun in the same direction, the sun's nucleus must assume a position in accordance with this orbital motion. This nucleus is part and parcel of the stellar world. If it possesses a rotary motion round its own axis, together with an orbital motion, there is nothing to prove that this rotation of the nucleus is the same as the photosphere. In other words, M. Goldschmidt opines that the axis and equator of the sun's nucleus are not identical with those of the photosphere. He also supposes the nucleus to be spheroidal, that is, flattened at the poles, while the photosphere is a perfect globe. Hence the latter must be much thinner in the regions adjoining the equator of the nucleus than elsewhere; and this, according to M. Goldschmidt, is the cause of the spots, it being easier to suppose a rent in the photosphere where it is thinnest than where its thickness is most considerable. If the nucleus be subjected to the attraction of some of the larger planets, it will press on the photosphere in that direction and tear it, as if wanting to escape; and thus a black spot would be formed.

Father Secchi, of Rome, has communicated to the Paris Academy of Sciences the results of his latest researches in solar physics, more especially relating to the Spots. He says, that we may conclude that the movement of the spots is generally made by irregular leaps in connection with the change in the form of the spots, which doubtless coincides on the Sun with new eruptions, which have just risen up over those already existing; and that the general movements are very complicated, and do not follow any symmetrical law in the two hemispheres. In respect to the depth of the spots and the solar parallax, the Father considers that, in future observations, means should be taken to eliminate this depth.

Lieutenant Ashe, director of the Quebec Observatory, gives a new theory of the Physical Constitution of the Sun. He conceives the sun's surface to be composed of an equally bright and incandescent photosphere; that our sun is a nebulous star, and that the nebula consists in what is seen as the zodiacal light; that the spots are small meteor planets that revolve round the sun, and they fall into it; and that, when they crack and split into pieces, they show the bright surface called the bridges; that the penumbra is the dross or thinnest portion of the melted matter; and that the faculæ are nothing more than the disturbance of this scum.

M. Faye has reported to the Paris Academy of Sciences an account of his investigations into the apparent inequalities of the solar spots, in which he expresses an opinion that these spots are not due to protuberances on the surface of the sun, and ought not to be considered as scoriæ, but are rather due to orifices in the photosphere.

M. Faye has also communicated his ideas on the physical constitution of the sun to the Academy. He explained the different appearances of the sun by considering it as a gaseous mass subjected to an immense pressure and an enormous temperature. The effects of this temperature on the primitive gaseous matter would be conformable to physical laws. An application of the law of Davy on irradiation would explain the different aspects of the gaseous strata. They would be luminous or obscure, in proportion as the temperature permitted the contraction of the combinations, or as the excess of this force prevented it. There would be also vertical currents, which would incessantly bring up the gaseous masses from the centre to the surface; there the gases become incandescent, would lose part of their heat, and return towards the centre by virtue of their change of density. This idea, Mr. Faye thinks, would permit new or variable stars to be considered as stars which have passed through different phases of this modified law. The objections to this theory by the English astronomers M. Faye does not consider of much importance.

The Rev. F. Howlett's observations of the great Sun Spot of October last, read at a meeting of the Royal Astronomical Society, appear in the *Monthly Notices*. It was visible from Oct. 7 to 17, during which time drawings were made exhibiting the forms and positions of the spot and other interesting phenomena. These observations are very important in relation to the establishment of a theory of solar physics, now made the subject of elaborate research by Messrs. Warren De La Rue, Balfour Stewart, and Lœwy. At the same meeting Mr. H. Brodie described the solar craters which were seen by him. The umbra of one seen on September 28 last was about 9,200 miles in length, and was covered with luminous matter resembling a mackerel sky, or cirro cumulus. The president, Dr. Warren De La Rue, referred to one of Mr. Brodie's observations as confirming those of others—namely, that the luminous matter, as it floats across a spot, seems to dissolve and disappear.

Mr. Stone, of the Royal Observatory, Greenwich, has announced his observation of a very clear definition of the Sun's photosphere in February last, in the magnificent equatorial, in which the phenomena discovered by Mr. Nasmyth, and by him named "willow-leaves," were distinctly visible. The fact was confirmed by Mr. Airy, from his own personal observation. The absolute tranquillity of the atmosphere during sunshine being very rare, has prevented many observers from seeing these objects, which, in Mr. Nasmyth's opinion, constitute the true structural element of the sun's light-giving envelope.

Two notes on the Surface of the Sun, by Professor John Phillips, appear in the *Proceedings of the Royal Society*, with engraved illustrations. In the first the Professor remarks on what he terms the porosity of the sun's surface as disclosed by a powerful glass, when it previously appeared even and marble-like, without any dark patches. In the second note he records the various positions of a sun-spot observed at intervals during one rotation.

A paper by Mr. William Huggins, F.R.S., read to the Royal Astronomical Society, gives the results of his observations on the bright granules of the solar surface termed "willow leaves" by Nasmyth, "rice grains" by Stone, "granulations" by Dawes, "crystals" by Chacornac, and "shingle beach" by Brodie. Mr. Huggins gives an interesting engraving of the distribution of these granules on the part of the sun which is free from spots. When the granules are observed with powers of about one hundered diameters, he thinks that no comparison is so appropriate as that of "rice grains;" but he states that when higher powers are employed, the apparent regularity of figure and size disappears to a great extent, some being quite round. He thinks that they are not flat disks, but bodies of considerable thickness, of an average size of ·1 or 1·5 second. Careful observers notice appearances which suggest considerable inequalities of level in the bright surface of the sun, and the whole photosphere appears corrugated into irregular ridges and vales over this uneven surface, not unlike that of a stormy sea; the groups of granules are irregularly distributed. With regard to the nature of these granules, Mr. Huggins agrees with Sir John Herschel, "that it is hardly possible not to be impressed with the idea of a luminous medium intermixed but not confounded with a transparent and non-luminous atmosphere." If the granules are incandescent clouds, their general oval form may possibly be due to the

ZODIACAL LIGHT.

M. LIANDIER has communicated to the Paris Academy of Sciences, an account of his observations of the Zodiacal Light from January to May. He asserts that the form of this light is a perfect cone; that its luminous intensity varies, that it sometimes assumes a dirty-grey tint, and that sometimes it rivals the milky way in its silvery whiteness. He conjectures that this luminous cone is a fragment of an immense atmosphere enveloping the sun in all its parts; adding that, if this supposition be correct, this gaseous envelope must exercise an immense pressure on the sun and cause a great evolution of heat; and if, like the earth's atmosphere, it is subject to variations of local pressure, this would explain the cause of the spots generally perceived on the surface of the sun as being due to the lowering of the temperature which the diminution of the pressure would

LUMINOUS METEORS.

THERE has been read to the British Association the Report on Observations of Luminous Meteors, 1865–6, by a Committee, consisting of Messrs. J. GLAISHER, R. P. GREY, E. W. BRAYLEY, and A. S. HERSCHEL. The Committee reported a ma[illegible] degree of progress over their success in previous years, a[illegible] dwelt in detail upon the various investigations of the past year. Bearing in mind the strong probability that existed of the occurrence during the year 1866 of a more extraordinary meteoric shower on the morning of the 13th of November, than any that had yet been observed at the English observatories, the Committee during the past year deemed it inadvisable to incur avoidable expense, or to exceed the means at their command in lithographing the charts of general radiant points of shooting-stars until a more convenient time. The occasion of the return of the great November meteoric shower being one of very rare occurrence, the Committee, with a view of profiting by the opportunity afforded of observing the spectra of luminous meteors, had this year provided themselves with two spectroscopes, especially adapted for analyzing the light of shooting stars by means of their prismatic spectra. The spectroscopes were directed for trial towards the luminous meteors of the 10th of August last, and seventeen spectra were observed. For this purpose, Mr. Browning had constructed three binocular spectroscopes for the British Association, on a plan approved by the Committee, and the instruments were employed by Mr. Glaisher and Mr. Browning on the 9th and 10th of August. At the Royal Observatory and at Richmond on the Thames, the sky on the night of the 10th was for the most part cloudy, and all attempts to catch the spectrum of a meteor proved unsuccessful. Spectrum observations were begun at Hawkhurst on the evening of the 9th, and, the sky proving remarkably clear, the observations were continued until daybreak on both of the following nights. No difficulty was found in mapping the course of the meteors in the spectroscope by the stars, of which a whole constellation, as, for example, the seven stars of *Ursa major*, can be seen in the instrument at a glance. The spectra of the meteor nuclei were seen distinctly in a few cases only. They were commonly hidden by the light of the streak when that was yellow, and presented highly-coloured and continuous spectra, like the spectrum of white-hot solid matter when the streak was greyish white. That which the spectral observations of the August meteors appear most distinctly to evince is the existence of an extraordinary amount of the vapour of sodium. It is impossible to suppose that the vapour of the metal sodium already exists in any sensible quantity at the confines of the atmosphere. It must manifestly be brought into the atmosphere by the meteors themselves from without, so as to be deposited by them in their flight in the luminous trains that mark their course. The nucleus is, therefore, probably a fragment of mineral matter, of which sodium is one of the chemical ingredients. The Report contained also, as usual, a full catalogue—on this occasion a very long one—of the luminous meteors observed in 1865–6.

NEW STARS.

The appearance of a New Star in Corona has given rise to a good deal of conversation among scientific men, and has been the subject of a paper at the Royal Society. On May 16, Mr. Huggins received a note from Mr. Birmingham, of Tuam, announcing the sudden appearance of a star of the second magnitude near ε Coronæ Borealis. Mr. Baxendell saw the star on the 15th, when it was about the third magnitude. On the 16th Mr. Huggins and Dr. W. A. Miller examined the spectrum of this strange star, which was then a little brighter than ε Coronæ. The information given by the spectroscope is interesting and unexpected. The prism resolves the light from the star into two different lights, each emanating from a distinct source. One spectrum tells us that the principal light of the star was emitted by incandescent solid or liquid matter. This light has suffered partial absorption by an atmosphere of vapours about the star through which it has passed. So far this new object is analogous to the sun or any of the stars. In addition, however, to this spectrum, there is a second spectrum of fine *bright lines*. The light which formed this spectrum must have come from luminous gas. The principal constituent of this gas is hydrogen. These phenomena, together with the sudden appearance and rapid fading away of the star, suggest the bold speculation, that in consequence of some internal convulsion a large quantity of gas has been suddenly evolved, and the hydrogen burning by combination with some other element gives rise to the bright lines, and also has heated the solid matter of the photosphere to vivid incandescence. As the hydrogen becomes exhausted, the star appears to fade away. The former observations of these gentlemen on the spectra of the fixed stars have shown that hydrogen probably plays an important part in the differences of physical constitution of the stars.

On Sunday, May 13, at 10 P.M., M. Courbebaisse, of Rochefort, perceived a brilliant star in the constellation Corona Borealis, which he had not seen on the preceding evening, and succeeded in determining, approximatively, its relative position. It was much brighter than the star termed the "pearl" of the crown, and was considered to be of the third magnitude. By letters in the *Times* from Mr. J. R. Hind and Mr. C. G. Talmage, we learn that the new star was seen in this country by Mr. Baxendell, of Manchester, on May 15. When Mr. Hind saw it, on May 19, it was reduced to the sixth magnitude, was perfectly colourless to his eye, and quite stellar in appearance with magnifiers up to 700. He says that, in its entire freedom from colour, this star presents a noteworthy contrast to the one detected at Mr. Bishop's observatory in the constellation Ophiuchus, in April, 1848, which exhibited red or orange flashes when at its maximum. The latter may still be observed as a star of the eleventh magnitude. At a recent meeting of the Paris Academy of Sciences the discovery of the new star was announced by M. Delaunay, who read a letter from M. Courbebaisse. After which, M. Le Verrier reported that, according to his observations, the star was "yellow and fuliginous," was probably very near the earth, and of the ninth magnitude. M. Wolf, after making a study of its light, reported that the spectral image contains brilliant bands, which lead him to consider it to be a star enveloped with an incandescent atmosphere.

Mr. Hind has read to the British Association, "Remarks on the recent extraordinary outbursts of the Variable Star in Corona," from which it appeared that observations relative to this star of a rare character had been taken by Mr. Barber, of America, and communicated to Mr. Hind. The star had been observed gradually to increase to a star of the second magnitude, and then again decrease. The chief assistant at the Royal Observatory, Greenwich, had afterwards seen the star, and considered the gradual increasing and diminishing of the star as a most curious and rare phenomenon. Many conjectures were entertained as to what matter forms the star, some being of opinion that the star was a burning world. A long discussion followed.

At a meeting of the Paris French Academy of Sciences, M. Faye has made some remarks on New Stars and Variable Stars. The appearance of a new star is a rare and, as yet, inexplicable fact. M. Faye, in the first place, considered the periodic stars. He stated that divers hypotheses have been put forth in order to explain the phenomena. The first and most accredited of these supposes that the stars have existed from all time, but have been invisible, and that they owe their sudden splendour to a convulsion. Bonillaud explains the appearance of the first periodic star by a rotation of 331 days. It seems that this phenomenon has occurred more frequently since the beginning of the present century, and that since 1846 147 new appearances have been counted. M. Faye is inclined to impute them all to periodicity.

Father Secchi, of Rome, has communicated to the Paris Academy of Sciences the results of the spectrum analysis of the light of several Stars, and some new observations on the Solar Spots. In the *Comptes Rendus*, No. 9, will be found an engraving of the spectrum of Antares, in which the rays due to sodium and magnesium are very prominent. Since his last report on the solar spots, he has remarked the disappearance of a remarkable spot, which had lasted from June 28 to July 23. Its movement, at first very rapid, gradually slackened, till finally, it became nearly stationary. These phenomena are, as yet, quite inexplicable.

In a note on the Falling Stars of 1865, M. Coulvier-Gravier states that the results of his observations corroborate the theories which he had previously given. He states that, after twenty years' observations, he finds that in dry seasons the falling stars approach more nearly to the east, but in wet seasons they descend towards the south-west. At the same meeting two new species of minerals were described: Chenevixite, by M. Pisani, and Adamine, by MM. Friedel and Des Cloizeaux.

PHOTOMETRIC INVESTIGATIONS OF THE STAR *a* CENTAURI.

PROF. ZÖLLNER, of Leipzig, who has been working at some of the most important questions which have of late occupied the attention of astronomers, finds, from his photometric investigations, that the star *a* Centauri seems to be equal to our sun. If the sun were at such a distance that 3¾ years would be required for its light to travel to the earth, it would then appear similar to Capella, and have a parallax of 0·874 seconds. Consequently if light undergoes no absorption in its passage through space, the light of Capella must be much more abundant and intense than that of the sun. Data are given for a comparison of intensities, and of the reflexion from different terrestrial and artificial surfaces; and the Professor throws out certain theoretical views which will, perhaps, be put to the test by those who have watched the recent progress of cosmical science. Every star-sun, to use his own term, has a history divisible into five periods: the glowing gaseous, the glowing liquid, the slag, the eruption, and the complete refrigeration period. Then applying this theory to actual phenomena, he finds the first period represented by planetary nebulæ; the second, by the invariable stars; the third, by our sun; the fourth, by new stars; and the fifth, by Bessel's dark stars. All the periods may be traced in the cosmical history of the earth. The non-planetary nebulæ occupy a place between the first and second periods. The third, or slag period, is that in which a cool non-luminous surface was developed; and in the fourth, or eruption period, the surface was vehemently disturbed and broken up by frequent outbursts of heated matter from the interior.—*Athenæum.*

NEBULÆ.

RECENT investigations into the nature of the Nebulæ have tended to confirm the accuracy of the views of Laplace, who held that the sun and planets were formed out of a great nebula, which by condensation separated into rings, and these rings finally collapsed into stars. Laplace's doctrine is illustrated and enforced by M. Delaunay in his *Cours Elementaire d'Astronomie.* The zodiacal light is supposed to be the remains of the great nebula out of which the solar system was constructed, and the condensed matter rained into the sun and there burnt, is supposed to be the origin of the sun's light and heat. One question, however, still remains unsolved: in what way did the nebulæ originate? Is each nebulous atom formed out of the other by the action of light and the aggregation of still minuter particles, in the same way in which a nebula, by its condensation, goes to form a planetary system?—*Illustrated London News.*

ARTIFICIAL METEORITES.

AT a meeting of the Paris Academy of Sciences, M. Daubrée reported the continuation of his interesting experiments for the Artificial production of Meteorites, and the suggestions which they afford towards explaining the formation of the planetary bodies and the crust of our globe. He described a series of reactions in which serpentine was transformed into peridot or chrysolite, and dwelt much upon the importance of magnesian rocks of the peridot type, as found in our planetary system, and their relation to a "universal scoria." In conclusion, he referred especially to the fact that oxygen, which is so essential to our organic nature, played also an important part in the formation of the planets, since without it we cannot conceive of any ocean, or of any of those superficial or profound effects of which water is the cause.

RESULTS OF BALLOON ASCENTS.

MR. GLAISHER, from his experimental ascents made during 1866, deduces that the decrease of temperature with increase of elevation is variable throughout the day, and the different seasons of the year; that at about sunset the temperature varies very little for about 2,000 feet; that, at night, with a cloudy sky, there is a small increase of temperature as the height increased; that, in the double ascent on May 29, the one just before sunset and the other after, it would seem, that after radiation is set in, the heat passes upwards till arrested where the air is saturated with vapour, when a heat greater by 5° is experienced after sunset than at the same elevation before sunset. Mr. Glaisher believes that many more experiments are necessary, and that they should not be confined to this country. Certain it is, from the very remarkable results obtained from the night ascents, which might, with a sufficient number of observations, have an important bearing, both on the theory of astronomical refraction and on the theory of heat, that nocturnal observations deserve repetition and extension.

At the Birmingham meeting 100*l.* was placed at the disposal of the committee; but circumstances not having permitted more than three ascents, only about half the amount has been expended. No further sum was asked for, as an amateur aeronaut —whom professor Tyndall considered quite a phenomenon in this country—had promised to defray all cost, except that of gas and travelling expenses.

M. De Fonville sums up as follows, in the *Panthéon de l'Industrie et des Arts*, the services already rendered by the endeavours to turn aeronautics to some practical account. "Without balloons," he says, "we should not know that parhelia, anthelia, &c., which used to be a subject of terror to superstitious populations, are caused by particles of ice suspended in the air by electric attraction; we should not know that the law of progressive refrigeration is not found to hold good at great altitudes, or that in the air there exists a sort of gulf-streams, if we may be permitted to call them so, consisting of hot air, and affording an easy explanation of the irregularity of the seasons. Without Mr. Glaisher's ascents, it could not have been proved that the bands of the spectrum are all of terrestrial origin, and that consequently the astronomical theories built upon the supposed part they play in the universe have no reliable foundation. It is not, therefore, possible to assign any limits to the utility of aerial navigation, as it is now practicable by the labours of distinguished philosophers."

A magnificent diamond ring has been presented to Mr. Glaisher by the Emperor of Russia. The present was made through Admiral Crabbe, the Russian Minister of Marine, who communicated his Imperial Majesty's appreciation of the services rendered by our eminent English meteorologist.

BLUE MIST.

MR. GLAISHER has explained to the British Association some particulars regarding the Blue or cholera Mist, and stated that its peculiar feature was, that where the mist was most dense, at that place there was no cholera. The first investigation he had made on that subject was upon being appointed to a commission by the Government, after the cholera, in 1854. He had made various investigations with reference to that mist, but, although it had been thought that the peculiar appearance called mist contained animal life, he had not found such to be the case. He desired microscopists to examine plates of glass which had been placed in the open air all the night, for the purpose of ascertaining what the mist really was. If the mist was connected with the chorem there was something else wanted to bring it into action, for at that time, where the mist predominated, that place was free from cholera.

Upon this, a Correspondent of the *Times* observes, "every careful observer of nature, particularly landscape-painters, must be familiar with the frequently grayish-blue haze which produces such a charming atmospheric effect in the scenery of this country; but it can hardly be imagined that philosophers like Glaisher and Lowe can have mistaken this effect for the phenomenon which they have recorded. It will naturally be conjectured that there may be a necessary relation between the blue matter forming the mist and the well-known blue stage of cholera. Medical practitioners, who are for the most part feebly imbued with the spirit of true philosophy, will be disposed to ridicule this notion, from a feeling of mortification that it should have escaped the attention of their own profession. In like manner Mr. E. J. Lowe's ingenious hypothesis that the "blue mist" may be caused by the tail of a comet, will probably be received with incredulity, if not with derision, by astronomers and chemists. But truth, when first discovered, has generally been scoffed at by ignorant, unworthy, and envious assistants. An investigation, concerning the nature of the tail of a comet, will certainly lead to entirely novel and important results, and may furnish a clue to the interpretation of cosmical phenomena which have hitherto proved impenetrable to the human understanding. It would be exceedingly interesting to ascertain why the "blue mist," seen at Greenwich, should have remained stationary, with the wind blowing at a velocity sufficient to produce a pressure of 9 lb. per square foot.

SOLAR RADIATION.

In a letter on the black-bulb thermometer, Professor Tyndall thus refers to a possible defect in the observations of meteorologists on Solar Radiation made by it. "The solar heat, as it reaches us, consists partly of visible and partly of invisible rays, a portion of the latter possessing very high calorific power. The ordinary black-bulb thermometer absorbs the visible rays of the sun, but the black glass of the bulb may be highly transparent to the invisible radiation. The invisible calorific rays, especially, augment in power as we ascend in the atmosphere; for it is those rays which suffer most diminution of intensity during their passage through the aqueous vapour of the air. Hence," says the Professor, "the black-bulb thermometer must, with reference to the total radiation falling upon it, become more and more transparent as we ascend in the atmosphere. It is not an exaggerated estimate, that at the limits of our atmosphere fifty per cent of the solar heat might cross the glass of the bulb, be reflected by the mercury within it, and contribute in no degree to the heating of the thermometer."

NEW ANEMOMETER.

Mr. Cator has described to the Meteorological Society, a new Anemometer for self-registering the pressure, velocity, and direction of the wind—obtained by the wind acting on one surface only—giving a daily register of its pressure in pounds in an area of a square foot, and the total daily horizontal motion of the air in twenty-four hours, or any other given time, and thence its hourly velocity. A facsimile of a recording sheet of this anemometer is given.—*Illustrated London News.*

ATMOSPHERIC DUST.

M. Jenilek has reported to the Academy of Sciences, at Vienna, the results of his observations of the Atmospheric Dust which has fallen in Silesia, Carniola, Italy, and various other parts during the last three years. All these falls have occurred during the prevalence of an intense south wind. The dust contains a very small proportion of organic matter, and is of a brownish red tint, circumstances which tend to support the hypothesis of Father Secchi, that it comes from the desert of Sahara, being raised from the soil by an atmospheric current, which transplants it across the sea to considerable distances.—*Ibid.*

NATURAL SNOWBALLS.

Mr. G. J. Symons, in a letter to the *Times*, from Camden-road, N.W., March 8, details the following phenomenon which, on this day, re-asserted its periodicity, at 1 p.m.:—" The phenomenon I refer to is the fall of water in a semi-solid state far denser than snow, and yet not hail nor ice, and which fall has occurred on March 8, 1857, 1858, 1859, 1860, 1863, 1865, and 1866.

"I pointed out this periodicity in a meteorological report for March, 1859, in *The Times*, April, and I then referred to the remarkable fall on March 8, 1857, when these soft hail balls were very large (three inches round), and covered the ground two or three inches thick. On that occasion the electricity of the atmosphere was so strong during their fall as seriously to derange the electrical apparatus at Greenwich; in 1859 there was also much electricity, and to-day thunder and lightning.

"I have said that they are far denser than ordinary snow. Snow is usually one-twelfth the density of water—*i. e.* 12 inches of snow give one inch of water; but about $2\frac{1}{2}$ inches of these balls give one inch of water; therefore their density was about half that of hail, and five times that of ordinary snow. Their shape is usually pyramidal, the base being uneven, somewhat like the flower of a cauliflower. The size varies from one inch in diameter down to a tenth; about two-tenths is most usual.

"In some years there is a second fall on the 9th.

"I am, of course, quite ignorant of any cause for this periodicity, which, so far as is at present known, is unique in meteorology. (Meteors, not being of atmospheric origin, are no parallel.) It may prove illusory at last; but when a phenomenon occurs on the same day seven years out of ten I think it wants watching."

ICEBERGS.

The *Journal of the Royal Society of Dublin* contains some notes on the Icebergs of the southern hemisphere, by Dr. J. M. Barry. These icebergs are much larger than those in the northern hemisphere, being reported to attain frequently a height of 1000 ft., their ordinary altitude being 200 ft. or 300 ft. The greatest number are found between New Zealand and Cape Horn, and they may be met with in any season of the year. According to the evidence of several captains, ice has been greatly on the increase in the South Pacific during the last ten years, and a good look-out is essential, as the indications of the thermometer cannot be trusted.

GROUND-ICE.

An interesting memoir, by M. Engelhardt, on the formation of ice under water, termed Ground-ice, has appeared in the *Annales de Chimie.* This phenomenon, which some foreign philosophers declared to be impossible, was noticed by Plot in his history of Staffordshire, and also by Stephen Hales in 1731, who then remarked that the waters must be in motion in order to bring the mass to zero, and referred to the influence of asperities and projecting bodies. M. Engelhardt gives a *résumé* of the observations of many philosophers on this subject, and describes his own experiments, which corroborate Hales's remarks. The subject is very important to people who live on the banks of rivers, since much damage is frequently done by the masses of ice which are detached from the bottom of rapid rivers, such as the Danube and Rhine, when a thaw comes after a severe frost.

REGELATION OF ICE.

The *Philosophical Magazine* contains a short note by Professor Helmholtz on the Regelation of Ice, in which he examines the theory of Professor Tyndall—*i. e.* that the latent heat rendered free when two pieces of ice freeze together is conducted through the adjacent ice, as the difference between the freezing points of the interior and superficial ice is certainly very small, the heat rendered sensible must diffuse itself through a comparatively large mass of ice if internal liquefaction is to be avoided. Professor Helmholtz confesses that the question cannot yet be regarded as decided. The three preceding Abstracts are selected from the *Illustrated London News.*

PERIODICAL VARIATIONS OF TEMPERATURE.

A most important contribution has been made to the science of meteorology in a paper which M. Ch. St. Claire Deville has presented to the Paris Academy of Sciences, "On the Periodical Variations of Temperature in the months of February, May, August, and November." It is accompanied by diagrams of curves, showing the variations of temperatures on certain days, founded upon observations made in Paris for 60 years, in London for 50 years, and in Berlin for 110 years. The observations and calculations show that the maximum of temperature always occurs on or about the same day in the months mentioned.—*Mechanics' Magazine.*

HEAT AND DEW.

Professor Magnus, in a paper on the influence of the absorption of Heat on the formation of Dew, given in the *Philosophical Magazine*, examines the results obtained by Professor Tyndall relating to this subject, and which were applied by Professor Frankland in his lecture on the probable cause of the glacial epoch in the history of our planet. Professor Magnus describes his own experiments, which, he asserts, show that aqueous vapour does not possess the great absorptive power attributed to it. He says that "the conclusions which Professor Frankland deduces for the glacial epoch from the great absorptive capacity of aqueous vapour, and Professor Tyndall for certain climatic phenomena, remain unchanged if nebulous be substituted for actual vapour. For this it is which maintains the beautiful green of the British islands; for it moderates the burning rays of the sun as well as prevents the great colds, which only occur with a clear sky and a copious radiation." This paper is followed by some remarks by Professor Tyndall, in which he meets objections by reflections suggested by Professor Magnus's description of his own experiments. Professor Tyndall refers to other researches on this subject, and expresses his conviction that by the further development of the question by field meteorologists "the evidence in favour of the action of aqueous vapour on solar and terrestrial radiation will soon be overwhelming."—*Illustrated London News.*

HIGH TEMPERATURE.

M. Perrot has communicated to the Paris Academy of Sciences, an account of his apparatus for producing very High Temperature by means of coal-gas mixed with atmospheric air. He unites a certain number of Bunsen's burners so that their flames may form a single band of flame without penetrating each other, and thus obtains a column of heated gas of intense calorific power in such a position that its energy may be readily controlled. Into this he introduces air, in such a manner that as little heat as possible shall be lost. With an apparatus consuming two cubic mètres of gas per hour, he states that he has been able to melt 670 grammes of silver, and in thirty minutes to melt and run out into bars a kilogramme of copper. Further details will be found in the *Comptes Rendus*, vol. lxii., No. 3.

AUTOMATIC TEMPERATURE REGULATOR.

M. GASSIOT has communicated to the Royal Society an illustrated description of the late Mr. Appold's ingenious Apparatus for regulating the Temperature and keeping the air in a building at any desired degree of moisture. The apparatus, termed the "Automatic Temperature Regulator" and the 'Automatic Hygrometer," which Mr. Appold used for many years in his own house, has been thoroughly repaired and presented to the Royal Society by Mrs. Appold.

TRICHINOSIS.

PROFESSOR DELPECH, of the Paris Faculty of Medicine, and Professor Reynal, of the Imperial Veterinary School at Alfort, who were charged with a mission to study the above-named disease in Germany, both in human beings and mammals, have presented to the Minister of Agriculture, Commerce, and Public Works a Report of the results of their investigations at Huy (Belgium), Hanover, Magdeburg, Berlin, Halle, Dresden, Leipzic, and Mayence. To render their investigations more complete, they solicited and obtained the co-operation of most of the eminent German physicians who had made the disease in question their especial study. The chief practical facts ascertained are as follows:—The epidemic Trichinosis, lately prevalent in Germany, has now almost entirely disappeared. The mortality was everywhere slight, except at Hadersleben. At Zwickau, Soltendorf, and Sommerfeld, there were 88 patients, not one of whom died. In every case the disease was caused by eating imperfectly cooked pork containing trichines, a case of rather frequent occurrence in Germany. In Hanover, in 21 months, out of 25,000 pigs, 11 were found full of trichines, 16 out of 14,000 in Brunswick, and 4 out of 700 in Blakenburg. The animal, while living, shows no signs of their presence, nor can they be detected in the meat with an ordinary magnifying glass, but a powerful microscope renders them distinctly visible. The utility of a microscopic inspection of pig's flesh by competent observers is so evident, that many of the German Governments have rendered it obligatory, and MM. Delpech and Reynal would not hesitate to recommend it in any country contaminated with trichinosis; but they think it unnecessary in France, where no case of the disease has yet been noticed. In Germany the hospitals receive many patients suffering from this affection; during last year there were 13 at Magdeburg, of whom only one died. *Post-mortem* examinations have also shown, among persons who died from other diseases, numerous cases of old trichinosis cured by the encystment of the parasites. The proportion of these at Leipzic has been about six per hundred. In places where the complaint prevails, the rats which infest slaughter-houses are found to have it, as proved by Leisering at Dresden, Adam at Augsburg, and Roll at Vienna.

Since their return, MM. Delpech and Reynal have examined many of these animals as well as pigs, without finding the trace of trichines; consequently there is no reason, in France, for any person to refrain from eating hogs' flesh, especially when so thoroughly cooked as is usual among the French. In Germany, on the contrary, many of the peasantry eat it almost raw or only smoked. The most timid may safely eat the heart, kidneys, brain, and fat of pigs, as those parts never contain trichines. MM. Delpech and Reynal assert, as an undoubted fact, that a temperature of 75 deg. C. (167 Fah.) is sufficient to kill trichines. Meat thoroughly salted is also perfectly safe. Smoke-dried sausages, which have been kept a long time, are considered free from danger; but the wisest plan is to give them a good boiling. The authors of the Report attribute the spread of the disease among pigs to the fact that they are foul feeders, and will eat any offal, such as the dead bodies of rats and other animals, which are now known to be liable to trichinosis. Great care ought therefore to be taken to keep such things out of their reach. MM. Delpech and Reynal likewise advise all experimenters never to throw away trichinized flesh, but to burn it as soon as their examination is completed; for a fragment of it carelessly exposed might be eaten by a rat, the rat devoured by a pig, and this last become the cause of fatal accidents. They recommend farmers to be very cautious in feeding their pigs.

ON HANGING.

THE *Philosophical Magazine* contains a paper by the Rev. Samuel Haughton on Hanging, considered from a mechanical and physiological point of view. He refers to this punishment as adopted by the ancients, especially to the execution of Penelope's twelve faithless handmaids, described in the twenty-second book of the *Odyssey*. The doctrines respecting the origin of muscular power recently put forth by Professors Fick and Wislicenus, and brought before the members of the Royal Institution by Professor Frankland, in his lecture on June 8, are fully considered by Messrs. Lawes and Gilbert, in their article on Food and its relations to various exigencies of the animal body, in this number. These gentlemen state that, so long ago as 1852, they advocated substantially the same views, and give the results of experiments upon animals, which show, that a too high relative importance is currently attached to nitrogenous foods, and that the prevailing opinions on the subject require considerable modification.—*Illustrated London News.*

THE BATAVIAN SOCIETY AT ROTTERDAM.

THE Prize List of the Batavian Society for Experimental Philosophy at Rotterdam contains, as usual, subjects peculiar to the Netherlands:—The management of polders; water-raising machines; an apparatus for measuring the rate of a river current; the movement of silt, and plans for irrigation. Among the purely scientific questions is an elaborate one on crystallography; the effect of pressure on electrolysis; and whether boilers burst by a development of hydrogen gas, or by transition of the water to the spheroidal state. Others are:—an examination whether some parts of the sun's surface have a higher temperature than others, or not; and, in case of an affirmative, whether it is always the same parts? It is important for those occupied with the study of electricity to acquaint themselves with the principal phenomena produced in telegraphic wires by storms or the aurora borealis; many of these phenomena are known but to a few individuals, although it is much to be desired that they might be widely published and their consequences deduced: the Society, therefore, asks for an historico-critical notice of the principal observations made with reference to currents produced in telegraphic wires by the aurora or by storms. Another question refers to researches made in the Royal Institution. Dr. Tyndall believes he can deduce with certainty, from his experiments, that the vapour of water exerts on radiant heat an absorbing effect much more powerful than dry atmospheric air. Prof. Magnus, on the contrary, feels himself justified in concluding, from his experiments, that this difference of absorption does not exist. The Society, therefore, asks for decisive experiments to settle the argument.—*Athenæum.*

LONGITUDE OF RIO JANEIRO.

M. MOUCHEZ has pointed out a strange discrepancy existing with regard to the Longitude of the capital of Brazil. Hitherto, it had varied between five and ten seconds. Admiral Roussin adopted 3h. 2m. 35s. for the longitude of Rio Janeiro at the point called Villegagnon, while Triesnecker's data would have given 3h. 1m. 57s. In 1842 Daussy, in the *Connaissance des Temps,* fixed the longitude of Rio exactly at 3h. 2m. M. Mouchez, after five years' observation, has come to the conclusion that Triesnecker's longitude, derived from the transit of Mercury, is minutely exact. He was about to adopt it, when, to his surprise, he found another longitude marked in the *Connaissance des Temps* for 1867, determined by M. Liais, who has repeatedly verified the result. Yet there is between this and Triesnecker's a difference of 30 seconds, which is so enormous that it could never have escaped detection by any captain having three or four chronometers on board; nor is there at present any single maritime point on the globe subject to doubt to such an extent. M. Mouchez is decidedly of opinion that the longitude adopted by the *Connaissance des Temps* is wrong.—*Proceedings of the Paris Academy of Sciences.*

Electrical Science.

CHEAP ELECTRICITY.

By far the most important of recent discoveries in the Electrical field has been made by Mr. H. Wilde, of Manchester, who has found that "an indefinitely small amount of magnetism or of dynamic electricity is capable of inducing an indefinitely large amount of magnetism, and that an indefinitely small amount of dynamic electricity or of magnetism is capable of evolving an indefinitely large amount of dynamic electricity." The apparatus by means of which he has obtained these remarkable results is described as consisting of "a compound hollow cylinder of brass and iron, termed a magnet-cylinder, the internal diameter of which was $1\frac{5}{8}$ in. On this cylinder could be placed at pleasure one or more permanent horse-shoe magnets. Each of these permanent magnets weighed about one pound, and would sustain a weight of about ten pounds. An armature was made to revolve rapidly in the interior of the cylinder, in close proximity to its sides, but without touching. Around this armature 163 ft. of insulated copper wire, 0·03 of an inch in diameter, was coiled, and the free ends of the wire were connected with a commutator fixed upon the armature axis, for the purpose of taking the alternate waves of electricity from the machine in one direction only. The direct current of electricity was then transmitted through the coils of a tangent galvanometer; *and as each additional magnet was placed under the magnet-cylinder, it was found that the quantity of electricity generated in the coils of the armature was very nearly in direct proportion to the number of magnets on the cylinder.*

"Experiments were then made for the purpose of ascertaining what relation existed between the sustaining power of the permanent magnets on the magnet-cylinder and that of an electro-magnet excited by the electricity derived from the armature. When four permanent magnets capable of sustaining collectively a weight of 40 lbs. were placed upon the cylinder, and when the submagnet was placed in metallic contact with the poles of the electro-magnet, a weight of 178 lbs. was required to separate them. With a larger electro-magnet, a weight of not less than 1,080 lbs. was required to overcome the attractive force of the electro-magnet, or twenty-seven times the weight which the four permanent magnets used in exciting it were collectively able to sustain. It was further found, that this great difference between the power of a permanent magnet and that of an electro-magnet excited through its agency *might be indefinitely increased.*" It would thus seem, that the problem of the economic application of electricity as a source of motive power is nearer its solution than most of us had imagined.—*Mechanics' Magazine.*

ELECTRICAL STANDARDS.

MR. FLEEMING JENKIN has read to the British Association a Report of the Committee "On Electrical Standards;" from which it appeared that, by obtaining a force, currents could be measured. Speaking of electrical standards, the author of the report stated that Professor Wheatstone had been the first who made a unit, and they owed to him the term of a unit and multiples of that unit. Although the committee had introduced some improvements, it was due to Professor Wheatstone to state that he had been the introducer of the unit. Was it a matter of indifference what that unit was? The measure, gallon, and bushel had been taken at haphazard, but, on account of the progress of mathematical science, the cubic inch had since totally superseded the measure called a gallon. The cubic foot was the true mathematical standard. In pursuing their inquiries of electrical standards they came back to the measurements of time and space. When the steam-engine was first introduced the power was measured by that of horse-power, but as the mathematical relation between work and resistance became known, the mode of estimating power by so many pounds' pressure, per foot, was adopted. The committee had conducted experiments during the past year regarding standards. Ten standards had been exhibited last year which were made of different metals, many multiples of which had been made. A list was read of the companies who had adopted the standards of the committee. Various contracts had been let in different places on the standards laid down by the committee, many of which were within his own knowledge. He might state that the French Government had taken up the question, and had communicated with the committee in order to obtain their reports. The committee had during the year expended the sum of 300*l*. During the past year the committee had simply been testing the permanency of the standards, and new instruments had been obtained to carry out various experiments. Part of such experiments would be the measurement of capacity, in which commercial men had interested themselves more than the really scientific men. He thought it would be advisable to re-appoint the committee to continue their investigations.

HYDRO-ELECTRIC PILES.

M. MONTHIERS has reported to the Paris Academy of Sciences his construction of three new Hydro-electric Piles. The first is formed by placing in a cylindrical vase an iron cylinder, into the interior of which is plunged a prism of carbon; he then pours in some water containing sulphuric acid. The carbon and iron form the two electrodes of the pile, the force of which, with one or two elements, is sufficient to put in motion the arrangements for an ordinary signal-bell. The other piles are formed by means of a solution of the sulphate of the protoxide of iron and a piece of zinc, and by a solution of carbonate of ammonia and a piece of zinc also. These piles are said to be equally effective and economical.

THERMO-ELECTRICITY.

M. EDMOND BECQUEREL has published a memoir on Thermo-Electricity in the *Annales de Chimie*, which includes an historical sketch beginning with its discovery by Seebeck, in 1821. He describes the phenomena derived from thermo-electric currents in circuits composed of a single metal, in circuits in which liquids form a part, and in couples formed of metals and alloys, &c. In conclusion, he says that, on account of the feeble electromotive powers of the most energetic thermo-electric piles, even under the most favourable circumstances, when compared with hydro-electric piles, he does not think they can ever be employed in preference to the latter. The thermo-electric piles utilise only a small part of the heat communicated to the couples; while in the hydro-electric piles, with a constant current, all the interior chemical action is turned to account. The study of this interesting subject has led to the construction of new apparatus of very great sensibility.

The same number of the *Annales*, contains M. de la Rive's Researches on the propagation of Electricity in elastic fluids highly rarefied, and particularly on the remarkable stratifications of the electric light which accompany this propagation—beautiful phenomena, for the production of which we are so much indebted to Mr. J. P. Gassiot.

ANIMAL ELECTRICITY.

DR. C. RADCLIFFE has transmitted to the Royal Society an account of his experiments on Animal Electricity. He states that electroscopic indications of animal electricity were detected for the first time by a new method of experimenting, and that his facts "exhibit animal electricity, not in the form of a feeble nerve-current, or of a feeble muscular current, or of still feebler currents of a less definite character, but as endowed with a considerable amount of tension. They bring to light a property of animal electricity which is more intelligible on the supposition that the primary condition of this electricity is not current but statical."—*Illustrated London News.*

ST. ELMO'S FIRE.

PROFESSOR FRANKLAND has communicated to the *Philosophical Magazine* a note received from Captain Briggs, of the *Talbot* steamer, giving an account of the occurrence of the rare electrical phenomenon termed "St. Elmo's Fire," in the Irish Channel, off the Isle of Man, on the morning of the 17th February. During a severe snowstorm, which lasted from 1 to 3 A.M., blue lights appeared at each masthead and gaff-end. Captain Briggs had the opportunity of closely examining one light, which appeared at the stem-head. He found that the light, which appeared large at a distance, was made up of a number of jets, each of which expanded to the size of half-a-crown, appeared of a beautiful violet colour, and made a slight hissing noise. He felt a sensible warmth when he placed his hand in contact with one of the jets, and three of them attached themselves to as many fingers; but he could observe no smell whatever. The jets were not permanent, but sometimes went out, returning when the snow was heaviest. At daylight he carefully examined the place, but no discoloration of the paint was seen. He states that the ship is an iron one, but that he did not observe any effect upon the compass; and that he had seen the phenomenon abroad, but never in these latitudes. Professor Frankland remarks on this statement, that there had been about the time much electrical disturbance in the atmosphere, and that he had ascertained that a thunder-storm passed over Cheshire on the evening of March 6. The "brush" discharge seen to issue from various parts of the ship he considers to indicate a negative charge, either in the surrounding atmosphere or in the snowflakes falling thickly at the time.

ELECTRODES.

M. ELIE WARTMANN has printed in the *Bibliothèque Universelle* of Geneva a note on the explosive distance of the direct induced current between identical Electrodes. In concluding, he states that his various experiments prove the form of the termination of the exciter to be very diverse; and that the adjunction of a resistance towards one of the extremities of the induced wire is not necessary to produce a disparity in the manner in which the discharge traverses a constant interval in the atmosphere. Pfaff made use of a ball 8 in. in diameter, in order to obtain sparks 18 in. long from a machine the conductor of which was terminated by a ball only 4 in. in diameter; and Faraday found that between two unequal balls the spark sprang the farther when the smaller ball was at the same time positive and induced. M. Riess demonstrated that these results are not general, but depend upon the construction of the machine.—*Illustrated London News.*

HEAT OF THE ELECTRIC SPARK.

DR. A. SAALZOW, of Vienna, has made some careful investigations respecting the Heat of the Electric Spark. The main object of his experiments was, to ascertain the nature of the relations between the heat of the spark, the quantity and tension of the electricity, and the resistance of the apparatus; and as these three magnitudes can be most readily varied in the case of the Leyden jar, he directed his attention first of all to the thermal relations of sparks from the Leyden battery. The heat of the spark was determined by three different methods: namely, by means of a thermopile and galvanometer, by means of Riess's air thermometer, and by means of a finely graduated mercurial thermometer. The thermopile used was provided on one face with a cap of vulcanite, fitting nearly airtight; into this cap brass electrodes were screwed, airtight, from four to five millimètres apart, and in such wise that sparks could not leap from them on to the face of the thermopile. When a discharge took place between the electrodes, the warmed metal and the particles of air affected the pile both by radiation and by conduction.

The results obtained are stated as follows:—"The heat of the spark increases with the quantity and tension of the electricity. With the necessary amount of resistance (by which is understood that of the short thick copper wires connecting the electrodes with the outer and inner coats of the battery) it has its greatest value. If the resistance be increased, the heat decreases, and reaches a minimum. Let the resistance be made still greater, and the heat again increases, attaining a second but smaller maximum. By further augmenting the resistance, the heat again declines, till it becomes *nil*, in which case the resistance is so great that the battery can no longer discharge itself—a condition attained by the introduction of a column of water, of requisite length, into the circuit." Those degrees of resistance which lie near the point at which the heat of the spark attains its second maximum are characterised by (1) the striation of light in rarefied gases, (2) the incandescence of the negative wire when fine wires are employed as electrodes, and (3) the absence of "Abria's lines" in fine powders. This last-mentioned characteristic is a proof that the air is not perceptibly set in mechanical motion, and we thus find that striation of light and incandescence of the negative wire only take place when the duration of discharge has been so augmented by great resistance that the velocity of the electricity is too small to communicate a perceptible amount of mechanical movement to the medium in which the spark appears. The sparks near the second maximum of heat presenting a great similarity to the "electric brush," Dr. Saalzow was led to examine the heating power of sparks from the electrical machine, and he then found that "brush" sparks which are accompanied by a hissing noise develope much more heat than those of any other kind. The *form* of the electrode has consequently an influence on the heat of the spark, the brush being formed with less or more difficulty, and so being attended with less or more noise, accordingly as the electrodes are pointed or rounded. These results will be of value to the constructors of electrical exploding apparatus.—*Mechanics' Magazine.*

THE ATLANTIC TELEGRAPH LAID.

The long-deferred hope of Telegraphic communication between the Old World and the New was accomplished on the 27th of July, 1866. The chronological record of the event is briefly as follows. July 7, the shore end of the New Atlantic Cable was fixed at Foilhummerhum Bay, near Valentia, and paid out thirty miles to be spliced on to the main cable on board the *Great Eastern*, lying ready to receive it. On the 15th it was successfully spliced, and the steamer proceeded to deposit the main cable. On the 27th the shore end was safely landed in Newfoundland, messages were sent, and the cable to connect it with the American continent, about 70 miles, was at once commenced. Messages passed between Queen Victoria and President Johnson on the 29th and 30th. A curious circumstance, which has sometimes been noticed, but never carefully recorded till now, is that, between 12 and 2 in the day, and only at those hours, the Atlantic cable is always at its worst conductive power. With regard to the portion of the cable submerged last year, it is found that, exactly in proportion as the barometer rises, the resistance of the current increases, and *vice versâ*. In plain terms, a low barometer means a good cable, and a high barometer a bad one.

The history of the Atlantic Telegraph, though full of import, may here be summed up in a few words, as it is now generally well known. Four attempts have been made to lay a cable in the bed of the Atlantic, and four expeditions have contributed towards the present successful results. The first attempt was made in 1857, when the cable gave way, owing to a strain being put on the paying-out machinery by the sudden dip of the Irish bank, which the apparatus was neither strong nor flexible enough to withstand. In 1858 the *Agamemnon* and the *Niagara*, each having one half the cable on board, met in mid-ocean, effected a splice, and, steering in opposite directions, ultimately laid the cable. It was through these wires that the first congratulatory messages were exchanged between the Queen and the President, after which numerous messages were passed, until the transmitting power grew more and more feeble, and at length, after a few days, died out altogether. Seven years elapsed ere another attempt was made, and that was the attempt of 1865, which failed from causes which had been least guarded against, because least anticipated. The fourth attempt is the present, which has succeeded so admirably, and which will doubtless prove the precursor of many succeeding lines of electrical communication between the two countries. The vocation prophetically assigned by Brunel to the *Great Eastern* has been established.

The *Mechanics' Magazine* states:—"The new cable differs from the old one in only two particulars. The conductor, it will be remembered, is composed of seven copper wires, six round one, each wire separately embedded in Chatterton's compound, and the whole surrounded by layers of gutta-percha, so as to form a core ½ in. thick. This core is further protected by ten solid iron wires, each covered with five strands of Manilla yarn, the wires being laid spirally round the core. In the old cable the yarn was tarred; in the new it is left white, to decrease weight and facilitate the discovery of foreign substances, and the iron wires have been galvanised. The manufacture of this cable, when it was completed, had the total length of 1,660 knots. It weighs 38 cwt. per mile, which is almost double the weight of the original Atlantic cable. It is, of course, out of the question to compare the new cable with the one of 1857; but, placed by the side of that of 1865, it will be found stronger, lighter, and more flexible. These qualities give it an immense aggregate superiority, and enable it at any point to resist a strain of eight tons. This year 2,730 miles of cable were shipped, to complete both lines, the length put on board last year being 2,300 miles. Should hauling in become necessary, it might be done either from the head or stern of the *Great Eastern*. From the stern it could be effected by the paying-out machinery, the drums of which had been altered and strengthened, and reversing gear had been added; so, in fact, the machine could be used either in paying out or hauling in. The machinery for this purpose in the bow of the ship was entirely new; it has double drums, and is calculated to work up to a strain of sixteen tons, and will not give way under a pressure of considerably more than thirty tons. It is specially constructed with a view to grappling for the old cable, and was worked by a double-cylinder trunk-engine of 40-horse power, nominal. The dynanometers for the picking-up as well as for the paying-out machinery were fitted with adjusting weights, and had larger scales attached, so that more delicate observations were attainable this year than it was possible to take in the previous summer."

We have not space for the details of the recovery of the picking up former cable.

The splicing of the cables is thus detailed. The end of the cable was brought on board the *Great Eastern*. From this time until 5 minutes to 3 in the afternoon, the operation of splicing went on. Tenderly carrying the shore-end into a little covered hut on deck, where it met the end of the coil brought from the tank farthest aft, busy fingers were soon at work upon both. The protecting manilla twist and galvanised iron wire were speedily unravelled, until several feet of cable were bare to the gutta-percha skin, and of the size and appearance of a bit of piping. The gutta-percha itself was next removed, and the fine copper wires which, twisted together, forming the cable's core, were unwound. Different lengths of these were strongly twined together from each cable's end, so that no two joints should be in one place. A light thread-like wire was bound round each junction, and the whole carefully soldered so as to form one solid wire. Then came thin layers of gutta-percha, like scarf-skin, each layer receiving a coat of the glutinous insulating material called "Chatterton's Compound." The galvanised outer wires and the manilla twist were next plaited over it, and communication was at once established between the *Great Eastern* and the receiving-house at Foilhummerhum-bay. At twenty minutes before 11 those watching the galvanometer saw its stationary light move rapidly across the scale, and the following message was immediately afterwards read:—"Got the shore end; going to make the splice. Everything is right." Then the flickering speck of light stood stern and motionless, and all in the hut knew that the real work of splicing had commenced. The next few hours were spent in anxiously waiting for another message through. "Splice all O. K.; we are going off," at last gladdened the eyes of those watching the galvanometer; and after "God speed you" had been sent in reply, the recently spliced cable was cut adrift from the *Great Eastern*, and, steaming slowly out by her screw, and subsequently with one paddle-wheel, she sped on her way to America. The messages sent and received after the splice was made went through the entire length of the cable; the ends from the three tanks being joined together, so that every message tests the whole 2,370 miles.

The successful laying of the new cable and the recovery and completion of that of 1865 are subjects of congratulation on both sides of the Atlantic, while the happy results of their indefatigable and persevering efforts form a just reward of those who have for so long a time devoted their best energies to this great and arduous undertaking. At every stage of the proceedings, persons suggested difficulties which would impede or destroy the practical advantages of the telegraph. Thus, when the cables were at last safely deposited in the calm, cool depths of the Atlantic, suggestions of speedy decay from corrosion and the intensity of the currents used were freely put forward, and gave rise to doubts, which, happily, appear to be entirely unfounded. So far from the 1865 cable having suffered deterioration in respect of "conductivity" by its year's submersion, Mr. Latimer Clark telegraphed from Valentia that the tests had been completed, and the cable of 1865 had been found to be even better than its successor.

Some readers will remember that, during the laying of the Atlantic cable in 1865, a number of suggestions and speculations were offered as to the cause of failure. One of the most plausible was a magnetic storm; and this is now supported by an American telegraphist, who, having made observations on the effect of the aurora on 100 miles of wire, is led to the conclusion that, on some occasions, the "auroral energy" is equal to more than thirty-two million horse-power for each cubic mile of space. In communicating his observations to the *American Journal of Sciences and Arts*, he remarks:—"When we remember that the effects of this aurora, or magnetic storm, were felt in England, as noticed by Mr. Airy, and probably upon the Atlantic cable then being laid, we can, in some degree, realise what mighty energies may be at play around us, and yet their effects be as harmless as the silvery moonbeams."

M. Babinet, who, in 1864, foretold the failure of the expedition of the *Great Eastern*, announced the successful laying of the Atlantic electric cable, but expressed his fears that the slow but sure action of the salt water would decompose the iron wire enveloping the cable.

In fifty-five days, from the 28th of July to the 21st of September, the cable earned 46,048*l.*, which would make an average, including Sundays, and stoppages of land lines, of 837*l.* a day; and if they excluded the exceptional days, when the cable could not work at all, the average would be 960*l.* a day. The largest sum taken in one day had been 2,008*l.*; and the two most profitable messages the company had transmitted had been the King of Prussia's speech, and an account of the fight between Mace and Goss.

The longest message transmitted through the Atlantic Telegraph was a despatch from the United States Government at Washington to the American Minister at Paris. It consisted of more than 4,000 words, occupied ten hours in transmission, and was sent at the average rate of seven words per minute. The cost of the message was over 2,000*l.* The message, if printed, would occupy about three columns of a daily paper.—*Railway News.*

From the improvement which these comparative cables show, both in the increased strength of the rope, its increased conductivity by the enlarged copper wire, and, above all, by its increased and more carefully guarded insulation, anyone will be able to see at a glance what strides have been made towards ultimate perfection. But it is chiefly in what cannot be seen, in the instruments for detecting faults and for working through them when they are detected, that the main progress has been made. In commemoration of the event her Majesty was pleased to confer the honour of a baronetcy in two cases, and of knighthood in the four others :—

1. Sir Daniel Gooch, Bart., M.P., the first engineer who has received a baronetcy.

2. Sir Curtis Miranda Lampson, Bart., deputy-chairman of the original Telegraph Company.

3. Sir Richard Atwood Glass, Knt., who designed and made the cables of 1865 and 1866.

4. Professor Sir William Thomson, Knt., the famed electrician.

5. Sir Samuel Canning, C.E., Knt., engineer-in-chief of the Telegraph Construction and Maintenance Company.

6. Captain Sir James Anderson, Knt., commander of the *Great Eastern*.

THE NORTH ATLANTIC TELEGRAPH.

MR. N. J. HOLMES has read to the British Association a paper "On the North Atlantic Telegraph." After some introductory remarks, Mr. Holmes said:—It is well known that long, unbroken lines of submarine cables are placed at a very great disadvantage in their transmitting power, as compared with land wires; the retardation (or slowness of transmission of the currents) that takes place from the law of induction forms one very serious cause of interference. The constant flow of induced earth-currents through the wire, variable both in their intensity and direction, is likewise another disadvantage to the employment of long, unbroken lengths of submarine cables, and, however much mechanical ingenuity may overcome the retardation offered to the passage of the transmitting currents on the one hand, or the interference of the variable earth-currents on the other hand, it must be remembered that the same amount of ingenuity can with greater advantage be applied to shorter lengths of line not in themselves subjected in such a marked degree to the disturbing influences just mentioned. In every telegraph line the speed of transmission is at all times a most important element of success; and upon a long, unbroken line, where the whole capital is, as it were, absorbed and dormant during the transmission of any current, or succession of currents, this is of vital importance. Upon the speed depends the tariff to be charged; upon the tariff, the earnings; and upon the earnings, the dividend.

The magnitude and serious nature of the transmitting difficulties existing in all long unbroken sea-lines has led to the contemplated construction of what is known as the Russian-American Line—a land line of telegraph intended to reach New York from St. Petersburg by wires through Siberia, and on to San Francisco, with a short sea section across Behring's Straits, a total distance of about 12,000 miles. This Russian-American line is already far advanced towards completion. By far the most important line of telegraphic communication between England and America is that to be immediately carried into effect, *viâ* Scotland, the Faroe Isles, Iceland, Greenland, and the coast of Labrador, and known as the North Atlantic Telegraph. A glance at the map in the direction pointed out will at once show that convenient natural landing-stations exist, breaking up the cable into four short lengths, or sections, instead of the employment, by necessity, of one continuous length, as between Ireland and Newfoundland. Not only will this subdivision of the cable reduce mechanical risks in submerging, but, what is of more importance, the retardation offered to the passage of the current through the several short sections is almost as nothing when compared with that of the unbroken length of 2,000 miles. Speed of transmission is obtained, and by that means a reduced tariff for public transmissions over the wire. Indeed, such will be the advantages gained in this respect, that the present rate by the Anglo-American line of 20*s*. per word will be charged, on the new route, at 2*s*. 6*d*., or even a less sum. The average depth of the ocean between Scotland and the Faroe Isles is only 150 fathoms, the greatest depth 683 fathoms. Between the Faroes and Iceland 250 fathoms, with about the same maximum depth between Iceland and Julianshaab, the intended landing-place of the cable in Greenland, the greatest depth is 1,550 fathoms; and between Greenland and Labrador rather over 2,000 fathoms. These lengths of cable and depths of ocean are both not only manageable but practicable, and no difficulties in the working exist that are not already known by reference to the practical working of existing cables under the conditions of similar lengths and depths. As regards the presence of ice, it is only at certain seasons of the year that the south-west coast of Greenland is closed. At other times this ice breaks up, and the coast is accessible to the Danish and other trading vessels frequenting the port and harbour of Julianshaab, the proposed station and landing-place of the cables, and at such times the cables will be laid.

PICKING UP SUBMARINE CABLES.

MR. FLEEMING JENKIN has explained to the British Association the apparatus of which he is the inventor, called "A new arrangement for Picking up," but in reality for Winding in, "Submarine Cables," as soon as the end has been grappled for and caught. The great danger and difficulty of the process hitherto had arisen from the unequal strain put upon the cable by the rising and falling of the vessel, which had the effect, especially in rough weather, of a series of jerks upon the cable. The arrangement which he has made admitted of the cable being pulled in and paid out without stopping or altering the speed of the winding-wheel. The line may actually be in process of hauling in when the vessel dips, and rest stationary or be paid out again as she rises, and yet no alteration of the machinery would be necessary. If a spell of fine weather presents itself, by a mere addition of weight the winding-in speed can be materially accelerated. What he has aimed at is, to produce an arrangement which should play the line just as it is necessary to play a fish that you wish to secure. In this aim experiments conducted in presence of the Section showed that he had entirely succeeded.

AUTOMATIC TELEGRAPHY.

MR. A. BAIN has read to the Society of Arts a paper on Automatic Telegraphy, in which he gives some information about recent improvements in portions of his printing telegraph. By his system the message is not sent along the wire by the hands of officials; but the letters, in the form of dots and dashes, are punched in a long ribbon of paper, where they appear as a straight line of long and short perforations. This paper is next placed on a metallic drum, and has a brass spring pressing upon it. When the drum is made to revolve, the brass spring sometimes touches the metallic drum through the perforations, and every time it does so the act of contact sends a longer or shorter pulsation of electricity through the telegraph line to the distant stations. The message, as before, is received on chemically-prepared paper, which is decomposed by the passage of the current, whereby the message is written in dark marks.

HOOPER'S CABLES.

MR. HOOPER has read to the British Association a paper "On the Electrical and Mechanical Properties of Hooper's India-rubber Insulated Wire for Submarine Cables." The author described the method by which he secures the durability of his rubber. Its high degree of insulation was pointed out, and its durability under very trying conditions, over long periods of time, confirmed by experiments conducted by Sir Charles Bright, Capt. Mallock, and others. It was stated that Mr. Latimer Clark had found it unnecessary to ship Mr. Hooper's cables in water-tanks; and the Ceylon cable, then on its way out, is coiled dry. The inductive capacity of Mr. Hooper's wire remains practically the same at all temperatures, while that of gutta-percha increases considerably at 100° Fahr. Diagrams, representing the effects of pressure and immersion, were shown, from which it was seen that pressure improves the insulation of his wire in the same way as is observed with gutta-percha. The result of carefully-conducted experiments, extending over three years, proves that the absorption of water is so small that the most refined electrical tests failed to discover it.

DEEP-SEA TELEGRAPHY.

A PAPER has been read at the Inventors' Institute, by Mr. Kaulbach, on a special plan for the establishment of Ocean Lines of Telegraph. This plan consists in the formation of a permanent way or bridge, formed of a series of vessels floated 10 to 15 fathoms beneath the surface of the ocean at moorings, for the support and carrying through of the wires. The vessels can, within a few minutes, be brought to the surface, together with their respective burdens, when required, without any effort or machinery. By means of a simple appliance, messages may be sent from mid-ocean through any one of the buoys along the wires, by ships privileged to use them, and wishing to communicate with either of the continents or islands wherewith the permanent-way may be connected, or with each other. The actual cost of permanent-way communication between Cape Race and Cape Clear has been estimated at about 400,000*l*.

ONE WIRE TYPO-TELEGRAPH.

A PAIR of experimental instruments, embodying improvements, have been completed, for Mr. J. H. Simpson, the patentee, by the well-known instrument-makers, Messrs. Elliot Brothers. The two instruments, says *Engineering*, are similar, and either of them may be used for receiving or transmitting a message; the only variation required being, that the sending instrument should be supplied with type, and the receiving one with prepared paper. They each consist principally of a wooden wheel, 42 in. in diameter, having disposed heliacally round its circumference eighteen styles, which are each pressed outwards by a spring. The wheel is placed so as to revolve at a short distance from a desk, the face of which is curved to suit the circumference of the wheel, this desk carrying either the type or the prepared paper, as required. As the wheel revolves, the styles successively traverse the type or paper placed upon this desk in a series of parallel lines; and the desk being of less length than the interval between the following styles, one only is passing over it at one time. Either the styles of the two instruments are connected to a single line wire and the desks to "earth," or *vice versâ*; and the usual battery connections being also made, it follows that, as each style of the sending instrument passes over the type, it will transmit a series of currents through the line wire to the receiving instrument, and cause the style of that instrument, in passing over the prepared paper, to record a series of marks corresponding to the type. The synchronous motion of the two wheels will be ensured by the employment of a governor—we believe a modification of that patented by Professor Thomson and Mr. Fleeming Jenkin—and they will be driven by falling weights. Perfect means of adjustment are supplied for instantaneously correcting any variation in the speed of the two instruments. The advantages of this system appear to be principally these: that the instruments can be kept at work incessantly, there being no occasion to stop them even for the insertion of a fresh message; that either clear Roman characters or a cypher can be employed at pleasure; and that, from the way in which the messages are developed by the passage of successive styles, it would be impossible to obtain information by "tapping" the line.

THE TELEGRAPH IN DIFFERENT COUNTRIES.

At a meeting of the members of the Liverpool Historic Society a paper has been read by Mr. E. B. Bright, C.E., on this subject; in the course of which he stated that in the world there were 86,600 miles of telegraph line, carrying very nearly 250,000 miles of wire. In England there were 16,148 miles of line, and 73,810 miles of telegraph wires; so that, as to the length of line, England returned between one-fifth and one-sixth of the whole of the telegraphs of the world; and, as to the length of wires, it was between one-third and one-fourth. The English rate of charge, after that of France and Switzerland, was the lowest in the world. In America the rates were exceptionally high, and consequently the signal company there realised exceptionally large profits. A great part of the telegraph abroad was worked for political purposes, and was kept in the hands of the Government for that reason, and it was not worked on a commercial basis at all. In France there was formerly a loss of 130,000*l.* to 140,000*l.* a year on the working of the telegraph, and last year there was a loss of 40,000*l.* In India the last returns showed a loss of 70,000*l.* on the year in the working of the telegraph, and that notwithstanding that the rate for transmitting messages in India was higher than it was in England. It had been asserted that the rate system for the transmission of telegrams might be made to assimilate to the postal system; but it must be borne in mind that letters from one town to another could be conveyed in the same train, whereas, if even one firm had to transmit twenty messages, those messages would have to be transmitted separately, and taken separately to the persons to whom they were addressed.

THE RUSSO-AMERICAN TELEGRAPH.

THE Russian papers publish a detailed account of the proceedings of the Russian engineer-in-chief, M. Abaza, and three American engineers, Captain Meyhood, Lieutenant Busch, and Lieutenant Kennan, who were instructed to survey the line of country through which the Russo-American Telegraph is to be constructed. The party started from Petropaulovsk on August 8, 1865, and succeeded after many difficulties in tracing the exact course of the future telegraph. At last, says a letter in the *Poste du Nord*, "the surveys have been completed from Anadyrsk to the Amour, a distance of 6,000 versts, and the direction of the line has been determined. This immense task has been executed by the chief of the expedition and three engineers, in the course of a dreadful winter, during which they have had to contend against incredible difficulties, traversing day by day vast deserts, sometimes mounted on reindeer, sometimes drawn by dogs, but more frequently travelling on foot with the aid of snow shoes, and always accompanied by fierce hurricanes and dreadful frosts. As soon as the sea of Ohkhotsk shall be free, vessels belonging to the Telegraph Company are expected to arrive at Guigiga from America with the necessary materials for commencing the works immediately. These ships will also bring a number of Yakoute labourers, who are already hired for the works, which will be actively pushed on from the Amour to Behring's Straits. Already between Ohkhotsk and Anadyrsk the works have been commenced with the assistance of the inhabitants of the country, who are engaged in constructing houses and trimming trees to serve as telegraph poles.

Chemical Science.

DIALYSIS.

CHEMISTRY owes much to the Master of the Mint, especially for his Dialysis, a method (first published in the *Philosophical Transactions*) by which liquid substances, however intimately mingled, can be readily separated one from the other. The instrument or apparatus used in the process is known to chemists as a dialyser. As an example of the result, it may suffice to mention that the juice of the meat can be separated from a quantity of brine, leaving the solution of salt behind. Mr. Graham now carries his dialysis a step further, and shows that he can separate the oxygen from the atmosphere. The process is remarkable for its simplicity. An India-rubber bag, filled with air, and connected with a system of glass-tubes, is gradually exhausted of its contents, and the vacuum being maintained by the flow of mercury down one of the tubes, a passage of oxygen through the substance of the bag takes place, and this oxygen is carried down, entangled, so to speak, with the mercury, to a point where it can be collected in test-tubes, and its presence demonstrated in the usual way. The quantity of oxygen which thus passes through is stated as 40 per cent. It is the opinion of the *Athenæum* that, to those able to appreciate it, this is a most promising experiment, not only in prospect of laboratory research, but also of commercial enterprise. If, as the report states, the process is remarkable for its simplicity, the benefit must be great.

Among the papers read at the closing meeting of the Royal Society's session there was one which is likely to engage the attention of chemists and metallurgists, for it carries on, and with striking results, the researches arising out of Mr. Graham's important discovery of Dialysis. Treating of the absorption and dialytic separation of gases by colloid septa, the first part of the paper gives the results obtained by a septum of caoutchouc, and the second part those of different metallic septa at a red heat. It has long been known that palladium and some other metals, when heated, absorb gases. Mr. Graham now finds that palladium will take up several hundred times its bulk of hydrogen, and that iron at a low red heat absorbs a considerable quantity of carbonic oxide; and that, contrary to long-standing belief, this gas does not act on the surface of the metal only, but permeates its entire substance. This fact is particularly interesting to metallurgists. Having taken up the gas, the iron will retain it for any length of time, and in this condition is best adapted for conversion into steel, as by the permeation of the carbonic oxide the subsequent process of carbonisation is largely facilitated. Hence arises the suggestion that the process of acieration would be best accomplished by changes of temperature; a low red heat to fill the iron with carbonic oxide, after which it may be put away, if required, to await the final process at a high temperature of conversion into steel. Concerning another form of iron, Mr. Graham remarks that wrought iron, in the course of its preparation, "may be supposed to occlude six or eight times its volume of carbonic oxide gas, which is carried about ever after. How the qualities of iron," he asks, "are affected by the presence of such a substance, no way metallic in its characters, locked up in so strange a way, but capable of reappearing at any time with the elastic tension of a gas, is a subject which metallurgists may find worthy of investigation." It would not be easy to overrate the importance of the paper of which we have given here so brief a sketch, for it is remarkably suggestive and original throughout. When published in the *Philosophical Transactions*, with all the details, it will secure the attention it deserves. If Mr. Graham had never written more than this paper, it would suffice to place him in the foremost rank of the chemists of Europe; and it may be that metallurgists will now be ready to claim him as one of themselves, for what he says about iron and other metals.—*Athenæum.*

CAPILLARY AFFINITIES.

M. E. Chevreul has communicated to the Academy of Paris Sciences the results of his researches on the phenomena of Capillary Affinities, a great number of which are produced by forces to which philosophers, in his opinion, have not given sufficient attention. He refers, for example, to the colouration of stuffs plunged into dyes; to the absorption of gases by porous bodies, such as charcoal, meerschaum, &c.; and to the formation of steel by the union of carbon with iron. He gives in tables the results of experiments made with white lead, china clay, and the white clay of Gentilly, showing their absorption of linseed-oil and water under various circumstances. He asserts that, independently of the ordinary capillary attraction, there exists in these bodies an elective capillary affinity, the applications of which are very numerous and varied. He terminates his memoir with an explanation of the process of petrifaction of organised bodies, due to the salts and gases penetrating their tissues.

STANDARDS OF MEASURE.

The subject of the best material for the "Mural Standards of Measures of Length," proposed to be erected in some of our principal towns and cities by the Committee appointed by the British Association, has been brought under discussion by a paper by Mr. J. Yates, to the Chemical Society. Metals, on account of their expansibility, and as being more or less subject to corrosion, were not regarded with so much favour as porcelain, some out-door thermometer plates of which, manufactured by Mr. Casella, were shown to the meeting by Dr. Frankland. Mr. Mackie explained a very ingenious plan for extreme accuracy, mentioned to him by Mr. R. Sabine, of having an interspace of an exact mètre between two points, one fixed to the wall, the other working in a slot against the end of a metal bar, which should, by expanding at twice the rate of the wall, keep the moveable point always at an exact mètre from the other, whatever the temperature of the air. As the wall would expand about $\frac{1}{1200}$, and copper about $\frac{1}{580}$, between freezing point and boiling point, a bar of that metal a mètre in length would, by a slight adjustment, answer all requirements. Mr. Warren De La Rue, Dr. Matthiessen, Mr. Siemens, Dr. Müller, Mr. Becker, the President, Mr. Casella, Professor Leone Levi, and others, made many excellent remarks and suggestions, the general expression being that it would be better to call the proposed public standards "comparative measures of length," as they were not likely to possess those minutely accurate conditions which justify the use of the term "standard."

CHEMICAL ACTION.

PROFESSOR G. C. FOSTER has delivered to the Chemical Society a lecture, "On the Thermal Phenomena of Chemical Action," which embraced a critical notice of the researches in this branch of physics, extending over a period of nearly a century. The Calorimeters of Lavoisier, Favre, of Silbermann, Raoult and others, were described, and the general laws enunciated by their use fully stated. Certain anomalies observed in the amount of heat given out during the combustion of bisulphide of carbon, turpentine and its isomeric hydrocarbons, &c., were pointed out, as well as some interesting thermal considerations regarding the elements, phosphorus, sulphur, and carbon, in their several allotropic conditions.

PROFESSOR TYNDALL ON HEAT.

AT the Royal Institution, Professor Tyndall has delivered a course of lectures on "Heat," to large audiences. He states that as heat is simply the vibration of the ultimate particles of all bodies, the less that vibration the greater the sensation of cold. Ice contains much heat, and will liquify and boil solid carbonic acid. There is no evidence that any substance on this earth has ever been deprived of all its heat; but the point at which that result is obtained is believed to be 273 degrees below the zero of the Centigrade scale. The Professor charged the lecture-room largely with moisture, and in the course of his experiments formed clouds, snow, ice, and hoar frost. By artificial means, he imitated the geysers of Iceland, a great flood of hot water and steam shooting up through a hole in the middle of a large iron basin. Finally he reproduced, on a small scale, the Strokr, an irritable boiling spring, which exerts its powers whenever lumps of dirt or large stones are dropped into its mouth.

HIGH TEMPERATURES.

SOME very remarkable results have been obtained by M. Schlœsing, in the production of exceedingly High Temperatures by the combustion of gas with air. By regulating the quantity of hydrogen and air brought together at the time of combustion, a considerable range of temperature can be obtained; the highest named in a communication recently made to the Paris Academy of Sciences, by Sainte-Claire Deville, being 2736° Cent. By taking hydrogen obtained by the decomposition of water, and causing it to pass over incandescent charcoal, before it arrives at the place of combustion, where it is charged with the requisite quantity of air, a temperature of 2870° Cent. was obtained. It is proposed to apply the heat thus readily obtained, not only to the operations of the laboratory, but to extend it to the foundry and the workshop.

THERMO-CHEMISTRY.

M. BERTHELOT has commenced the publication of his important researches on Thermo-Chemistry, in the *Annales de Chimie*, in which he proposed to himself to examine into the calorific phenomena which preside at the formation and decomposition of organic substances; in other terms, what is the extent of the power of the active forces engaged in their synthesis? The first two memoirs now published contain the general principles relative to the heat disengaged in chemical action; also, the determination of the quantities of heat disengaged or absorbed in the formation of the principal organic compounds, and more generally in the reaction of the hydrocarbon bodies. In succeeding memoirs he will apply the results to animal heat, and will give an account of his researches relative to the influence of heat (*i. e.* elevation of temperature) on organic compounds; concluding with a comparative study of the endothermic and exothermic reactions (*i. e.* those reactions which are produced with absorption of heat and those which take place with disengagement of heat).

SURFUSION.

M. PASTEUR, in the name of M. Gernez, has reported a new physical phenomenon termed Surfusion. Sulphate of soda, sulphur, phosphorus, acetic acid, and many other bodies, remain in the liquid state at a temperature notably inferior to their natural point of *passion*. These bodies crystallise instantly when a solid fragment of the same substance is let fall into their liquid mass. M. Gernez has affirmed that the shock produces a similar phenomenon in a mass kept liquid with this particularity.—*Illustrated London News.*

ORGANIC CHEMISTRY.

In the *Bulletin of the Chemical Society of Paris* we have several papers testifying to the rapid progress of Organic Chemistry, based on the profound study of the methods in which natural compounds are formed. Among these may be remarked the notices on phosphoric, boric, and other ethers, by MM. Carius, Schiff, and Heintz. M. Kékulé has published a memoir, in which he further develops his theory as to the formation of aromatic matters, especially relating to the products formed by the substitution of benzoin, and their crystal ine structure. In a note on the functions of leaves, M. Corenwinder states that they fix much more carbon during the day than they lose during the night; and that adult leaves, completely developed, never give off carbonic acid in the open air; but if they are kept in an apartment far from windows, or in a very shady place, they disengage more or less during the day, according to the nature of the plant and the feebleness of the light. MM. Faivre and Dupré give analyses of the gases which they obtained from the mulberry and the vine, by injecting with mercury portions of the roots and branches. Branches of the mulberry, with no signs of vegetation, at the end of March, gave oxygen, 21 and 20·8 per cent.; May 15 (active vegetation), carbonic acid. 3·3; oxygen, 13·33; June 16 (very active vegetation), carbonic acid, 15·7; oxygen, 2·5. As vegetation slackened, the proportion of carbonic acid diminished and that of oxygen increased.—*Ibid.*

THE ALBUMEN OF THE EGG.

IN describing some researches on the chemical constituents of albumenoid substances, Dr. A. Commaille refers to White of Egg, and points out that raw Albumen differs chemically as well as physically from coagulated. It has a different solubility in dilute acids, and it is certain that heat causes the elimination of a small quantity of a peculiar substance, which is only imprisoned in the coagulated mass. This fact was pointed out by Bostock in 1808. A culinary experiment shows that cooking effects a dissociation of the principles of white of egg, or some peculiar change in the albumen. Silver is not affected in a raw egg, but everybody knows it is blackened in a boiled one. The author put a recently struck coin in white of egg, and then heated it to coagulation in a water bath. The coin came out not only blackened, but corroded in places. Nothing like this was observed with the raw egg, or with the yolk raw or cooked. M. Wurtz has pointed out that sulphuretted hydrogen is evolved during the coagulation of albumen, but the author is not certain that this gas alone gives the peculiar odour to hard eggs. He rather believes that there is a volatile substance which contains all the sulphur hitherto supposed to be a constituent of the albumen itself.—*Mechanics' Magazine.*

IDENTITY OF VEGETABLE AND ANIMAL SUBSTANCES.

DR. BENCE JONES, in his address as President of the Chemical Section of the British Association, noticed the chemical discoveries and observations of the past year, and dwelt upon the analysis which shows that vegetable substances are composed of the same elements as animal substances, whereas it was formerly believed that nitrogenous compounds belong exclusively to the animal kingdom, and that vegetables are formed of carbonaceous matters only.

THE BRAIN.

M. Liebreich has published his researches on the chemical composition of the Brain. He has obtained from it a new substance, which he names "protagon," from which he has procured a new base, termed "neurine." Details of their properties and reactions will be found in the *Bulletin of the Chemical Society of Paris.*

ANIMAL QUINOIDINE.

At the Conversazione of the Royal Society, Dr. Bence Jones, aided by the electric light, has shown the fluorescent substance, Animal Quinoidine, on which he has lectured at the Royal Institution, and treated of in a paper read before the Royal Society. The specimens, some of which had been obtained from the living human subject, exhibited the greenish fluorescent light seen in a solution of vegetable quinine; and Dr. Bence Jones, to whom the discovery of this remarkable substance is due, states that it exists in every part of the bodies of man and animals. It is another example of the progress made by physiological chemistry in demonstrating that substances once supposed to be exclusively vegetable are also animal products. Chemists now know that starch, sugar, woody fibre, colouring matter, such as indigo, and albuminous substances, are common to the three kingdoms of Nature—animal, vegetable, and mineral. Of course the processes are different, for while the vegetable builds up synthetically acids, neutral hydrocarbons, fats, alkaloids, and albuminous substances from carbonic acid, ammonia, and water, the animal forms analytically alkaloids, fats, neutral hydrocarbons, acids, water, ammonia, and carbonic acid from albumen. Assuming that medical science will continue to progress, the result of this new discovery will be the discovery of other substances—medicines which will exert a controlling power over the changes of the bodily textures in fevers and inflammation, and remove the products of insufficient chemical action which at present occasion cataract and gout. Dr. Bence Jones's discovery is another proof, if one were needed, of the value of the spectroscope in chemical research, particularly in the detection of very minute quantities. —*Athenæum.*

APPLICATION OF THE ANILINE DYES TO PAINTING.

It is found that all resins have acid properties—caoutchouc and the Aniline Dye-stuffs—dissolve in the solution of aniline.

Shellac is thoroughly soluble in it, and the resulting solution may be coloured with the concentrated solution of an aniline dye-stuff, the result being an excellent material for producing transparent paintings on glass, porcelain, &c., to which it very firmly adheres. The aniline dye-stuff may be dissolved directly in the aniline solution of shellac, with the aid of heat; but not fuchsine, since this, when heated with shellac, is changed to blue: hence, when this substance is to be dissolved, a solution of it in aniline, prepared without heat, is to be mixed with the aniline solution of shellac. These shellac solutions of the dyes may be mixed with oil paint not containing lead, and thus a brilliancy of tone may be imparted to the various colours in oil which they do not themselves possess.—*Scientific Review.*

GREEN COLOUR.

If green is not a mixture of blue and yellow, how can we account for the familiar experience of the production of a green pigment by the mixture of a blue one with a yellow one? Helmhotz answered that question in this way:—"Light reflected from a painted surface is of a twofold kind: first, that which comes directly from the surfaces of the little atoms of coloured powder; this will, in ordinary daylight, be white, and small in amount. Secondly, by that light which penetrates through two or more atoms of the pigment, and then is reflected; this is always coloured, and coloured merely because, in its passage through the atoms, certain rays have been absorbed. For example, the white light which penetrates through an atom of ultramarine in this operation becomes deprived mainly of the red, orange, and yellow rays; the green, blue, and violet rays are left comparatively unweakened. The particles of chrome yellow, on the other hand, in the same process absorb the blue and violet rays, reflecting back the red, orange, and green rays. Hence it will be seen that by the joint action of the ultramarine and chrome yellow, all the rays of the spectrum are absorbed except the green; hence green light alone is reflected back to the eye." Mr. O. M. Rood, the Professor of Physics in Columbia College, Philadelphia, has lately devised some ingenious spectroscope experiments which completely prove the entire accuracy of this theory.—*Mechanics' Magazine.*

SUBSTITUTES FOR GUNPOWDER.

Professor Abel, the principal chemist of the War Department at Woolwich Arsenal, has given at the Royal Institution an account of the recent progress in the history of proposed Substitutes for Gunpowder. He began with remarks on the fact that this ancient mixture is still almost the sole destructive and propelling agent employed for war and civil purposes, its modifications being merely matters of detail. After rapidly exhibiting the properties of its constituents, and the various kinds of gunpowder now in use, he next proceeded to discuss the composition and action of some new explosive mixtures. In some cases the nitrate of soda or barytes has been substituted for the saltpetre, making good blasting powder. Chlorate of potash, a powerful oxydising agent, has been also used in some explosive mixtures in place of saltpetre. This powder has much greater power than gunpowder, but it is far more dangerous to manufacture and use. It might be economically employed for shells and military mines, but could not be sufficiently regulated for fire-arms. The Professor pointed out the fallacy of inventors of new powders, who refer to the advantages of keeping the ingredients apart till the mixture is to be used; since no uniform action can be obtained unless these ingredients are thoroughly incorporated. In regard to the scheme entertained by artillery authorities thirty years ago, and revived recently by Mr. Gale, of rendering gunpowder comparatively safe, when stored or transported, by mixing it with a non-explosive powder, such as that of glass, which is a bad conductor of heat, the Professor explained the principles involved, and illustrated them, showing by experiment that the degree of safety appeared to have been exaggerated. He then described the nature and properties of the sawdust gunpowder recently patented by Captain Schultze, and those of the explosive liquid nitro-glycerine, of whose unstable and fearfully destructive character such awful evidence has been recently furnished. In conclusion, he gave a brief account of the progress of the manufacture of gun-cotton during the last two years, more especially by Messrs. Prentice. The Government Commissioners are still pursuing their investigations, and the results obtained are encouraging in regard to the military applications of this substance. The numerous experiments of the lecture included examples of blasting, and the use of gun-cotton in making fireworks.

Mr. Gale's Gunpowder experiments have been repeated, and a breech-loading pistol, which he has invented, exhibited and explained. In this invention the *maximum* of rapidity seems certainly to have been attained; a difficulty, however, arises with regard to the distribution of weight which the inventor must overcome, if possible, before he can expect the weapon to be largely adopted. The principle is extremely simple. A box filled with cartridges, and in shape resembling one of the toy Pandean pipes, traverses the stock and lower end of the barrel, much in the fashion of a moveable bench in the case of a steam planing-machine. Each tube of the Pandean pipe holds a cartridge, fired on the Eley principle with a pin, which is exploded by the action of the hammer. Each pipe, therefore, is for the time the breech of the pistol, and the same action that raises the hammer for the next discharge slips on the empty pipe, and brings its loaded neighbour next in succession in line with the barrel, through which the bullet is to obtain its direction. The objection which at first sight presents itself is, that the longer the box of tubes, and consequently the more the number of shots available, the greater is the strain of the weight, now to the right and now to the left of the pistol. Moreover, the loaded barrels being always to the right and the discharged to the left of the barrel, it would be a strain which, under any circumstances, would never be equalised. Mr. Gale, however, avers that this objection may be overcome; and meanwhile, in point of simplicity and rapidity, the action probably is without a rival.

NITROLEUM, THE NEW SUBSTITUTE FOR GUNPOWDER.

A HIGHLY-INTERESTING official report has been made by Colonel Shaffner of a series of experiments conducted by him at Washington for demonstrating the use of Nitroleum (which, it should be explained, is the new and far preferable name by which the colonel designates the compound which has hitherto been called Nitro-glycerine) in the explosion of mines. The results fully confirm the fact that the explosive qualities of nitroleum are far in advance of gunpowder. Two similar cast-iron pieces, weighing each 300 lb., had a hole 1 in. diameter and 15 in. deep bored in them, and were charged, one with powder and the other with nitroleum. The powder discharged through the fuse-vent, 3-16 in. diameter, did no injury. The nitroleum tore the iron to pieces, the force extending downward from the bottom of the charge, leaving a cone with its apex at the bottom of the drill-hole. Four musket-barrels were placed in wrought iron cylinders, two filled with gunpowder and two filled one third full with nitroleum. The musket barrels charged with powder were exploded by electricity; they burst open, tearing the iron to pieces. The explosion of the barrels charged with nitroleum produced a very different effect: they were flattened, and not so much broken to pieces; the force was so sudden and great that after the barrel had irregularly broken up and down the iron appeared like rolled plate, even and polished. The experiments appear to demonstrate that nitroleum can, with ordinary precautions, be handled and employed without greater danger than is common to gunpowder, and for blasting operations, at least, it presents undoubted advantages.—*Mining Journal.*

Captain Grant, R.N., has reported upon the explosiveness of Nitroleum as follows:—It is a manufactured substance, composed of glycerine, nitric and sulphuric acids. It is called nitro glycerine, glonoin oil, and Nobel's patent blasting oil. It is exploded by concussion, and apparently, under ordinary circumstances, by nothing else—neither by friction nor fire. Generally a trifling percussion is sufficient to explode it. Its explosive force is about ten times that of gunpowder. It is usually carried in tin cans, holding each about 25 lb. weight of the oil. It has all the appearance of ordinary oil; so that there is nothing in itself, or in the tins used for its carriage, to give notice of its dangerous nature. The cans are packed each in a wooden case, for carriage by land or water. The oil is manufactured by the patentee, Mr. Nobel, of Hamburg, and by other persons abroad, under his licence. It is at present employed for blasting only. It is extensively used both abroad and in this country.

Recent explosions have drawn attention to the dangerous character of this production. At the Mersey Dock Board, lately, a communication was read from the Town Council on the subject, and it was stated that this oil is forwarded from Germany to Hamburg, thence to Hull, and thence by railway to Liverpool. A small quantity is sufficient to shatter a block of iron of 30 tons, and it might have caused the utmost destruction at Liverpool. Mr. Forward stated that the trade was so lucrative that the most fraudulent means were adopted in forwarding these oils. He personally knew an instance in which seventy cases of gleonine oil had been shipped at London, a sufficient quantity (had it exploded) to have shaken the metropolis to its centre, and destroyed an immense amount of property.

M. Kopp has transmitted to the Paris Academy of Sciences a note on Nitro-glycerine as employed in the quarries near Saverne. He describes it as a yellowish-brown oil, heavier than water, in which it is insoluble. It is soluble in alcohol and ether. At a slightly intense prolonged cold it forms elongated, needle-like crystals. A violent shock is the best mode of making it detonate. Without this it may be handled with little danger. When dropped on the ground it is ignited with difficulty by a burning body, and burns only partially. It may be volatilised without decomposition by a controlled heat; but detonation is imminent if the ebullition become lively. A drop of nitro-glycerine falling on a moderately hot cast-iron plate volatilises quietly; and if the plate becomes red the drop inflames immediately, and burns quietly, like a grain of gunpowder; but if the plate, without being red, is hot enough for the nitro-glycerine to enter into ebullition, the drop will decompose with violent detonation. M. Kopp considers that the recent explosions of this substance are due to its impurity, and asserts that it may be advantageously employed, without danger, when due care is taken. By means of charges of 1500 or 2000 grammes of glycerine from forty to eighty cubic mètres of a hard rock may be detached with little injury to the stone.

About three years ago a new metal, called Indium, was discovered by Richter and Reich, of Freiburg, the name of indium being given to it from the beautiful blue colour of the characteristic line of its spectrum. In appearance this metal resembles platinum, and it is not tarnished by exposure to the air; but it is softer than lead, is easily fusible, and is as volatile as zinc. Of this metal a very complete account has lately been published by Mr. F. Gillman. It was originally discovered by the aid of the spectroscope, and it is obtained from the Freiburg zinc by dissolving the zinc, except a small portion, in hydrochloric acid, whereby a spongy residuum is obtained containing all the indium and other foreign metals present, such as lead, iron, arsenic, and cadmium. The residuum consists chiefly of lead; and these metals are got rid of by dissolving the mass in nitric acid, from which the lead is precipitated by the addition of sulphuric acid, and the cadmium and arsenic by means of sulphuretted hydrogen. The solution is next boiled to get rid of the sulphuretted hydrogen, and the iron is oxydised by chlorate of potash, when the addition of ammonia precipitates a mixture of peroxide of iron and protoxide of indium. The precipitate is next dissolved in diluted acetic acid, from which a sulphide of indium is precipitated by sulphuretted hydrogen. The sulphide is converted into an oxide by dissolving in hydrochloric acid, from which the oxide is precipitated by the addition of an alkaline earth, and the metal is obtained from the oxide by reducing it by hydrogen of cyanide of potassium. Its specific gravity, when hammered, is 7·277, and all its salts impart a blue colour to flame. The proportion of indium present in the Freiburg zinc is from 0·008 to 0·0448 per cent.—*Illustrated London News.*

HARD IRON.

M. Gaudin, some years ago, made exceedingly Hard Iron by combining it with a small quantity of boron. He has now produced an equally hard material by combining fused cast iron with phosphate of iron and peroxide of manganese. The mixture cannot be forged, but is easily cast, and can thus be applied to the manufacture of machines. He states that a still harder material, fit for making cutting-tools, is produced by the addition of tungsten.—*Ibid.*

COPPER RESEARCHES.

M. W. Blasius, in continuation of the researches of M. Wicke, relative to the Copper contained in the soil and in plants, has been led to seek for this metal in the organisms of men and animals. Sarzeau, Vauquelin, Chevreul, and other chemists have already recognised its presence in the blood and muscles; and several, when searching for it in the spleen and liver, obtained only negative results, because they operated with very small quantities. M. Blasius, by very minute analysis, has confirmed the results already obtained, and has furnished new proofs of the presence of copper in every part of the organism; and he has refuted the opinion of Wackenroder, that it is only in the animals living in the proximity of man that copper is met with. He has also determined its presence in the white and yellow of the egg. A table, giving the results of his analysis, laid before the Society of Sciences at Göttingen, is given in *L'Institut*, No. 1706.

MANUFACTURE OF STEEL.

M. Boussingault has given to the Paris Academy of Sciences some details of the experiments of Captain Caron, so eminent for his researches relating to the Manufacture of Steel; which were instituted with the view of determining the cause of the occurrence of bubbles in steel when cast and cooled in certain crucibles, which bubbles are not found in pure cast iron. M. Caron thinks that the difference is due to the substance of which the crucible is made. When earth is employed for this purpose, the iron under the influence of heat may be oxydised, and thus form, with the silex of the crucible, silicates of iron, which disengage no gas. In steel, on the contrary, the carbon may reduce the first atom of oxide formed, and thereby disengage a gaseous oxide of carbon, which produces the bubbles. M. Caron avoids this inconvenience by making the crucibles of magnesia. M. Regnault asserted at the meeting that the application of magnesia was due to Thilorier.—*Illustrated London News.*

HOW TO MAKE GOLD.

M. Frantz, a metallurgist, and M. Henri Faure, editor of the *France Médicale*, have announced to the learned world that they have discovered a method for transmuting silver, copper, and mercury, into Gold, all these, they say, being "only one and the same metal in different dynamic states." This idea is quite in accordance with that of the old alchemical writers on the subject; and the possibility of transmuting metals has been admitted by Sir H. Davy, Dr. Faraday, and other eminent modern chemists. Whether, in this case, it has really been done, however, we cannot testify.

PLATINUM AND PALLADIUM.

Mr. Thomas Graham has found by recent experiment, that, in the form of sponge, Platinum absorbed 1·48 times its volume of hydrogen, and Palladium 90 volumes. The former of these metals, in the peculiar condition of Platinum black, is already known to take up several hundred volumes of the same gas. The assumed liquefaction of hydrogen in such circumstances appears to be the primary condition of its oxydation at a low temperature. A repellent property possessed by gaseous molecules appears to resist chemical combination, as well as to establish a limit to their power to enter the minuter pores of solid bodies.

NEW MINERALS.

Adamine, a new mineral, principally composed of arsenic and oxide of zinc, discovered in combination with native silver, at Chanareillo, in Chili, is described by MM. Friedel and Des Cloizeaux in the *Bulletin of the Chemical Society of Paris.* It has received its name in honour of M. Adam, to whose liberality mineralogists are much indebted, by his having placed at their disposal a collection of specimens, accumulated during many years.

Professor Knop, of Leipzig, has discovered, while searching for specimens of crystallised cryolite, a new mineral, to which, from its appearance, he has given the name of Pachnolite—πάχνη, frost. It occurs in two varieties: the one in right-angled parallelopipedons, with three unequal cleavages; the other in rows of small crystals, grouped in the form of a comb, within hollows of the original cryolite.—*Athenæum.*

ASBESTOS.

A CORRESPONDENT of an Australian paper, the *Orange Guardian*, writes as follows:—"Some twenty-two years ago I recognised the Asbestos, or Amianthus Rock, in this district, and since then I have from time to time exposed portions of the stone to atmospheric influence; and the result has always been a perfect change of the stone into asbestos, or into a substance closely resembling the finest staple of wool, only something stronger, and, if possible, whiter in appearance. I have sometimes obtained it six inches in length, have combed it out, and found it as soft and pliant as any silk. This substance, as no doubt you are aware, is inconsumable by fire. The stone may be brought into the state of asbestos in a very short time. I have been employed sinking a well of late, and some days I got as much of this mineral as would make a suit of clothes. I can show the stone here in all its stages, from stone itself to the asbestos state. Should asbestos ever come into general use, it will, in some measure no doubt, from its incombustible nature, supersede the evils of crinoline. Besides this great advantage, it will also set aside the vexatious expense and use of soap and water; for all a lady will have to do when she unrobes herself will be to pitch her articles of apparel into a glowing fire, and when they have become as white as a snowflake, she may resume them at her pleasure. Perhaps you may deem some parts of the foregoing rather extravagant; nevertheless, I really believe that, by proper appliances, the amianthus may yet become a source of revenue, and I therefore recommend the thing to your attention."

FIRE-PROOF CHESTS.

M. F. WIESE, of Vienna, is now manufacturing strong Fire-proof Chests, in which a certain space is reserved for the reception of a layer of pulverised alum. At an elevated temperature this alum gives up its water of crystallisation and disengages a notable amount of steam, which, in forming, absorbs much heat; and, so long as this evaporation lasts, the interior temperature of the chest does not increase. In order that this effect may be produced regularly, it is necessary that the chest should be made with double walls filled with ashes, in order that the heat applied exteriorly may propagate itself very slowly to the interior. In this case, the conductibility of the iron may be sufficient to equalise quickly enough the temperature of the interior walls. The alum placed at the bottom will be then heated before the other parts of the chest are too much inflamed, and, by giving up its water, it will produce an absorption of heat in proportion to its quantity. We learn that ammonia alum has been used for this purpose in our own country.—*Illustrated London News.*

MAGNESIUM AND ITS LIGHT.

We find in the *Mining Journal* the following able note on the New Oxide of Magnesium Light:—It is well known that the oxide of magnesium is practically infusible, and that it has the property of being volatilised, but in the smallest quantity, in a flame of oxygen and hydrogen mixed together, and without imparting any colour to that flame. The oxide has also the property of spreading, on being placed within the flame, an intense, bright, and constant light, and which is admirably suitable to photography. Many magnesium salts, and particularly chloride of magnesium and carbonate of magnesia, have the property of leaving some oxide of spongy magnesium on being decomposed by the oxyhydrogen flame. Availing himself of a knowledge of these principles, Professor Prospero Carlevaris, of Genoa, proposes to employ the process now to be described. A piece of chloride of magnesium, larger or smaller, according to the effects of light required, is placed upon a small prism of gas retort coal, and upon it, through a small tube purposely made, the flame of the oxyhydrogen gas (the mixture of oxygen and hydrogen) is directed; or a prism, or even a small and well-compressed cylinder, of carbonate of magnesia, is placed within the flame from the same mixed gases. The chloride of magnesium or the carbonate of magnesia is directly decomposed and resolved into oxide of spongy magnesium, from which the intense, bright, fixed, and constant light comes forth, causing all the chemical phenomena of diffused sun light. The gases of the said combination, which are pure hydrogen, or even ordinary illumination gas, and pure oxygen, or even atmospherical air, flow separately from two different gasometers, and are mixed only in a very small tube at the end of the pipes. They can be prepared in the ordinary way when wanted in small quantities; if wanted on a large scale, pure hydrogen is prepared by causing steam to pass over incandescent charcoal. Oxygen is prepared with manganese, and hypochlorite of lime with manganese and silicic acid, or with dry sulphate of iron, the products of whose decomposition are caused to pass upon platinated pumice-stone, turning to profit the sulphurous acid resulting from the process to the preparation of sulphites. The invention is, therefore, essentially the production of light, by placing the oxide of spongy magnesium in a flame produced by a mixture of oxygen and hydrogen.

Mr. H. Larkin has exhibited to the British Association two Magnesium Lamps, the distinguishing peculiarity of which is that they burn magnesium in the form of powder, instead of riband or wire, and do not depend on clockwork, or any similar extraneous motive-power, for their action. The stream of the metal powder is mixed with a small portion of gas and fine sand in its progress through the tube; they escape together at its mouth, where they are ignited, and continue burning with a brilliant flame. The price of the light is 1*l.* per hour.

The one thing needful for the success of this light seems to be some process that will produce it more cheaply than Sonstadt's process. It is the sodium that costs the money, and though Deville has said that sodium, if required in large quantities, could be produced at a very low price, yet, though it now is wanted in large quantities, no one has yet produced it at even a moderately low price, nor does it appear to be probable that it can be produced at a very low price; the iron tubes in which the reaction takes place are so rapidly destroyed. There is nothing left, then, but to try to reduce magnesium from one of its salts or its oxide by some method that will dispense with the use of sodium.

When the metal magnesium was first introduced in the arts it was expected by many persons that valuable alloys with other metals might be made by its employment. This prospect, however, has been finally dispelled by the investigations of Mr. Parkinson, who has made numerous experiments in the production of such alloys, and who finds that they are very brittle, and that most of them become black. The most permanent of those alloys is that formed with zinc; but even it does not seem capable of any useful application. Mr. Parkinson has also made experiments with compounds of magnesium with silica by igniting magnesium filings with fine sand. The compound when dropped into water generated siliciuretted hydrogen, which caught fire spontaneously on coming into the air.

Magnesium, by the way, is perhaps the only metal which occurs in commerce in a state of absolute purity. This peculiarity of commercial magnesium is leading to the introduction of the use of it, instead of zinc, for the detection of arsenic, and other poisonous metals, in toxicological analyses. Its entire freedom from admixture with any substance capable of simulating the appearance of either arsenic or antimony gives it a very great advantage, for use for this purpose, over the purest commercial zinc.

It has been estimated, says the American *Gaslight Journal*, that the ocean contains 160,000 cubic miles of magnesium—a quantity which would cover the entire surface of the globe, both sea and land, to a thickness of more than 8 ft. In obtaining salt from sea-water, the residuum is largely magnesium. It constitutes 13 per cent. of magnesian limestone—a rock found in all parts of the world in enormous quantities. Three years ago all the chemists who had obtained magnesium at all, had probably not obtained an ounce among them. One year ago its price was 112 guineas per pound. Now, owing to improvements recently introduced, magnesium wire is sold at 3*d*. per foot. It has been suggested that, when it shall be cheap enough, vessels of war should be built of it; for, whilst but little heavier than heart of oak, it is as strong and tenacious as steel.

MAGNESIUM RAILWAY LIGHT.

COMMANDER BAMBER, R.N., of Jersey, has constructed an apparatus whereby the light from the metal magnesium may be produced in a continuous stream, and rendered applicable and useful to many purposes; such as to throw a light through a railway tunnel by the engine-driver as a security against accident, to signal on railways, or from steamers or other vessels, for lighthouses, and any other purposes where such light may be required. The apparatus consists of an oblong case of wood or metal to contain the working parts; at one end of this case Commander Bamber arranges in suitable bearings a conical barrel or reel, around which the magnesium tape is coiled. In the middle of the case a standard is fixed containing two friction wheels placed one over the other, between which the tape is drawn from the barrel. The standard also supports in bearings a spring barrel from which rotary motion is communicated to the friction wheels; this spring barrel is wound by a key and secured by a paul and ratchet in the ordinary manner; an adjusting spring and screw are arranged to act on the upper friction roller to regulate the speed of the take-off motion; and a hand lever is employed whereby the working parts are set in motion and stopped. A guide is placed on each side of the rollers, and another close to the reflector. in order to lead the tape from the barrel and through the reflector in front of the instrument, above which a funnel or ventilator is placed, and beneath or under the reflectors there is a second ventilator, and an ash-pan to receive the refuse of the burning magnesium. It is thus obvious that by use of this apparatus a continuous light can be produced from magnesium, and thrown by the reflector to a great distance. The apparatus may be furnished with differently coloured lights, such as white, red, green, blue, or otherwise, in order to provide a code of signals to be determined on.

MAGNESIA CRUCIBLES.

THE earth magnesia has hitherto received very few applications in the arts – it has been confined, indeed. almost exclusively to medicinal use—but it is now, in the wake of its base, the metal magnesium, beginning to attract considerable attention from the more advanced labourers in the field of industrial chemistry. Deville's recent discovery of the remarkable hydraulic qualities of hydrated magnesia has already been recorded and illustrated, and we have to add that the plan of saturating citric acid with magnesia, so as to obtain a crystallisable bibasic citrate of that base, very convenient for transport to England as the raw material from which citric acid may be manufactured, is now being introduced in Sicily. M. Caron, whose very laborious researches with respect to the constitution of steel have excited so much interest at various times during the last few years, has just presented to the Academy of Sciences of Paris a paper on "Blisters in Steel," in which he alleges that blisters are never found in iron or steel which has been melted in magnesia crucibles. For his theory in explanation of this alleged fact we must refer the reader to the *Comptes Rendus* of February 5th. In the course of the discussion which followed the reading of the paper, M. Balard suggested that the floors of puddling furnaces should be made of magnesian bricks, floors of which material would last, he said, very much longer than the floors at present used; M. Henri Sainte-Claire Deville stated that magnesia crucibles, made by pressure, had been for some time in use in his laboratory, with the best results; and M. Regnault mentioned that magnesia crucibles had been made as far back as 1846 by Thilorier, who used them to melt platinum in.—*Mechanics' Magazine.*

PHOSPHORUS EXPERIMENTS.

In the *Philosophical Magazine* are described M. Hittorf's elaborate experiments on Phosphorus, by means of which he has obtained a crystallised form of this element. "There is it is said, "a metallic phosphorus, which is amorphous, Schrötter's modification, and crystallised in this new form, and a non-metallic form—that originally discovered by Brandt." Amorphous phosphorus, when heated for a long time, passes into the crystalline modification. M. Hittorf also states that Geissler, by placing colourless phosphorus-vapour in closed glass tubes, has changed it into red, by passing the electric spark through it while in the state of vapour.

PHOSPHORESCENCE OF SULPHURETS.

Several years ago M. E. Becquerel discovered that the Sulphurets of strontium and barium became Phosphorescent after exposure to intense light; and these phenomena were exhibited to the members of the Royal Institution by Professor Faraday, on June 17, 1859. At a recent meeting of the Paris Academy of Sciences, M. Becquerel reported that M. Sidot had discovered that the sulphuret of zinc has similar properties. He found that the central nucleus of a mass of this crystal presented a very intense phosphorescence, but that the edges were white and transparent and not so brilliant. The phosphorescence of the external layers was a deep blue, while that of the internal layers was colourless, except when the velocity of the phosphoroscope, was augmented. The solar spectrum projected on a surface covered with sulphuret of zinc behaved differently than when projected on the sulphurets of barium or strontium. Phosphorescent bodies, according to M. Becquerel, completely absorb the red rays, and give only a completely black band.

PHOSPHORUS IN IRON.

In the *Journal of the Chemical Society*, Mr. John Spiller describes a modification of the process usually employed in the estimation of Phosphorus in Iron and Steel, in which the acetic treatment is dispensed with; and whereby a saving of time is effected, without impairing the accuracy of the results. This method was introduced in the course of the extensive series of analytical examinations conducted under the direction of Professor Abel, the chemist of the War Department.

SAFETY LUCIFER MATCHES.

M. Gaillard suggests the making of a Safety Lucifer Match by dipping the stick into melted sulphur after the application of the phosphorus. The sulphur being insoluble in water, and not melting below 110 deg. Centigrade, would hinder the phosphorus from doing any harm if the matches were dropped into food; and the greater friction necessary to ignite such a match would be a safeguard against accidental ignition.

THE FENIAN FIRE.

The above is no myth, as the so-called Greek fire was thought by many to be. On the contrary, it is highly probable that the Greek fire known to have been used on several occasions in the late American war, and the formidable preparation which has obtained the name of the Fenian fire, are of similar composition. It is not unlikely that some rabid American Fenian, having ascertained what were the principal ingredients of the Greek fire, manufactured this compound, and introduced it to his brother Fenians as a fit mode of warfare to be adopted by themselves. It is a solution of phosphorus in bisulphide of carbon. The peculiar properties of the former are well known, while those of the latter, as being a comparatively recent chemical preparation, are not generally understood. The bisulphide of carbon is a highly inflammable liquid, colourless, and almost transparent, giving off fumes of sulphurous acid when burnt. It volatilises very rapidly at ordinary temperatures, and when its vapour is mixed with air, and a light applied, it inflames with a slight explosion. Its vapour is poisonous. The phosphorus dissolves readily in the bisulphide of carbon, if the temperature of the latter is slightly raised. The Liverpool detectives are reported to have seized, as they were being removed from a house in that town, three boxes, each containing 15 jars or cans of phosphorus. In each jar were 20 sticks of phosphorus, each stick being at least 6 in. long and 2 in. in circumference. Several bottles of the compound of phosphorus and bisulphide of carbon have also been seized, as well as some bottles of the latter without the phosphorus dissolved in it. These bottles were all of the same size and shape, were quite full, and held about three pints; had short necks and small mouths, and were made of green glass, probably having been manufactured for the purpose, as their shape was somewhat peculiar. Several experiments have been made at different times to test the properties of the compound. On one occasion one of the bottles was thrown against the centre of a high wall. A loud explosion followed, and the concussion and exposure of the fluid by the bottle breaking were sufficient to ignite its contents, when a flaming fluid streamed down the wall, evolving dense fumes of an irritating, poisonous nature. A stream of water from a large hose, which had previously been placed in readiness, was immediately directed against it, but some gallons of water had to be poured upon the wall before the flame was extinguished; and even some hours afterwards, when the day was darkening, a glimmering light was observed on the wall where the fluid had been, doubtless, given off by the phosphorus which had remained adherent, so highly charged with that substance was the fluid. It was further found that the compound ignites most rapidly when used in small quantities, spread over a large surface, and freely exposed to air; therefore, when poured upon cotton, tow, and similar materials, it ignited instantaneously.—*The Lancet.*

BORAX.

The greater part of the Borax of commerce was formerly obtained from certain salt lakes in India, Thibet, and other parts of Asia, the waters of which yield, on evaporation, a yellowish-white mass, containing from 30 to 50 per cent. of real borax (borate of sodium). This yellow mass was known in Europe as "crude borax," or "tincal," and was refined chiefly at Venice and Amsterdam. For a long time past, however, the borax of commerce has been chiefly prepared artificially, by treating with carbonate of sodium the boric acid obtained from the volcanic district of Tuscany. In that district vast numbers of jets of vapour are constantly issuing from clefts in the earth, and the boric acid is found in the pools of water which form round these "suffioni," as they are called. Latterly, the "suffioni" have yielded continually less and less boric acid, and hence considerable interest attaches to the discovery, just announced, of a lake in California which contains large quantities of borax, and yields it, by evaporation, in a state of almost absolute purity. Borax from this source will very shortly be introduced into commerce. —*Mechanics' Magazine.*

ALUMINOUS SOAP.

An English inventor has patented the addition of Alumina to Soap produced in the ordinary way, and we now find that the American Company which has recently entered upon the manufacture of soda from cryolite is making soap containing alumina by the simple method of using in the manufacture of the soap, not caustic soda, as in the ordinary process of soap-making; but, instead, the aluminate of soda, which is obtained by decomposing cryolite, in the presence of steam, by means of quicklime, and thus making soap.

PYROLIXINE.

Pyrolixine as a solvent is omnipotent to dissolve all manner of vegetable products, and in this respect it rivals the fabled alkahest or elixir of the alchemists, which was stated to be a universal solvent and to cure all manner of diseases to which humanity was subject. United with oil, it forms parksine, and with colour, produces the most successful imitations of ivory, amber, tortoiseshell, malachite, and many other natural substances.—See Memoir in the *Art-Journal.*

MANUFACTURE OF SODA.

Mr. Walter Weldon has read to the British Association a paper on "The Proposed Use of Fluorine in the Manufacture of Soda," and in the course of the discussion which followed, Dr. Macadam pointed out that a great advantage of the proposed process was, that it yielded the soda in the caustic state, and not as carbonate. A hope was expressed by several speakers that the process would succeed on the large scale, and it was observed that if it did the profit would be reckoned by millions.

BLEACHING.

A new Method of Bleaching has been announced by MM. Karcher, Jung, and Tegeler, in the *Chemisches Centralblatt.* They do not dispense with the use of chlorine, but endeavour to render its use innocuous, by previously submitting the vegetable fibre to the action of sulphuretted hydrogen or of bisulphuret of hydrogen; which is done by plunging the fibre into a bath of alkaline sulphur and afterwards adding an acid. For textile fibres a new hydrogenation is required after bleaching by chlorine.

WHALE POISON.

A new method of Killing Whales has been projected in France, and has been brought into successful operation in some late whaling voyages. A mixture of the woorali poison and of strychnine is inclosed in a small explosive shell, which is fired from a gun into the whale's body and there bursts. The poison, diffusing itself speedily, kills the whale, when it is towed alongside and cut up.

NEW BASE.

Dr. H. Müller has read to the Chemical Society a paper "On Hydrocyan Rosaniline," a colourless base, which he has succeeded in forming by the action of cyanide of potassium upon magenta crystals (acetate of rosaniline). In composition and properties it is somewhat allied to Hofmann's leucaniline. The salts of the new base were exhibited and described, and the author stated that he had been unable to prepare a similar compound from Perkins's aniline-purple.

NEW ALKALOIDS.

In looking for morphia, Hesse has discovered a new Alkaloid called Rhœadine, in the red poppy; it is also to be found, he says, in good opium. It is soluble in water, alcohol, and ether, crystallising from the last in white prisms. Ammonia precipitates it in white crystalline flocculi, bichloride of mercury gives a white amorphous precipitate, chloride of gold or yellow precipitate. Strong acids decompose it in the gold, giving a purple solution.

HYDRAULICITY OF MAGNESIA.

M. H. Ste. Claire Deville has published some facts respecting the Hydraulicity of the Magnesia, which has been obtained by M. Balard from the calcination of the chloride of magnesium (common salt) extracted from sea-water. This magnesia, in small compact masses, after having been kept in running water for several months, acquired the hardness and consistency of marble and became as translucid and crystalline as alabaster. Casts of medals, &c., taken in this magnesia are as durable as marble. When calcined to a white temperature for twelve hours, and then pulverised and formed into a paste, it lost the power of combining with water, unless it was left several weeks in contact with air, and even then it hardened very slowly.

MOULDINESS OF FRUITS.

M. Davanne has communicated to the Paris Academy of Sciences the results of his researches on the Mouldiness of Fruits. This phenomenon has been regarded as a simple chemical alteration, an exaggeration of ripening; yet fruit, perfectly ripe, carefully preserved, never becomes mouldy, but gradually becomes quite dry. Mouldiness is produced by the development of certain fungi, principally the mucor mucedo, which covers the fruit with a black efflorescence; and the penicillium glaucum, which covers it with a greenish efflorescence. This mouldiness is produced by the mycelium, which exists in all the parts attacked, and by the spores produced on the surface. The use of the microscope has enabled M. Davanne to follow the progress of the contagion, and correct erroneous views on the subject.

ENGRAVING ON GLASS.

ENGRAVING upon glass has hitherto been, not unfrequently, effected by the use of fluoric acid, which often produced dangerous wounds, when by accident it came in contact with the skin of the workman. M. Henri Sainte-Claire Deville has exhibited to the Paris Academy of Sciences some very fine examples of glass-engraving executed by means of a solution of the fluoride of calcium in hydrochloric acid, with which there is no such danger. The results obtained by this method are said to be exceedingly satisfactory.

RESEARCHES ON OZONE.

DR. DAUBENY has read to the British Association a paper on Ozone, in which he considered first the dependence of the amount of ozone present in the atmosphere on the direction of the wind; and proved, by tables registering the quantity during a period of eight months, that in Devonshire it abounds most during those winds that blow from the sea. He then proceeded to show that the ozone present in the air is derived, partly at least, from plants, the green parts of which generate ozone when they emit oxygen. From observations made on fifty-seven species of plants representing forty-seven natural families, it was concluded that a certain amount of colouration was produced upon Schoenbein's paper by leaves during the continuance of solar light beyond what could have been brought about by light alone; but that this colouration did not go on progressing at any definite rate, and even in certain cases diminished after a long exposure. Precautions were taken to exclude from the air of the jar any ozone that might come from without, and the effects produced upon the paper placed in tubes exposed to different light and in entire darkness were noted. It was shown that ozone was generated by the leaves only, and not by the flowers, of plants; and, upon the whole, it seemed to be fairly presumable that plants are the appointed agents, not only for restoring the oxygen which animals consume, but also, by generating ozone, for removing those noxious effusions which arise from the processes of animal life and putrefaction. In the discussion which followed, Mr. Glaisher stated that his meteorological investigations on the outbreak of cholera in 1854 went to confirm the conclusions arrived at by Dr. Daubeny in his paper. Where there was ozone he found abundant health, and where there was none a great deal of sickness prevailed.

M. G. Planté has communicated to the Paris Academy of Sciences a description of his method for the production of ozone, the chief point of which is the employment of electrodes of lead instead of electrodes of platinum, when ozone is sought to be obtained by the electro-chemical decomposition of water. He asserts that a larger proportion of the gas may thus be obtained.

A letter from M. Soret to Professor Tyndall gives an account of the researches, by which he has been led to conclude that "the density of ozone is once and a half that of oxygen."

At a meeting of the Paris Academy of Sciences, M. Boillot has reported some experiment relating to combustion, tending to show that Oxygen is not only a combustible principle, but is also a combustible gas. He says that oxygen is in no way to be distinguished from hydrogen, carbonic oxide, or any other of the gases susceptible of entering into combination with the disengagement of more or less light and heat. "Combustion is in reality only combination with a vibratory motion, so rapid as to result in heat. Oxygen unites with hydrogen as much as hydrogen with oxygen; neither burn, or, rather, both burn together."

PEROXIDE OF HYDROGEN.

Professor Schoenbein has discovered a new and very ready method of procuring the Peroxide of Hydrogen. It consists simply in agitating, in a large flask, to which air has access, amalgamated zinc, in powder, with distilled water. Oxygen is then absorbed by both the zinc and the water, with formation of oxide of zinc and peroxide of hydrogen. The peroxide of hydrogen obtained by this method, unlike that obtained by the ordinary process, is quite free from acid, and so may be kept for a long time without decomposition. It does not contain, moreover, a trace of either zinc or mercury, but is absolutely pure. This new process has therefore great advantages over the old process of preparing peroxide of hydrogen, both as being far simpler and more expeditious, and as yielding a much purer product; but it is almost as far as the old process from yielding peroxide of hydrogen cheaply enough for use in the arts.

ABSORPTION BY CHARCOAL.

Mr. John Hunter, of Queen's College, Belfast, has published in the *Journal of the Chemical Society* an account of his experiments on the Absorption of Vapours by Charcoal, a property which had been observed by Priestley, Scheele, and other chemists. Mr. Hunter's object was to obtain greater absorptions than any previously known, by using charcoals made from very dense and hard woods, such as logwood, ebony, and boxwood. He found that the charcoal made from the shell of the cocoa-nut had by far the greatest absorbing power. It is very dense and brittle, the pores are quite invisible, and, when broken, the edges present a semi-metallic lustre. Having examined the absorption of a large number of gases, he extended the inquiry to the absorption of vapours, and gives the results in tables. He found that the absorption of vapours by charcoal terminates in a much shorter time than in the case of the permanent gases.

FRICTION OF GASES.

THE Royal Society's Bakerian Lecture has been given by Mr. James Clerk Maxwell, "On the Viscosity or Internal Friction of Air and other Gases." From the abstract which has appeared in the Society's *Proceedings*, we learn that the conclusions which are drawn from experiments agree, as far as they go, with those of Mr. Graham on the transpiration of gases. The coefficient of viscosity is independent of the density, the temperature being constant, but increases with the temperature. The coefficient of the viscosity of hydrogen is much less than that of air. Mr. Maxwell gives details of his method of experimenting, and the calculations founded thereon.

VITALIZING AIR.

IN his inaugural address at the British Association, Mr. Grove mentioned a fact which may surely be made practically useful. "Atmospheric air, drawn through films of India-rubber, leaves behind half its nitrogen, or, in other words, becomes richer by half in oxygen." Mr. Grove spoke of this truth as pointing out a means of storing up force; but is not its sanitary value even greater than the possible mechanical uses to which Graham's discovery may be put? Men, so long as civilisation lasts, must continue to live in imperfectly oxygenated air. Why, asks a reflective writer in the *John Bull*, should not the air which enters crowded rooms, churches, &c., be passed through India-rubber, just as in the "City peach-houses and graperies" proposed some years ago, there were flannel screens to catch the carbon with which the air of towns is saturated? Does the India-rubber touch the carbonic acid? And does it at all ozonise the oxygen which it allows to pass through? Even if it does not, surely some way may soon be found, if needful, for at any rate partly vivifying the oxygen when it is present in such quantities. Why not try the India-rubber films in Spitalfields work-rooms and Mile-end lodging-houses?—*Builder*.

GAS IN MAKING COFFEE.

A REMARKABLE communication has been made by M. Babinet to the Paris Academy of Sciences, on the evolution of Gas in the process of making Coffee. If cold water be poured on roasted coffee finely ground, such as is generally used with boiling water, a considerable quantity of gas is generally evolved, about equal in volume to the amount of coffee used. If a bottle be half filled with this ground coffee, and cold water be then poured in until the cork is reached, which is to prevent the escape of the gas, a violent explosion, sufficient to force the cork out of the bottle, or even to break the latter, will result.—*Athenæum*.

GAS-CARBURETTING APPARATUS.

VARIOUS ways have been tried to add Carbon to ordinary Gas, n order to increase its brilliancy. One was to pass the gas through an apparatus where a large surface of a liquid rich in carbon was exposed. This acted very well at first, the gas taking up large quantities of the hydro-carbon vapour; but the more volatile of this being consumed first, and only the heavier and less volatile portion of the liquid being left behind, it necessarily yielded less and less vapour, and the gas became poorer and poorer, until it ceased to be in any degree improved. To obviate this, in the present carburettor, Mr. Welch, the patentee, places a reservoir over the apparatus, from which, by a simple arrangement, the liquid descends only as required to maintain the proper supply of vapour. Various plans have been devised to effect this, but none so simple or effective as the present. The gas, as it leaves the meter, enters the carburettor on one side; and, passing through the interior, comes out again the other side where it enters the pipes supplying the house. Beyond refilling once a month the carburettor requires no attention. By experiments the following results have been proved:—The illuminating power of ordinary gas being taken as 1·0, ordinary gas : 1 : : 3·6. That is, gas passed through this carburettor acquires an illuminating power of more than 3½ times that of ordinary gas. But the 1000 ft. of gas consumes only one-third of a gallon of liquid. Therefore the cost of ordinary gas being taken at 4*s.* per 1000 ft., and the liquid being 3*s.* 6*d.* per gallon, the cost of 1000 ft. of carburetted gas is 5*s.* 2*d.*, for which light is obtained equal to that of 3,600 ft. of ordinary gas, costing 14*s.* 4¾*d.* The saving is therefore 9*s.* 2¾*d.*, or over 60 per cent. Consequently, burners of about half the size of those at present in use, with ordinary gas, will, with carburetted gas, give a much brighter, purer, and clearer light.—*Patentee's Circular.*

THE "AUGASMA" LIGHT.

This new Light is produced by causing atmospheric air to take up a certain quatity of a hydro-carbon liquid in the form of vapour, which causes it to burn like ordinary gas. The attempt had long been made, but without success, owing to the imperfect nature of the apparatus employed; every difficulty is now stated to have been entirely overcome by Mr. Welch, the patentee of the carburettor just noticed, who has constructed an apparatus which fully answers the purpose; to this he has added a simple and compact machine which keeps up the supply of air at an even and sufficient pressure.

For domestic and general purposes the Augasma is a very brilliant illuminator; a single burner of the Parliamentary Standard giving a light equal to 23 sperm candles, while the light of ordinary gas with the same burner only equals from 14 to 17.

The extreme purity of the Augasma light consists in the total absence of all sulphureous and ammoniacal vapours, so that in combustion it gives forth none of the sulphuretted hydrogen, which in ordinary gas is so prejudicial to health and injurious to house decorations, paintings, gilded frames, and almost every description of shop goods. For the same reason, says the inventor's circular, it is well adapted for conservatories, its extreme purity rendering it perfectly innocuous to plants.

The apparatus is simple, compact, and portable, easy of management, and can be attached to gas pipes in common use; thus supplying a whole house with a light far more brilliant than gas, devoid of smoke, smell, or tarnishing properties, and free from the risk of explosion. The light is invaluable for railway trains, steamships, and other passenger vessels. A simple apparatus has been designed for trains, when running or stationary. In ships the apparatus is suspended as are ships' barometers. The cost of this light little exceeds that of coal gas.

POISONOUS PARAFFIN.

Dr. Stevenson Macadam has read to the British Association a paper "On the Poisonous Nature of Crude Paraffin Oil and the Products of its Rectification upon Fish." The great extension of paraffin oil works, both crude and refined, during the last few years, has led to attention being directed to the nature of the discharges which emanate from such, more especially to those matters which find their way into rivers which form the natural drainage of the district. The deleterious nature of these discharges has manifested itself already in the total destruction of all fish in more than one of our Scottish streams; and to the impregnation of the water with paraffin oil, and the products of its rectification to such an extent as to impart the characteristic taste and odour of paraffin to the water, and rendering it unsuitable for domestic purposes. He described at considerable length the nature of the discharges from paraffin works, and then proceeded to say that the importance of the subject would probably soon be greater than what it is at present, as the manufacture of crude paraffin oil in conjunction with gas has already been introduced into one of the gasworks in Scotland. The coal used was the Newcastle or cannel coal, which yielded, when distilled in gas retorts at a bright cherry-red heat, about 11,000 cubic feet of gas, with an illuminating or photogenic power of thirty-four standard sperm candles for every 5 cubic feet of gas burned during every hour. When distilled, however, at a low or black-red heat in large retorts, as in ordinary paraffin oil works, the coal yields only 3,000 to 3,500 cubic feet of illuminating gas, with the photogenic power of thirty candles for every 5 cubic feet burned during the hour; so that two-thirds of the total quantity of gas capable of being yielded by the coal is sacrificed, but in place thereof there are obtained about 60 gallons of crude paraffin oil, with a specific gravity of 900 to 905. The gasworks in question are virtually crude paraffin oil works, in which the gas is utilised; and as the change in the mode of working the coal appears to be profitable, there is every reason to consider it likely that other gasworks will follow the example, and become virtually crude paraffin oil works, with refiners attached thereto.

MEAT PRESERVED BY PARAFFINE.

A PROCESS for Preserving Meat by means of Paraffine has been invented and patented by Professor Redwood, of the Royal Pharmaceutical Society. It consists in immersing fresh meat in melted paraffine at a temperature of about 240° Fahrenheit for a time sufficient to concentrate the juices and completely exclude the air; after which the meat is covered with a film of paraffine, which prevents re-absorption of the air. The concentration may be carried on to any extent by extending the time during which the meat is kept in the bath of paraffine. For long keeping in hot climates the weight of the meat should be reduced to about one half by concentration, in which state the nutritive properties of one pound will be equal to about two pounds of meat in the original state, the loss being merely water. Less heating and concentration suffice for cool climates and for a shorter time of keeping. When prepared for hot climates the meat is fully cooked, but it may be conveniently converted into made dishes. In its less condensed condition it requires only half the usual cooking to become roast or boiled meat. The paraffine employed in the process is colourless and tasteless, and is readily removed from the surface of the meat by immersion in boiling water. Samples of meat thus prepared have been sent to South America and returned to England in good condition; and Messrs. Gillon and Co., the preserved provision merchants, of Leith, reported recently that samples of beef and mutton, preserved by paraffine by Dr. Redwood, were perfectly sound after having been seventeen days in their hot testing-room, exposed to a temperature of about 100° Fahrenheit, and they expressed their confidence "that these specimens would remain good in any climate, even in the tropics."—*Illustrated London News.*

NEW HYDROCARBONS—NEW CHEMICAL PROCESSES.

IN the *Journal of the Chemical Society*, Mr. C. Schorlemmer reports his discovery of a series of hydro-carbons of a high boiling point in crude benzole, by treating with concentrated sulphuric acid the light oils formed by the destructive distillation of cannel coal at a low temperature. These hydro-carbons were isolated in the form of white needle-shaped crystals by means of bromine.

In the *Bulletin of the Chemical Society of Paris*, M. Berthelot gives some additional facts relating to the history of the remarkable hydro-carbon inflammable gas acetyline; and Professor De Wilde describes several new methods of producing it, as well as the singular action of hydrogen upon acetyline when under the influence of platinum black. M. Berthelot also reports his researches on a new series of compound metallic radicals. Classified under the heads of mineral, organic, physiological, technological, and photographic chemistry, we have in this bulletin analyses of a large number of memoirs by the most eminent chemists of the world. Among the recent applications of chemistry we learn that M. Ehrhardt forms a gunpowder of equal parts of chlorate of potash, nitrate of potash, and tannin; that M. Shaler has proposed a method of preserving meat, fruit, &c., by inclosing them in carbonic acid at the freezing temperature; and that M. Knab has invented a process of condensing dry ammonia gas in chloride of lime, thus forming a portable powder.—*Illustrated London News.*

NEW MODE OF NOTATION.

PROFESSOR FRANKLAND, in his contributions to the Notation of organic and inorganic compounds, after stating that the typical formulæ now generally used to represent the different great families of organic compounds are far from fulfilling their functions in an equally perfect manner, describes a new mode of notation, which shall not only represent the atoms composing a body, but shall also indicate their internal arrangement, and the mode in which they are held together. This is effected by printing the "grouping element" in thicker type; and by employing signs to express the "bond" and the degree of its power, &c.

PRODUCTS OF PETROLEUM: CHIMOGENE.

BY condensation of the gases first coming off from Petroleum, Professor P. H. Van Der Weyde, of Girard College, United States, has succeeded in obtaining a liquid which boils at only 40°, and produces most intense cold upon evaporation. It has been named Chimogene. By applying heat to the petroleum, and gradually increasing it, there is obtained in succession gazoline (an inflammable and explosive liquid, which may be used without danger in metallic lamps filled with sawdust) naphtha, benzine, kerosene, and paraffin, leaving only coke behind. Petroleum itself is the best lubricator known, and is applicable alike to the most delicate mechanism and to the heaviest machinery; whilst, by slow distillation, at a low temperature, hair oil, liniment, and a petroleum castor oil, have been obtained; and from petroleum benzole, treated with a suitable acid, "extract of bitter almonds" is produced, and largely used for flavouring.—*Mining Journal.*

NATURAL GAS-LIGHTING.

THE inhabitants of Baku, on the Caspian Sea, have utilised the emanations of carburetted hydrogen gas which rise from the waters, for lighting purposes. The gas is collected by means of large funnel-mouthed tubes, which are attached to floating rafts and dip some feet into the water. Baku, it may be remembered, was the sacred city of the Guebres, or Fire-worshippers, and the neighbourhood abounds with naphtha springs and "blowers," as they are called in the north of England, which consist of streams of inflammable gas issuing from the ground. The most extensive of these "blowers" is known by the name of the "perpetual fire," and is situated some miles to the north-east of Baku. It is an object of great veneration, and is said never to have been extinguished.

THE LIME-LIGHT.

A METHOD of compressing oxygen and hydrogen gas into separate cylinders, to be used in the production of the Lime-light, has been introduced into American commerce, the cylinders employed being of iron, 9 in. diameter and 30 in. long; and the gases are condensed to a pressure of thirty atmospheres. The lime-light was used with excellent effect during the late war in America, especially in the attack upon Fort Wagner, where, after the sap had been approached to within 250 yards of the fort, further advance was prevented, from the trench being enfiladed by the guns at one end or other of the fort. Two lime-lights were then so placed as to throw a strong light upon the points from which the fire proceeded, while the trench was kept dark; and the gunners in the fort were thus exposed to so deadly a fire from riflemen properly posted that the cannonade ceased during the night, and the sap was thus carried with impunity so near to the fort that it was abandoned.

ON DISINFECTANTS.

DR. CROOKES has read to the British Association a useful paper on Disinfectants, recommending antiseptics, such as the tar acids, particularly carbolic acid, in preference to the oxydising agents, chloride of lime or permanganate of potash. "In practical work," he observed, "these disinfectants are always very inadequate, except for a short time after their application; at other times the oxydising agent has presented to it far more noxious material than it can by any possibility conquer; and being governed in its combinations by definite laws of chemical affinity, the sulphuretted and carburetted nitrogen, and phosphorus bases, and other vapours of putrefaction, will all have to be burnt up before the oxydising agent can touch the germs of infection, whilst the continued renewal of the gases of putrefaction will constantly shield the infectious matter from destruction. Oxydising disinfectants produce their effect by the actual destruction of the infectant substance. Antiseptics act by destroying its activity. In the presence of carbolic acid the development of embryotic life is well nigh impossible, and before its powerful influence all minute forms of animal existence inevitably perish. If the infectious matter of cholera be possessed of organic vitality, as is now almost universally admitted, it will be destroyed beyond the probability of a revival when brought into contact with thisvapour."

The antiseptic properties of carbolic acid are supposed by some to have been only recently discovered, but the fact is that, from time immemorial, carbolic acid, creosote, or bodies containing them, have been used as antiseptics. Passages in Pliny, read by the light of chemical science, show that the Egyptians used for embalming their mummies a compound made from pitch, which must have contained large quantities of creosote. Carbolic acid is the active agent in tar, which, either in its ordinary state or burnt as a fumigator, has always held high rank amongst disinfectants.

DEODORISATION AND DISINFECTION.

AUTHENTIC opinions on the above subjects cannot be too widely disseminated. We therefore give the advice of Dr. J. H. Barker, who, in his prize essay on "Deodorisation and Disinfection," sums up the results of several series of experiments in the following propositions:—1. For the sick room, free ventilation, when it can be secured, together with an even temperature, is all that can be required. 2. For rapid deodorisation and disinfection, chlorine is the most effective agent known. 3. For steady and continuous effect ozone is the best agent known. 4. In the absence of ozone, iodine, exposed in the solid form to the air, is the best. 5. For the deodorisation and disinfection of fluid and semi-fluid substances undergoing decomposition, iodine is best (employed in the form of tincture). 6. For the deodorisation and disinfection of solid bodies that cannot be destroyed, a mixture of powdered chloride of zinc, or powdered sulphate of zinc with sawdust, is best. After this, a mixture of carbolic acid and sawdust ranks next in order, and, following on that, wood ashes. 7. For the deodorisation and disinfection of infected articles of clothing, &c., exposure to heat at 212° Fah. is the only true method. 8. For the deodorisation and disinfection of substances that may be destroyed, heat to destruction is the true method.

SULPHATE OF IRON AS A DISINFECTANT.*

GREAT attention is paid, and with reason, in this country, in Holland, and in Belgium, to the disinfection of stalls and of the excrements of animals of the bovine race infected with typhus, in order to arrest the ravages of this terribly contagious malady.

The use of phosphoric acid, which is proposed for this purpose, is rational in that it enriches the manure, but not if you consider the expense, the difficulty of transport, and the many precautions necessary in handling it. Sulphate of iron, on the contrary, is of insignificant value (say a farthing per pound), economical, and easy of employment; and, having great effect upon all animal matters, would completely purify the infected

* See, also, "New Disinfectant," at page 103.

places and the manures of animals suffering from typhus. It does not injure the manure, but conserves its most energetic parts by converting the carbonate of ammonia into sulphate of ammonia, a fixed salt, which is easily appropriated by the plants.

It was in 1845 that Mr. Schattermann, director of the mines of Bouxwiller, departement du Bas-Rhin, proposed the disinfection of fecal matters and of manures by means of sulphate of iron, and since then this salt has been generally employed in France for this purpose, as well as to purify the slaughter-houses, ditches, and all places where noxious emanations arise. Its use is very simple. Dissolved, it gives a very acid liquid that can be handled without danger, and which penetrates everywhere when used to wash the infected places, or to mix with the manures.

When the cholera was at Marseilles, great quantities of sulphate of iron were used, not only in France, but also in Switzerland and in Germany, to disinfect closets, slaughter-houses, and all places giving off noxious emanations, and with perfectly satisfactory results.

If cattle that have died from rinderpest were saturated with a solution of sulphate of iron, they might be removed with perfect safety, even in the day-time, and the cost of disinfection would be some few pence only.—*Communication to the Builder.*

NICOTINE.

M. Melsens, a French chemist, has found that tobaccos from various countries contain Nicotine in very different proportions. In tobacco from some parts of France there is 7·96 per cent. of nicotine; while Havana tobacco contains only 2 per cent. He proposes to smokers a way of preserving them from the effects of the alkaloid, by putting into the tube of the pipe or cigar holder a little ball of cotton, impregnated with citric and tannic acids. As the smoke passes through the cotton, it will deposit the nicotine therein, in the shape of the tannate and citrate.

METHYLATED SPIRITS.

There is a provision in a recent Act of Parliament against the use of Methylated Spirits, either as a beverage or as a medicine. By the 29th and 30th of Victoria, chap. 64, it is declared that no person shall use methylated spirit or any derivative in the manufacture, composition, or preparation of any article whatsoever, capable of being used either wholly or partially as a beverage or internally as a medicine, or shall sell or have in his possession, under a penalty of 100*l.*; and the article, as well as the vessel in which the same is contained, to be forfeited. The provision is not to apply to the preparation of sulphuric ether or chloroform, or to affect the power of the Commissioners of the Inland Revenue to allow methylated spirit to be used by persons authorized by them in such branches of the arts and manufactures of the United Kingdom as they may sanction or approve. No alteration is to be made in the mixture called "finish," made from methylated spirit.

The Pharmaceutical Society, in drawing attention to this important Act, states that so stringent are the regulations of the Commissioners of the Inland Revenue on the subject that the Board will not allow the spirit to be used in the preparation of medicines for internal use for even cattle. Methylated spirit may, however, be used in the preparation of medicines for external application for both man and beast. For burning in lamps, and for use in our anatomical museums, in the preservation of specimens, it has been found a great boon. The saving effected in the Museum of the Royal College of Surgeons alone has been very great; where formerly as much as 25*s.* per gallon was paid for the pure strong spirit, the methylated can now be obtained for about 4*s.* 6*d.* Notwithstanding the nauseous taste of the article, attempts have frequently been made to disguise it, but ineffectually.

Heavy fines have been levied upon persons for selling methylated spirits to be used as an intoxicating liquor; it is much employed in the adulteration or "making up" of spirits.

ETHER AND CHLOROFORM.

At the Paris Academy of Sciences, M. Sedillot has communicated a paper containing the results of his investigations into the respective merits of Ether and Chloroform as anæsthetics; giving reasons based on facts, proving, in his opinion, the great superiority of the latter, as acting more swiftly, surely, and safely. The recovery from its effects are slow and quiet, while that from the effects of ether are frequently sudden and violent. We learn that M. Velpeau has declared that he has employed chloroform for above fifteen years, in several thousands of cases, and has not lost one patient.—*Illustrated London News.*

FORMIC ETHER.

A method of producing Formic Ether has lately been described which consists in mixing 14½ parts of binoxide of manganese with 4½ parts of starch, on which is then poured a cooled mixture of 14 parts of sulphuric acid, 2½ parts of water, and 7½ parts of alcohol. The materials are stirred together and placed in a still, when alcohol first comes over, and then formic ether. Heat may be applied to the still, if required.—*Ibid.*

WATER OF THE RED SEA.

MM. Robinet and Lefort have forwarded to the Paris Academy of Sciences the following results of their analysis of a litre of the water of the Red Sea: chloride of sodium (common salt), 30·30 grammes; chloride of potassium, 2·88; chloride of magnesium, 4·04; bromide of sodium, 0·06435; sulphate of lime, 1·79; sulphate of magnesia, 2·74; and traces of carbonate of soda and chlorhydrate of ammonia. Comparison has shown that, except a little higher mineralisation, the Red Sea possesses the same composition as the Mediterranean, and differs entirely from that of the Dead Sea. This permits the rejection of the hypothesis of there being any subterranean communication between the three seas at the present epoch.—*Ibid.*

LONDON WATERS.

PROF. FRANKLAND has offered to the Chemical Society some "Observations on the London Waters," which took the form of a series of deductions from his own and Dr. A. W. Hofmann's analyses during the past year. The most important fact elicited was the augmentation of total impurities, and especially of organic matter, during the winter months; and that the ordinary effect of rainfall upon the rivers was not to diminish, but to increase the amounts of solid matters, both in solution and suspension. The water-supplies drawn from the artesian wells of Kent and South Essex were nearly constant in composition throughout the year. Further observations upon the same subject were offered by the President, Dr. Attfield, and Prof. Way.

"ANGOSTURA BITTERS."

MESSRS. DUDGEON have written to *The Times*, *à propos* of Dr. Gavin Milroy's communication to the *Lancet* journal on "suitable drinks" in cholera seasons, to recommend one which they have used largely among their workmen at Millwall and Cubitt-town with the most beneficial effect; these districts are in the very centre of the cholera field. They speak of it as "the Angostura bitters imported from Venezuela, which have long been known and extensively used as a preventive for diarrhœa in the West Indies and South America, where this disease periodically prevails. From the small quantity required, it is a very cheap, agreeable, and effective remedy for a fearful and dangerous disorder." The Angostura bark is better known as Cusparia bark (the bark of *Galipœa cusparia*), and is esteemed in medicine as a substitute for other vegetable tonics, especially cascarilla and calumbo; it yields by infusion a very pure vegetable bitter. Its history in this country, however, suggests a caution which it may be well to make known. It was brought here in 1788, where, for some time, it was held in great esteem. But in 1804 numerous cases of poisoning having occurred with symptoms like those produced by strychnia, and which were traced to the admixture of the bark of the nux vomica tree with the true Angostura, the latter fell into disrepute, and has ever since been but little used even in Europe, and still less in the United States (Stillé). The use of Angostura bark was forbidden in 1804 in Hamburg, and in 1815 in Austria, Bavaria, and

Würtemburg, in consequence of repeated cases of poisoning occurring from the substitution of false Angostura bark—that is, strychnia bark. The differences are shown in a comparative table in Pereira, but they are not very well marked except to the expert. Hence some caution may be necessary in adopting these bitters as a common drink. Among the tests for distinguishing the true and wholesome from the false and poisonous bark, the simplest is this:—"The inner surface of Cusparia (Angostura bark) touched with nitric acid does not become blood red;" the false does.—*Lancet.*

ARTIFICIAL DIAMONDS.

At page 118 has been given a note on the origin of the diamond, by M. Goeppert; and an account of a remarkable yellow diamond, exhibited to the Paris Academy, with its extraordinary change of colour, explained by M. Gallardo Bastant. Next is a brief abstract of M. Chancourtois' memoir on the production of diamonds in nature, with a suggestion for chemists and electricians to produce diamonds by artificial means, of which the following process appears to be a realisation. Such is the process which has been tried and reported on to the Paris Academy of Sciences, in which sulphide or sulphuret of carbon has been used, but without additional carbon. "M. Lionnet," says *Galignani*, "has communicated to the Academy a process of his for obtaining pure carbon (diamond) in a crystallised state. His plan consists in taking a long and thin gold or platinum-leaf, rolling upon it a thin piece of tinfoil, and putting it into a bath of sulphuret of carbon. The liquid is decomposed under the influence of the weak electric current thus excited; the sulphur combines with the tin; and the carbon is deposited in crystals at the bottom of the vessel. The author thinks diamond must be produced by nature in a similar way." According to this report, artificial diamonds have actually been got by means of galvanic and chemical action from sulphide of carbon.

NEW SUBSTITUTE FOR COLLODION.

M. Persoz, Fils, has recently discovered a method for obtaining a material possessing the same characteristic qualities as collodion. *La Lumière* says: "This new substance is produced by dissolving silk in a suitable solvent, and then separating the latter by means of dialysis. If the film be of a certain degree of thickness it assumes on dyeing a golden tint, but this would no doubt be scarcely perceptible in a thin film, such as would be used in photography. The solvent chosen by M. Persoz is chloride of zinc, which, when kept at a warm temperature, readily dissolves the silk, but, if the solvent be not formed, the silk takes a much longer time to dissolve. Before employing the chloride of zinc it is heated with a small quantity of oxide of zinc, in order to neutralise any excess of acid in the chloride, and then filtered through a piece of fine cambric to remove the superabundant oxide. To separate the chloride of zinc from the solution of silk, M. Persoz has recourse to Professor Graham's method of dialysis. The apparatus for dialysis, which is a kind of sieve, is made by means of a broad strip of gutta-percha, bent round and cemented in the form of a cylinder, at one end of which is fixed a disc of parchment to form the bottom. The apparatus is floated upon a vessel of water, and the silk solution, previously diluted with water to the consistency of collodion, is poured into it. The chloride of zinc percolates through the moistened disc of parchment, and mixes with the water in which the apparatus is floating. In a few days the whole of the chloride of zinc will be found to have become separated from the silk solution; but the presence of a slight quantity of the chloride in the material is of no great consequence, as it merely gives rise to the formation, in the sensitive film, of a minute quantity of chloride of silver. Although M. Persoz does not mention the fact, there is no doubt that a dry film of this substance would be quite insoluble in water. Its employment is very simple. It is first iodised by mixing with it an aqueous solution of iodide, and then dried and sensitised. The exposure and development are conducted in the ordinary manner."—*Mechanics' Magazine.*

RESEARCHES IN PHOTOGRAPHY.

Harmonious and Artistic Photographs.—Mr. A. Claudet, in a communication to the British Association, says, "Perfection in the portrait would be attained, were it possible to do so, first by taking the image of the nose, then, after having altered the focus, the image of the eyes, and finally, after again altering the focus, the image of the ear; then, from these various images, forming a collective portrait. Such an idea may appear impracticable, possibly even absurd, and it is sure, on first thought, to be rejected and condemned." Yet the author seriously proposes its adoption as one of the greatest improvements which will have been introduced in photography since its discovery.

White Tablets.—In a paper read before the Philadelphia Photographic Society by Mr. Wenderoth, he gives the following as the method by which he prepares White Tablets for photographs. He coats the plate—a ferrotype or a glass plate—with a solution of albumen one ounce, water five ounces. He then adds to plain collodion so much fine precipitated chalk as will make a covering thick enough to prevent the plate from being seen through it. It should be poured on in the same manner as ordinary collodion, and care taken to prevent lines from being formed. Before coating, the collodion should be well shaken up, and then allowed to subside for a minute or two, to allow the heavy particles to fall to the bottom. When quite dry, coat with twelve parts of albumen and eight parts of water, adding two grains of clhoride of ammonium to each ounce of the solution. Sensitise for one minute in a seventy-grain ammonia-nitrate of silver bath; then fume, print, and tone in the usual manner.

Nitrate of Silver, which is so extensively used in photography, is by no means sold in the shops in a pure state, and photographers who wish to procure superior copies should therefore purify it. The following is Mr. Maxwell Lyte's process for the purpose:—The trade article is first partially purified by crystallisation; it is then redissolved to saturation in boiling water, and 1 per cent. of nitric acid is added. The liquid is constantly stirred while cooling. A crystalline powder is gradually deposited, which is collected on a filter, and washed with water acidulated with 10 per cent. of nitric acid. The salt thus obtained is chemically pure.

Fixing.—A great novelty is expected from Italy, and consists in a method of fixing photographic prints with chloride of sodium. The *Chemical News* states that it is the invention of Signor Roncalli, who takes his prints from the frame, and places them in a 5 per cent. solution of chloride of sodium, leaves them there some time in the cold, and then gradually heats the bath, finally boiling for about ten minutes; after which the print is completely fixed!

Photography and Painting.—Messrs. Groom and Lucas, of Wigmore-street, have published a set of photographs taken from well-known pictures by modern painters, which evidence the high state of perfection to which the photographic art has attained. Of course, many attempts to reproduce paintings by the aid of photography have been made previously; but in general the result has been unsatisfactory, the copies presenting merely flat colourless designs. Messrs. Groom and Lucas have succeeded in avoiding this disappointing effect by some variations of the processes usually employed. Thus, instead of attempting to copy a picture on the open air, with the light falling upon it from all directions, they have placed the picture as nearly as possible in a similar light to that in which it was painted; and by that means the differing thicknesses of paint, which in the picture contribute greatly to the effect of the whole, are reproduced in the copy in light and shade.

The Magic Photographs are produced from prints on albumenised paper obtained in the usual way, and then treated with a solution of bichloride of mercury, or "corrosive sublimate." The print, on being removed from the negative, is first carefully washed in a dark room, to remove all the free nitrate of silver, &c., and is then immersed, also in a dark room, in a bath consisting of eight parts of a saturated solution of bichloride of mercury, and one part of hydrochloric acid. This bath "bleaches" the print,—not, however, by destroying the image, but by converting the substance of which its dark parts are formed into a colourless double salt of silver and mercury. As soon as this bleaching process is complete, the paper upon which is the now invisible print is thoroughly washed, and is then dried in the dark, when it is ready to be packed for sale. As its surface is still slightly sensitive, it is packed between folds of orange-coloured paper, to preserve it from the action of light. With it is sold a piece of white blotting-paper which has been dipped in a solution of hyposulphite of soda and then dried. On placing this piece of blotting-paper on the surface of the piece of albumenised paper on which is the invisible picture, and dipping the two together into water, the hyposulphite of soda in the blotting-paper instantly acts upon the whitened picture, rendering it of a sepia tint, and so causing it to reappear in all its original detail.

New Lights.—Wilde's Magneto-electric Light is used by Mr. Woodbury, at Manchester, for the production of the gelatine reliefs used in his photo-printing process; and he finds, it is said, that he can get much sharper reliefs by means of the magneto-electric light than by means of sunlight. Moreover, the former has, of course, the great advantage over the latter of being equally available in all weathers, at all seasons, and at all hours of the day or night. Messrs. Saxon and Co. also use it, for the production of "enlargements" for "the trade," and we are told that "the possession of a permanent light, night and day, enables them to guarantee the return of negative and print within twenty-four hours."

Mr. G. Wharton Simpson, the editor of the *Photographic News*, has published an account of an experiment, the main value of which consists, not so much in its having resulted in the successful photographic reproduction of colour as in its showing that a layer of the violet sub-chloride of silver, upon none but surfaces at least chiefly composed of which substance has it hitherto proved possible to obtain chromo-photographs, can be obtained by simply exposing a layer of ordinary chloride of silver to diffused daylight for a short time. The process by which MM. Becquerel and Niepce de Saint Victor have obtained the films of violet sub-chloride, by means of which they have from time to time obtained such exquisite photographs in natural colours, is a complicated and troublesome one, and also very costly.

A new light, proposed as a substitute for the magnesium light, is thus described:—Nitrate of potash in powder, and well dried, 24 gms.; flour of sulphur, 7 ditto; red sulphuret of arsenic, 7 ditto. These three ingredients, being well ground together, the mixture, on being ignited, will yield a most powerful photogenic light; but 200 grammes of the compound are necessary to make the light last half a minute. The cost of the mixture is not more than 80 centimes per kilo., which would last two minutes and a half, while light from magnesium wire costs about 1*s.* per minute.

A new light is recommended by M. Sayers, derived from a compound consisting of twenty-four parts of dried nitrate of potash, seven of flowers of sulphur, and seven of sulphurate of arsenic. This light is said to possess great photographic power.

Geometric Plans.—The optician, Chevalier, of Paris, has arranged an apparatus for taking Geometric Plans by Photography. The instrument is provided with a meridional telescope, and a compass in order to set it to any given point; a circular collodionised glass is placed horizontally at the bottom of a camera obscura, formed of copper, and moved by clockwork, so as to describe within a given time the entire circle of which the station chosen is the centre; and the various objects, as they are received in turn by the lens, are photographed on the circular plate through an extremely narrow slit in the side of the copper box. The operation is to be repeated at three stations, in order to avoid error, and the result is said to be highly satisfactory. The three circular plates are then used to lay down on paper all the points of the plan described. The same instrument working vertically, instead of horizontally, serves also for levelling.—*Society of Arts Journal.*

Natural Colours.—M. Poitevin has reported to the Paris Academy of Sciences some facts of great importance in the production of Natural Colours in photographs on paper. The reaction consists in causing light to act on the chloride of silver violet deposited on paper in the presence of an oxygenated salt, whereby colours are produced resembling those obtained on plates. M. Edmond Becquerel, while remarking on this process, with a certain degree of hesitation as to its complete success, expressed his conviction of its tendency to increase our knowledge of the reproduction of colours by the agency of chemical action and light.

Positive Paper.—Mr. M. A. Taylor, instead of albumenising or salting by means of the usual preparations, coats his new paper with a solution of white lac in water impregnated with borax. Thus prepared, the sheet is sensitised and printed in exactly the same way as common albumenised paper. The photograph obtained is reddish, and would assume a disagreeable chocolate colour if it were merely fixed with hyposulphite of soda; but this drawback may be avoided by toning in a gold bath. If the print be first dipped into a bath of sulphocyanide of ammonium, and then definitively fixed in a bath of hyposulphite of soda, it will first become yellow in the former substance, and then change to bistre in the latter. The lac may also be dissolved in a watery solution of phosphate of soda. The paper, thus prepared and sensitised in the usual way, prints exceedingly well: its colour is black or sepia, and does not change materially when fixed with hyposulphite. If the white lac be dissolved in a mixture of phosphate and borate of soda, the paper coated with it will assume very agreeable tints varying between red and black; and these tints may be graduated at pleasure by varying the proportions of the two salts. The paper prepared with phosphate of soda is best adapted for hard and powerful prints; that with borate, on the contrary, should be preferred for delicate and light photographs. If the sheets prepared as stated be sensitised with nitrate, then dried, and afterwards once more dipped into the white lac solution, their sensitiveness will not only not be diminished, but materially increased.

Permanent Photographs.—M. Ponabert, of Paris, has found that by coating glass with ordinary positive collodion *at least a year old*, immersing for three minutes in a sensitising bath containing seven grammes of nitrate of silver and eight grammes of pure nitric acid to each hundred grammes of water, exposing in the camera for fifty seconds, developing with the ordinary solution of protosulphate diluted with two thirds of its volume of water and one-fifth of its volume of pyroligneous acid, fixing with a dilute solution of hyposulphite, toning with very dilute sulphide of ammonium, and finally well washing, photographic pictures are obtained which are almost absolutely unalterable. So completely do they resist the action of all reagents, that it is not possible to use the same glass twice.

Varnishing.—In Varnishing Photographs, M. Bussi first brushes the prints over with a solution of gum arabic, and when this is dry, applies a coating of collodion. The following are the proportions recommended:—1. Clear transparent gum arabic, 25 grammes; distilled water, 100 cub. cents.; dissolve and strain. 2. Gun cotton, 3 grammes; alcohol, 60 grammes; ether, 50 grammes. By this double varnish, the inventor ensures the preservation of the proofs.

Photozincography.—Colonel Sir H. James states that a deed could be copied by this process at a third or a fourth of the expense of copying by hand, and of course there would be no possibility of error in copying. Several copies could be obtained at a very much lower rate than one copy, and it is obvious that greater security could be obtained by making several copies and depositing them in different places. Copies of documents may thus be obtained without risk to the original; there is no fire, no artificial light, and no risk of spilling a bottle of ink over the original. The original would also be less handled.

Lunar Photographs.—Mr. De La Rue, President of the Astronomical Society, states that the Lunar Committee of the British Association have resolved to make use of photographs to prepare an accurate outline map of the Moon. Sections of these photographs are to be distributed among observers, who will occupy themselves with filling in the details of the several parts of the lunar surface. A series of zones being agreed on, each observer will have a zone assigned him, at which he will be expected to work whenever it may be visible.

Submarine Photography.—Mr. Bazin illuminates the bottom of the sea by means of electric light, for the purpose of discovering the position of sunken vessels, &c. His photographic studio consists of a strong sheet-iron box, braced transversely, and admitting the light through lens-shaped water-tight windows; and he can remain in it without inconvenience for about ten minutes. He has, it is said, produced sharp and well-defined photographs, suited to render easy the recovery of objects sunk to considerable depths, and has already worked at depths approaching to 300 ft.

Pictures by Pressure.—Mr. Carey has produced latent Photographic Pictures by simple Pressure. A plate is prepared and sensitised in the usual way; and then, a sheet of paper having been written upon with a style, so that the letters stand somewhat in relief, the paper is pressed on the sensitised plate. On applying the ordinary iron developer to the plate, a copy of the words is obtained. This operation is conducted throughout in the dark. Here, then, is a mechanical cause as powerful as light in producing a latent image on a plate.

PARLOUR MAGIC SCIENTIFIC TOYS.

THE Stereoscopic Company have issued the following novelties, which are not only amusing toys, but in the hands of the "larger growth" may serve to exemplify important phenomena.

The Art-Combination Portraits are executed by taking an ordinary *carte-de-visite* portrait; extending the paper, say to five inches by four, by printing it larger, and then filling in a background to the taste of the sitter in oils, or a sketch of some favourite spot in the country, your house or grounds, thus making the picture an interesting memento. By this new method, also, can be taken all the members of a family who have their *cartes* already taken; and they can be grouped in one large picture, so as to appear as if all photographed at once, and coloured. Thus family pictures can be made up, and every likeness strictly preserved, so as to combine the truthfulness of photography with the grace of art.

The Eidotrope originated from a suggestion of Professor Wheatstone, and is a valuable accessory to the Magic Lantern. It consists of two perforated metal discs, about four inches diameter, fixed on an axle; and, by a simple revolution, producing geometrical figures of exquisite beauty and delicate gradations of tone, when the discs are slowly revolved. While these changes are in progress, *one* perforation *only*, on the upper plate, will be found perfectly coincident with another on the lower; while all the rest are irregular, and form different combinations. When, however, for the Magic Lantern the discs are put into more rapid motion, instead of producing geometrical figures, flashing rays of light appear and are projected on the screen with extraordinary results. By employing variously-coloured discs of glass or other material in connection with the Eidotrope, fine effects of colour may be obtained. It can be worked in the hand, and its effects displayed by light from a window, lamp, or fire, or by reflection from a coloured card.

Instantaneous Vegetation is produced by folding a sheet of prepared paper backwards and forwards in the form of an extended clothes-horse, when it will stand firmly. Then apply a lighted lucifer-match along the entire upper edge, when the vegetation will issue forth in variegated tints and mysterious effects.

The Parlour Steam-engine consists of a glass spirit-lamp, which, being trimmed and lighted, forms the *furnace*; another glass globe is the boiler, which is to be held by its projecting arm for a few seconds, in or over the flame of the spirit-lamp, the bottom part downwards, at the same time keeping it in motion, to prevent unequal expansion. When it is thoroughly warmed, plunge the *tip of the steam-pipe*, for a moment or two, into a saucer of cold water or aqueous perfume, when, a vacuum being caused by the heat previously applied, the cold water or perfume violently rushes in, through the small opening or tip, into the projecting arm. When the glass boiler is *half* filled, withdraw it, and the loss by evaporation can be supplied by repeating the operation. Hold the glass boiler by the spiral wire (which should be previously straightened) over the spirit-furnace; the water or perfume will boil and become partly converted into steam, which, issuing in a feathery jet with great force from the small opening at the end of the tube, sets the engine in motion with such rapidity that, revolving on a swivel attached to the spiral chain, the projecting arm becomes invisible; or partly fill the boiler with spirit and suspend it as usual, then place a light on each side of it. When it begins to slowly revolve, the vapour from the warmed spirit, issuing from the jet, will ignite, and in its revolution the boiler will present the appearance of a solid body surrounded by a lurid belt, which bears a striking resemblance to "Saturn's Ring." The introduction of a few drops of a solution of copper will give Saturn's belt a beautiful celestial hue. The Parlour Steam-engine is patented.

NEW MINERAL.

At a meeting of the Paris Academy of Sciences, was read M. Wöhler's description of Laurite, a new mineral, discovered in Borneo, mixed with the ore of platinum. It is a sesquisulphuret of ruthenium combined with sulphuret of osmium, and is said to be the first natural sulphuret that has been found with metals of the platinum group. Laurite occurs in the form of small globules, not larger than half a millimètre, the most of them having brilliant facets, and being true crystals, very hard and very brittle.

Natural-History.

ZOOLOGY.

ON BIOLOGY.

PROF. HUXLEY has given to the British Association a brief abstract discourse upon the general subject of Biology. He wished to consider for a short time the object of the science indicated by the new term biology, and the scope of those persons who pursue it, and subsequently the position which had been given to its various branches in this section of the Association. Suppose him to be provided with two properties, an egg and a bean, he would draw the attention of his listeners to their contents. Neither of them contains anything but an incomplete rudimentary foreshadowing what they will produce. Imagine the egg incubated, or the seed placed in the ground. After a time, a being full of life and activity, and possessing even mental powers, will come from the egg; the chick will eventually become a fowl. So, too, the bean will become a beanstalk. In the whole set of changes undergone there is a definite order and succession of forms, to which the name Development is applied.

In studying each stage of this development, we only study a series of distinct *forms*. It is only form which is studied, as a rule, in development. The inquirer does not ask how or why these changes take place, but simply what they may be. When our chick or bean has arrived at maturity we have not a homogeneous mass. There are muscles and bones in the one, and fibres and tissues in the other. The study of the form of the internal parts is called Anatomy, and it is anatomy, whether on a small or on a large scale. The size does not affect the nature of the study; it is anatomy, whether we deal with parts one inch or one-thousandth of an inch in diameter. He would lay particular stress on this, because some persons had a confused notion on the matter; microscopic anatomy, or Histology, is assuredly anatomy. In all this we deal with *form*. So, in considering the relation of being to being, we observe that the *form* of an oak is more like that of a beanstalk than it is like a man's; again, a man is more like a monkey than he is like a crocodile. This study is that of Taxonomy, Classification, Systematic Zoology, and Botany. *Form* has still another study, that of Distribution, not only in space, but in time. The life on our earth is not a thing of yesterday, but goes back so far into past ages that the record breaks off ere we find its first commencement. Palæontology is the biology of the past, and a fossil animal differs only in this regard from a stuffed one, that it has been dead ages instead of days. We have, then, Development, Anatomy, Classification, and Distribution, all relating to form, constituting Morphology;

its methods are Observation, Classification and Registration. The facts concerning form are questions of force: every form is force visible; a form at rest is a balance of forces; a form undergoing change is the predominance of one over others. How has form come about? how does it commence? how does it end? The question *why* belongs to Physiology in its broader sense. In a narrow sense it has been used only in regard to the properties of individuals, as we say the Physiology of Man. But there is another physiology, dealing with the causes of life, the foundations of which as a science have been laid by Mr. Darwin, whose name will go down to posterity as that of the first man to organise this study. Such is a view of the relations of the various branches of biological science. Two things are wrapped up in it: Form and Cause. The study of physiology requires great preparation; over the door of the physiological department might well be written, "Let no one enter here who is not a chemist and physicist."

ORIGIN OF LIFE.

Professor James D. Dana, in reference to the question of spontaneous generation, discussed by Pasteur, Pouchet, Child, Clark, and others, gives a "Word on the Origin of Life" in the *American Journal of Science*. He dwells on the important fact that, without some pre-existing plant or animal to afford the hay, flour, or muscle, &c., there could have come none of the animals or plants bred by the alleged spontaneous generation. The organic matter is, in one sense, dead; but still it originated through life. When the decomposition of the material begins, and the forces are thus disturbed, then the moving things, claimed to be due to spontaneous generation, make their appearance. From the highest order of compounds in the animal or vegetable kingdoms comes the lowest in the vegetable kingdom—a cellular plant. He appends some observations by Professor W. H. Brewer, of California, showing that plants of a low grade may thrive in waters very near if not at the boiling point, and even when very acid or saline. Professor Brewer also refers to the occurrence of the larvæ of flies in Mono Lake, which is intensely saline. In a note he quotes statements by Lindley, Balfour, Berkley, and others, testifying to the germination of the seeds of the raspberry, grape, and other plants, after having been exposed to a boiling temperature.—*Illustrated London News.*

NUTRITION.

M. Lacaze-Duthiers, in a paper on the circulation of the lower animals, read to the Paris Academy of Sciences, specially refers to the violent contractions and the fluid emitted by snails and other molluscæ when irritated: and, after profound study of the nervous and circulatory system, records his conviction that the conditions in which Nutrition is accomplished in zoophytes, molluscæ, and other of the lower animals, differs most profoundly from those which correspond to the same function in the higher orders, since the blood of the former is very different from that of the vertebrata, and has also direct relations with the exterior world.

ANTHROPOLOGY.

At the late meeting of the British Association, Section D (Biology), three divisions were made—viz., the Section of Biology proper and the Departments of Physiology and Anthropology. The latter science had to struggle for recognition at the Birmingham meeting in 1865, but at Nottingham full recognition has been made of its claims, and a special apartment allotted to it in the People's College. The President (Mr. Wallace) congratulated the audience on the inauguration of a sub-section, in which all students of man, by whatever name they might call themselves, could meet harmoniously to state their views and opinions, with the sole object of eliminating truth. Anthropology the President defined as the science which contemplates man under all his varied aspects—as an animal and as a moral and intellectual being, in his relations to lower organisms, to his fellow-man, and to the universe. The anthropologist sought to collect together and systematise the facts and the laws which had been brought to light by all those branches of study which, directly or indirectly, had man for their object. They would then be in a condition to determine the special lines of investigation most needed to complete our knowledge of man; and might hope ultimately to arrive at some definite conclusions on the great problems which interested all—the origin, the nature, and the destiny of the human race.

HERMAPHRODITISM.

M. Balbiani's notes on the development of the aphides contain many remarkable details, tending to prove that Hermaphroditism is the normal condition of these creatures throughout the vivaparous period of their existence.

NATURAL SELECTION APPLIED TO ANTHROPOLOGY.

At the meeting of the British Association, Mr. E. Taylor has discussed some phenomena of the higher civilization, traceable to a rudimentary origin among savage tribes, a paper in which the Section manifested considerable interest. The principal essay, however, giving rise to a conversation, was that contributed by Dr. James Hunt on the principle of Natural Selection applied to Anthropology, in reply to views propounded by some of Mr. Darwin's disciples. Dr. Hunt pointed out the inaccuracies in the arguments used by Professor Huxley and Mr. Wallace, who had exaggerated the teaching of Mr. Darwin, as regards the application of the law of "natural selection" to the origin of man.

He showed that it was an illogical Darwinism which led to the inference of the original unity of the human species; and that Carl Vogt and the more philosophian transmutationists considered the polygamist hypothesis the more probable. He commented on the great amount of imagination which the Darwinian hypothesis required, and hoped that in a more accurate scientific age more precise doctrines would be elicited.

THEORY OF MODIFICATION.

MR. R. WALLACE has read to the British Association a paper "On Reversed Sexual Characters in a Butterfly, and their Interpretation on the Theory of Modifications and Adaptive Mimicry (illustrated by specimens)." In this paper the author, who is an independent originator of the theory advanced by Darwin, gave the result of some of his own and Mr. Bates's observations on the origin of species in Lepidoptera. The Heliconidæ, a group of butterflies with a powerful odour, such as to cause birds to avoid eating them, were simulated by the females of another group, which had no smell, and might otherwise fall ready victims to birds. By their great resemblance to the obnoxious butterflies, the scentless females were enabled to escape pursuit, and deposit their eggs. In different regions there were different species, thus imitating and being imitated. Mr. Wallace conceived that this case was a crucial test of the truth of the Darwinian doctrine. The females least like the Heliconidæ had always been more subject to destruction; and consequently, by this process of natural selection, the present state of very close resemblance had resulted.

Prof. Huxley cautioned Mr. Wallace against considering this as a decisive case. It was explained quite as completely by the teleological doctrine of the late Dr. Paley. Mr. Herbert Spencer thought he could show that the case described by Mr. Wallace could not be satisfactorily explained by Dr. Paley's teaching. He understood Mr. Wallace that the imitation was *not complete*, and varied in different individuals. This incompleteness was not to be explained were we to assume that the one butterfly was made in imitation of the other by the Creator; but it was readily accounted for by the law of evolution.

MICROSCOPICAL RESEARCHES.

IN the *Quarterly Journal of Microscopical Science*, Mr. James Smith describes a new method of preparing cells for mounting dry objects; Mr. Richard Beck gives details of an improved growing-cell, and shows how the object-glass may be made its own condenser by means of a new kind of illumination for opaque objects; Dr. Maddox describes his new brass slide clip as useful, and easily made; and Captain J. Mitchell explains how the true reading of measurements with the cobweb micrometer may be obtained—a subject of much importance when the instrument is applied to such delicate investigations as "the diameter of blood corpuscles when a man's life is in the balance."

HUMAN CRANIA.

PROFESSOR HUXLEY has read to the British Association a valuable paper, entitled "Remarks on Two Extreme Forms of Human Crania," the object of which was to show that synostosis could not be relied upon as the cause of abnormal developments of crania. One of the skulls exhibited, that of a Tartar, was an instance of extreme brachycephaly with ossification of the sagittal suture. The other, that of a New Zealander (?), was an example of extreme dolicocephaly not associated with synostosis. The Professor wished to impress on the audience—first, that the period at which synostosis took place cannot be positively ascertained, and that early synostosis may occur without producing alteration in shape; secondly, that extreme alteration may occur without synostosis. The importance of making a section through crania before expressing an opinion upon them was also pointed out and illustrated. The angle of the basi-cranial axis may be the same, but the adjacent parts may be so arranged as to produce very different outlines.

Mr. William Turner said that he possessed two skulls possessing peculiarities similar to those exhibited; one, a Bohemian, was very brachycephalic, though the sagittal suture was ossified. This was all the more remarkable, because the person was probably not more than 21 years of age. The second, found in Lincolnshire, very dolicocephalic with the sagittal suture still open. Mr. Sebastian Evans asked whether there were marks of external compression in the case of the Tartar skull. Mr. Huxley was of opinion that there were not, though Dr. Barnard Davis and Dr. Carter Blake thought that there were. Dr. Barnard Davis was of opinion, that where synostosis occurred in early infancy one-third of the skulls would be altered.

Mr. James Hunt communicated to the department the results of observations made in ninety-eight cases of modern Norwegians. The cranial measurements of the majority of the cases indicated that the form of the skull in the Norwegian is much more rounded than had hitherto been supposed. The average height of eight cases of males was 5 ft. 8 in. The hair, in the majority of cases, was light brown, the eyes light blue. The author contended that there was no such thing as a Norse type, the races inhabiting that country differing quite as much, if not more, than any now inhabiting this country. The author gave some details of his examination of Swedes and Lapps, and concluded by suggesting the desirability of not confusing the inhabitants of Norway and Sweden.

POLYNESIAN RACES.

M. QUATREFAGE has presented to the Paris Academy of Sciences a work of his on the Polynesian Races, in which he endeavours to prove the following propositions:—1. That the Polynesians were not created in separate nations nor on the spot. 2. That they are not the remnants of a pre-existing people, partly destroyed by some convulsion. 3. That, whatever the origin of the islands in which they were found, they arrived there by voluntary migration or involuntary dispersion successively, and proceeding from west to east, at least, as a general rule. 4. That they started from the Eastern Archipelago of Asia. 5. That in the latter the primitive race of those offshoots may be found perfectly recognisable by its physical characteristics, as well as by its language. 6. That the Polynesians first established themselves at Samoa and Tonga, and thence passed into the other archipelagoes of the immense ocean before them. 7. That some of the islands on which they landed were entirely deserted, and others contained a few inhabitants of different origin, more or less dark-skinned, who must have arrived there in the same way. This, our readers will perceive, is the weak point of the author's theory. Where did the latter aborigines come from?

SUPPOSED FOSSIL JAW.

DR. CARTER BLAKE has read to the British Association a paper on the supposed Human Jaw recently found near Dinant, in Belgium; in which he pointed out the deviations which it presented from the ordinary human type, with its great resemblance to the jaws of Australians, and, to a certain extent, of the apes. He detailed the geological circumstances under which the jaw was found in a deposit of stratified river-gravel, and assigned to it an antiquity coeval with that of the elephant, rhinoceros, and hyæna bones found with it. An animated discussion took place, joined in by Mr. Wallace, Dr. Hunt, Dr. Barnard Davis, and others.

MAN'S PAST AND PRESENT CONDITION.

A PAPER has been read to the Victoria Institute, by Mr. Reddie, the honorary secretary, on "The Various Theories of Man's Past and Present Condition." He considered the theories now entertained as chiefly three:—The religious theory of the creation of Adam, a perfect being, who fell; the Darwinian theory, which derives mankind from apes; and the Polygenous theory, which considers the primitive men to be low-caste savages of different colours, at first even without speech; and in that respect the Darwinian and Polygenous theories agree. Two chief objections were urged against Darwinism, that it has never even been attempted to explain how the first young mammal could be nourished if its progenitor was not a mammal; nor how monkeys could possibly train up the first human baby they produced, granting that they could produce it.

COLOUR OF MAN.

Dr. Davy has read to the British Association a paper "On the Colour of Man." The author first enumerated the various shades of complexion, and the position in which they were found, and then went into the subject of causation. The warmer the climate the less the difference in the venous and arterial blood. The Esquimaux were neither fair nor dark-brown, but intermediate. The long, continuous solar effect for one-half the year, associated them with the inhabitants of the tropics; whilst their living underground the other half, assimilated them to inhabitants of the fairer countries. He showed that the circumstances of a colder climate favour fairness of the skin. With regard to the Chinese, he ventured the conjecture that their colour might be owing to the imperfect development of blood in the bile. The hereditary colour might pass, in course of time, into that distinctive of the climate. Of this he gave a variety of instances; and invited discussion on a subject of no ordinary interest in regard to health and beauty.

YOUNG HIPPOPOTAMUS.

A fine young Hippopotamus, about eleven months old, and which was born in the Zoological Gardens at Amsterdam, has been exhibited at the Crystal Palace. "Hermann," as his keeper calls him, is a most interesting and amusing beast, being about the size of a very large pig, though, of course, much more massively made. He is much lighter in colour than the full-grown animal; the sides of the head, eyelids, lower parts and flanks, being all of a pale pink tone, the back and upper surface of a light greyish tint. His tusks are just protruding through the gums, and his molar teeth have appeared some little time. He is fed on milk and oatmeal mixed together, his attendant being obliged to place his hand in his pet's mouth during the process. He is kept in one of the side galleries of the tropical department, where a large tank of water is placed for him; in this he disports himself with great enjoyment, splashing and diving most energetically, and occasionally uttering the trumpet-like snort so peculiar to the animal.—*Land and Water.*

IVORY.

The number of elephants that must be destroyed annually to meet the demand for Ivory is absolutely enormous. It is stated on good authority that the cutlery establishments of Sheffield alone consume annually the ivory which is supplied by slaying more than 20,000 elephants, and every country must also have its supply. The other sources from which ivory is obtained, the walrus, the narwhal, &c., afford but an insignificant item in the supply, and as no other substance has been discovered or invented which can take its place, and as the demand is constantly increasing from year to year, it would seem that the race of elephants may, before long, become extinct. The best ivory known is that which comes from Africa, for though it is not so white as that furnished by the Asiatic elephants, it preserves its colour best, is most transparent, freest from cracks, and receives the highest polish. This is owing to the fact that the African ivory contains about equal parts of animal and earthy matter, while in the Asiatic the proportion of earthy matter is greater. One great source of the supply of ivory in Russia and the northern countries of Europe is the tusks of extinct species of elephants and mammoths, which are found in the banks of the rivers of Northern Siberia in a remarkable state of preservation. In very cold countries ivory of fossil elephants is preserved for ages. In our own country the fossil remains occasionally dug up are dry and brittle; but boiling in a solution of gelatine will supply the want of the original albuminous matter. So, on the other hand, by dissolving a portion of the earthy matter, which is one of the principal ingredients, ivory retains its tenacity, but becomes exceedingly flexible. It is thus prepared for making surgical instruments. What will supply the place of ivory when the race of elephants is destroyed we cannot tell, but ingenuity is already at work to furnish a substitute, and is stimulated by the offer of large rewards. A short time since a reward of $5,000 was offered in this country by parties interested in the manufacture of billiard-balls for a substance possessing the same qualities in about the same proportions. Its elasticity adapts it to this purpose, but as ivory is affected by dampness and expands unequally according to the grain, it is found that the balls do not retain their perfect sphericity in all states of the atmosphere. For this reason, and on account of its increasing scarcity, some other substance is in demand. Vegetable ivory, so-called, is used in making many articles, but it is of comparatively little value. There seems to be more hope that the requisite material will be obtained from some compound of India-rubber or gutta-percha than from any other source.—*New York Journal of Commerce.*

POISON FOR RATS.

A NOTE by M. Cloez has been read at a meeting of the Paris Academy of Sciences, relative to the effects of the vapours of the sulphuret of carbon upon animals. The Museum of Natural History is infested with Rats, and all the known methods of destroying them have hitherto failed. M. Cloez, after several experiments, has proved that an atmosphere containing one twentieth of its volume of the vapour of sulphuret of carbon is fatal to these animals. He arranged apparatus for the introduction of this vapour into the holes of the rats, and numerous corpses testified to its poisonous efficacy.

THE LEMMING.

M. GUYON has communicated to the Paris Academy of Sciences some additional particulars respecting the Lemming which he brought over from Norway, and which, after about a year's residence in France, was accidentally killed by being trodden upon, its death being due to its invincible opposition to captivity. Its struggles for freedom continued day and night, and it gnawed the hardest wood and twisted and scratched iron, and when at large it endeavoured to bury itself alive rather than be taken. When at bay, it would sit upon its hind-quarters, and hiss, and bark, and spit forth saliva of a rather poisonous nature. M. Guyon at length provided a nest for his *protégé*, being a cage filled with moss, from which it came forth at night, and into which it retired at the approach of day. It manifested great shyness in feeding, yet learnt to make signs to attract notice when in need of a supply. It partook of ordinary human food—such as bread, nuts, figs, sugar, cheese, &c. M. Guyon proved, contrary to the general opinion, that the lemming is susceptible of a certain amount of sociability; it would stop in its movements when it heard the imitation of its peculiar cry; but yet seemed never to put off wholly its habitual mistrust of man. Martins and other travellers consider the mountains which separate Sweden from Norway to be the home of the lemming; but M. Guyon is inclined to give it a larger extension, comprising the summits of the principal mountains of Scandinavia; and he refers to various positions where remains of this animal have been discovered.

THE MOLE.

IN regard to the agricultural utility of the Mole, M. Weber, of Zurich, reports that he has carefully examined the stomachs of fifteen moles, taken in different places, and has not found in them any vestige of plants, or roots of plants, but only remains of worms. If vegetables had been eaten, part would have remained, as they are more difficult to digest than animal substances. M. Weber also inclosed some moles in a box filled with earth, partially covered with fresh turf, together with a box of worms. He states that in nine days two moles had eaten 341 white worms, 193 earthworms, 25 caterpillars, and also a mouse, skin and bone, which had been put into the box alive. When he gave them raw meat mixed with vegetables, they ate the former only, and when they were left with nothing but vegetables, they died of hunger. It has been calculated that two moles destroy 20,000 white worms in a year.

EXTINCT BIRDS OF THE MASCARENE ISLANDS.

PROFESSOR NEWTON has read to the British Association his Report on the Extinct Birds of the Mascarene Islands. The Committee appointed by the British Association at Birmingham, September, 1865, for the purpose of assisting Mr. E. Newton in his researches for the remains of the extinct Didine Birds of the Mascarene Islands, have the honour to report as follows:—Almost immediately after the appointment of the Committee, intelligence was received in England of the very important discovery by Mr. G. Clark, of Mahebourg, in Mauritius, of a large deposit of bones of the true Dodo (*Didus ineptus*, L.) in a marsh known as the "Mareaux Songes," an account of which that gentleman has published in the *Ibis* magazine for April, 1866. Several fine series of these bones having been sent to England: some were purchased by the Trustees of the British Museum, and formed the subject of a memoir "On the Osteology of the Dodo," read by Prof. Owen to the Zoological Society, 9th January, 1866; some other fine series of these bones were exhibited. Several smaller series of bones have likewise been variously distributed by sale or gift, both in England and the Continent, so that numerous museums and collections have already reaped the benefit of Mr. Clark's valuable discovery; the importance of which may be better appreciated, when it is remembered that previously the only remains of the dodo known to naturalists were the head and foot at Oxford, the skull at Copenhagen, the portion of an upper mandible at Prague, and the foot in the British Museum. Now, it is believed that almost every bone of the bird's skeleton has been recovered with the exception—though that is an important exception—of the extremity of the wing. The attention of Mr. E. Newton has been especially called to this deficiency, which seems likely to be supplied by a thorough and systematic examination of the "Mareaux Songes," or at least of the part of it which had been most prolific in dodos' bones.

THE DODO.

Professor Owen has read to the Zoological Society a paper on the Dodo referred to in the above abstract. The dodo, he said, was one of the curiosities of Natural History, on account of its entire extinction and the paucity of its remains. Till a very short time ago, nothing but a very few fragments of its bones, and those scattered over several museums, were known to exist. In 1863, however, Mr. Owen, having been introduced, by Miss Burdett Coutts, to the Bishop of Mauritius, endeavoured to intérest the right Rev. Prelate in a search for further relics of the dodo in his diocese; and in November last he received from his Lordship a letter, accompanying a collection which had been discovered by Mr. George Clark, master of the Government school in the island, and an ardent naturalist. These comprised no fewer than a hundred bones and fragments of bones, which had apparently belonged to four or five individuals, somewhat differing from each other in size. The dodo was undoubtedly a pigeon, but it was flightless, and its structure was modified in conformity with this circumstance. It was somewhat larger than a turkey-cock, and Mr. Clark's discoveries completely authenticate the well-known portrait of it in the British Museum. It was addicted in some measure to animal food, and it was doubtless this fact that made its flesh less palatable to the Dutch settlers of the sixteenth and seventeenth centuries than they found that of its *volant congenus*. A writer, quoted by Sir Thomas Browne, reports that he saw a specimen exhibited in a [illegible] and he adds, that its keeper pointed out to him a heap [illegible] pebbles, some of which were as large as nutmegs, and [illegible] said, the creature ate. It may be further observed, "in [illegible] connection," that the extreme smallness of the dodo's brain ful[illegible] entitled it to its distinguished epithet of "Inept."

BIRDS OF AMERICA AND EUROPE.

Mr. S. F. Baird, in his paper on the distribution and migrations of North American birds, in the *American Journal of Science*, arrives at the following conclusions, in regard to the Interchange of Birds between America and Europe. European birds, especially the land species, reach Greenland and return to the Continent by way of Iceland, the Faroe Islands forming a stepping-stone from Great Britain and Scandinavia. In very rare instances, species seem to proceed direct to Greenland without stopping in Iceland. The European birds found on the continent of North America reach it by autumnal movement from Greenland, in company with strictly North American species. Birds of North America rarely, if ever, reach England from Greenland by direct spontaneous migration by way of Iceland. Most specimens of American birds recorded as found in Europe were taken in England (about fifty out of sixty-nine); some of them in Heligoland; very few on the Continent. Land birds in only five instances. In nearly all cases, these specimens belonged to species abundant during summer in New England and in the eastern provinces of British America.

ARTIFICIAL BIRDS' NESTS.

The *Bulletin de la Société d'Acclimatation* states that Artificial Birds' Nests are now made in Switzerland under the direction of the societies formed there for the protection of insectivorous birds. One of the members of a society of this description, who inhabits Vevey, having observed that many species of that kind selected for nests the holes they find in the trunks of rotten trees, and that they consequently do not find it easy to settle in orchards, where all the trees are in good condition, began, twenty-five years ago, to set up rotten trunks in his grounds; and since then he has had no need to trouble himself in the least about clearing away caterpillars, that care being entirely left to his winged guests, who perform their duty admirably.

ZOSTEROPS DORSALIS.

Dr. J. E. Gray reports that the British Museum has received a specimen of the Zosterops Dorsalis, a singular little bird which has lately made its appearance in Wanganawi, New Zealand, and which appears to have migrated for the winter from Tasmania. It promised to prove a blessing, by arresting the progress of the American blight among the apple-trees in its temporary home. At first its advent was hailed as a blessing, on account of its rapidly devouring the blight insects; but this benefit has been greatly neutralised by its feeding also upon the tender buds of trees; and, as it retires into the high grounds at the approach of summer, it gives the blight time to reappear as bad as ever before its return. Unlike the native birds, the zosterops fly about in large flocks of several hundreds, making an incessant chattering.

FINE VULTURE.

COLONEL R. C. TYTLER, in the *Proceedings of the Asiatic Society of Bengal*, describes a fine specimen of the very rare and noble bird Vultur Monarchus, which he shot, on the 3rd of March last, at Umballah, while it was feeding, with two others, on the dead body of a horse. It weighed 17 lb., and its wings extended, from tip to tip, 8 ft. 2 in. Its length, including bill and tail, was 3 ft. 7 in. The extent round the body and wings was 3 ft. Its general colour was a very dark brown, the entire neck, eyebrows, and region of the ears being devoid of feathers, and the skin of a livid white. When flying, this vulture is easily distinguishable from others, as no white is visible, and the tail is very rounded.

GIGANTIC BIRDS.

THE fossil remains of a Gigantic Bird, estimated to have stood 25 ft. high, have been discovered in some beds of limestone at Nelson, in New Zealand. The remains consist of a head minus the lower jaw, the dimensions of which are 3 ft. 4 in. by 1 ft. 10 in.; the orbit of the eye measured 4½ in. by 2½ in.; also a body minus the neck; the thorax is highly developed but rather flat, the tail long, and body bulky; the wings, which are well defined, are large and close to the body, and are separated by a saddle or cradle, very graceful in form; the feathers covering the body are of a large size and lying close.—*Australian Paper*.

Professor Owen suggested that a feather or bone of the above extraordinary fossil bird or reptile discovered at Nelson should be forwarded to him for examination. That fossil might have been better described from its appearance as an enormous brickbat. Mr. Dobson, who, in consequence of Professor Owen's request, inspected the supposed fossil, declared it to be merely a mass of highly quartzose sandstone. By the next mail, Dr. Hector, F.R.S., the Government geologist, sent some elaborate drawings, &c., of a portion of a moa's egg, with the bones of the chick in an advanced state of incubation. The egg was found at Otago.—(*Letter from Wellington.*)

Professor Owen says:—"The notice of the remains found in the province of Nelson assures me that they are those of a saurian reptile, and indicate the jurassic age of the 'beds of lime-stone' in which they have been petrified. Parts of a plesiosaurus were discovered in that province, by Mr. J. H. Hood, of Cluny House, Dunkeld, in 1861; but the present are of another kind."

NEW CASSOWARY AND HONEY-EATER.—CAPRIMULGIDÆ.

MR. P. L. SCLATER has exhibited to the Zoological Society a small bundle of feathers of a species of Cassowary, supposed to be those of *Casuarius Australis*, which had been taken out of a native hut in northern Queensland, and are of great interest, as being the only portion of this bird ever brought to Europe. Mr. Gould exhibited, on the part of Sir W. Jardine, Bart., a specimen of a new species of Honey-eater, of the genus Ptilotis, from Victoria, Australia, proposed to be called *Ptilotis cassidix*, together with some other rare Australian species, amongst which was a skin of the rare Finch, *Emblema pictum*, from Northern Australia. Mr. P. L. Sclater also read some additional notes on the Caprimulgidæ, relating principally to certain American species, of which one was characterised as new to science, *Antrostomus ornatus*.

THE PRESERVATION OF EGGS.

THE Preservation of Eggs is a matter about which there exist many opinions. At a late meeting of the Farmers' Institute in New York, a note was received from Mr. W. M. Brown, of Indiana, inquiring whether there is any way to pack eggs so as to keep them good from spring until the winter months? Upon this question the following discussion took place. The name of the first speaker is not given:—There are various modes of keeping eggs, none of which are quite successful. Sometimes eggs packed in water saturated with lime keep perfectly well, and sometimes they do not. Some persons say they can keep them in water saturated with salt; others keep them packed in fine dry salt, others in charcoal-dust. If packed in sand, and kept in a very cool cellar, they will remain through the year. They should always be packed small end up. The best way to preserve eggs is to store them in one of Professor Nyce's preservatories.

Professor Smith, Columbia College, said, that the common way of preserving eggs in the north of Europe, and which appeared to be more effectual than any other mode he had ever seen, was this:—The eggs are placed in a barrel, keg, earthen jar, or any other suitable vessel, and then melted tallow, only just warm enough to flow, is poured in, filling the interstices, and thus hermetically sealing the eggs from the air, which appears to be all that is necessary for their perfect preservation. When wanted for use, they are easily obtained by warming the open end of the vessel to soften the tallow.

Mr. Solon Robinson said he thought lard or oil would answer the purpose; it would be more convenient. He had heard molasses recommended, and did not see why it would not answer perfectly.

Mr. Carpenter said, he had found no difficulty in preserving eggs in fine dry salt. He packs them endwise, and about once a month reverses the ends of the casks, or rather box with straight sides, so that a board and cloth or paper fits down and holds the contents in their place when reversed.

Professor Tillman gave it as his opinion, that anything which would exclude air would preserve eggs. Recent experiments in France have developed the fact that varnishing the shell destroys the value of the egg for incubation.

Mr. E. Williams said he had seen eggs perfectly preserved by packing in meal.—*Abridged from the Canada Farmer.*

VISION OF FISH AND AMPHIBIA.

M. Plateau, of Ghent, has recently published a sketch of his researches on the Vision of Fish and the Amphibia. His investigations were only extended to fresh-water fish, owing to the difficulty of procuring others in a fresh state. He finds that the cornea is flattened in the centre, but that a curvature is very apparent at the border. The crystalline lens is always spherical, and the liquid which fills the cavity of the eye is of the same, or nearly of the same, specific gravity as water. For purposes of comparison he has examined the eyes of aquatic birds, and of frogs, and of some aquatic mammalia, and he finds that, in all, the cornea is sensibly flattened in the centre, and the crystalline lens approaches the form of a sphere. In order to show that, in the fish, vision is as distinct in air as in water, and that this distinctness is independent of any power of accommodation, he prepared a recently removed eye in such a manner as to show the formation of the image of external objects. He found that the distances of distinct vision were sensibly the same, whether the organ was in air or immersed in water. These experiments were made upon the eyes of two or three kinds of fresh-water fish and frogs. He did not extend them to the eyes of aquatic birds and mammals, but instances the similarity of structure with the eyes of fish as a proof that the same principle prevails in both cases. The memoir and plates appear in the *Mémoires des Savants Etrangers* of the Belgian Academy.

INCREASE OF FISH.

The proverbial inexhaustible ichthyological wealth of the sea is in great measure borne out by the following authentic returns procured by the Fishery Commissioners. The quantity of fish conveyed to London by the North-Eastern, Manchester, Sheffield and Lincolnshire, Great Northern, and South Devon Railways in 1856, was 11,714 tons; in 1857, 15,156 tons; in 1858, 21,615 tons; in 1859, 27,440 tons; in 1860, 27,468 tons; in 1861, 33,337 tons; in 1862, 36,869 tons; in 1863, 37,833 tons; and in 1864, 40,337 tons; thus showing an increase of more than threefold in nine years.

OSSEOUS FISHES.

A PAPER has been read to the British Association, "On the Conditions of the Protoplasmic Movements in the egg of Osseous Fishes," by Dr. Ransom. The subject of these rotations or oscillations had engaged attention since the time of Rosconi. By means of diagrams, the phenomena of movement visible in the unimpregnated egg were shown. After water has entered the ovum, a distension of the outer rim and a diminution of the yolk mass itself occur, while the separation of the food-yolk takes place. Then the protoplasmic movements cease, fissile contractions commence, and the general process of yolk-division occurs. The author detailed the results of a number of experiments with various agents, the object of which was to ascertain their action on the rhythmic movements he had described in the yolk.

FLYING FISH.

MR. HORACE MANN, in a letter printed by the Boston Society of Natural History in their *Proceedings*, describes the method of flight of the Flying Fish. He supposed that the animal must acquire some considerable momentum below the surface before rising from it, and wished to see if its motion, after leaving the water, was more accelerated than during the later periods of its flight. He thinks that he discovered a slight difference in the rate of motion, but also thinks that the motion is kept up by the fins, and that the weight is sustained by them. These fishes plainly have the power of altering their course, so far as rising and falling, and can go over the surface of a not very high wave. Mr. Mann has seen a school of a dozen or twenty rise and fall slightly into the water, and issue from it again and again, altering their course for the distance of seventy-five to a hundred yards. Sometimes they fly thirty or forty yards without touching the water, but usually do not go more than half that distance. They rise commonly not much more than a foot from the water; but sometimes rise eight or ten feet.

SCOPELINIDES.

AN abstract of a memoir by Professor Leuckart appears in the *Bibliothèque Universelle* of Geneva, in which it is stated that, after closely examining the brilliant spots distributed over the bodies of fishes of the family of Scopelinides, he has been led to the opinion that these spots are accessory visual organs, in consequence of their anatomical structure. They have the form of small cylinders, the anterior portion of which is occupied by a spherical body of a very crystalline nature; behind this is a species of vitreous substance. The layer of pigment which envelops this ocular bulb presents a silvery lustre and a structure identical with the back part of the eye of the plagiostoma. The genus Stomias also has numerous rows of small silvery spots, which, according to M. Leuckart, are of a similar character. These observations should certainly direct the attention of naturalists to this group of remarkable fishes.

FISH-HATCHING.

DR. W. H. RANSOM, in a note, states that, in his experiments on Fish-Hatching, having had many losses through the impurity of the water, just at the time when the embryo began to respire, he had obviated the difficulty by adding to the water, night and morning, a few drops of a weak solution of permanganate of lime, which at once sweetened the water and supplied oxygen. He lost no more fish, and the young fry remained healthy and vigorous.

Mr. F. Buckland has elicited from Dr. Ransom the opinion, that it was a mistake to pack eggs in damp moss, since they required oxygenation by fresh pure water, and he had found them live longest under that condition.

VOICE OF FISHES.

A MEMOIR by M. Dufossé, on the different physiological phenomena termed the "Voice of Fishes," but which he proposes to name "ichthyopsophosis," or "fish-noise," has been laid before a meeting of the Paris Academy of Sciences. He asserts, that facts prove that nature has not refused to all fishes the power of expressing their instinctive sensations by sounds, but has not conferred on them the unity of mechanism in the formation of sonorous vibrations, as in other classes of vertebrata. Some fishes, he says, are able to emit musical tones, engendered by a mechanism in which the muscular vibration is the principal motive power; others possess the faculty of making blowing sounds, like those of certain reptiles; and others can produce the creaking noise resembling that made by many insects. M. Dufossé's memoir was referred to a committee of naturalists for consideration.

SCIENTIFIC CULTIVATION OF A SALMON RIVER.

MR. F. BUCKLAND, in a paper contributed by him to the proceedings of the British Association, compares the ascent of salmon from the sea to the interior of the country, where it lays its eggs, to the process of following a tree from its root upwards through all its branches. The salmon is a very clever fish; the feeling it shows, when preparing to lay its eggs, is so peculiar, that he preferred to call it "feeling" rather than "instinct." The distance which salmon ascend into the interior and thus exhibit the powerful feeling they are influenced by when preparing to deposit their eggs, is instanced by their ascent of the Rhine to a distance of 400 miles, where they are stopped by the falls of Schaffhausen. Allow the salmon to lay, and it

. . . the care; put down ladders for it to climb upon, not nets to catch it. The salmon has many enemies—traps, haicks, cormorants, and herons; otters also hunt the salmon not only for food, but as we ourselves do, for sport. Of all the enemies the salmon has to contend against he has not a more terrible than the millers. They are dreadful fellows. When a salmon comes to a water-wheel it will stay by it for days. The miller stops the wheel, and when the pool becomes calm the salmon ventures on and is caught in his net. Steamers too are its enemies, and though the salmon is not a nervous fish, it is delayed by them. It is very sensitive to smell: when it comes near large towns it is often obliged to take out its pocket handkerchief. It will not venture to pass up rivers filled with sewage. What does it do then? It waits until a flood comes and then ascends in purer waters. The salmon is no friend to waterfalls. There is a waterfall at Knaresborough. People thought the salmon used to jump every Sunday morning to please them, but the fact was, the millers were obliged, by law, to let the water down on Sunday, and then the fish leaped. Poachers are great enemies of salmon. During the winter months, it was not an uncommon thing for one poacher to destroy 1,000. He heard from a converted poacher a confession that made his hair stand on end—he used to feed his pigs with salmon!

Mr. Ashworth, of Galway, has now the model fishery of the United Kingdom. In 1853 it produced about 1,600; in 1862, 15,000; 1863, 17,000; 1864, 20,000—a number representing 20,000*l.* Is not that a valuable fishery? To cultivate salmon fishing, however, one must not lie in bed in winter; this business admits of no idleness. Mr. Ashworth asked the salmon poachers how much they made by poaching during the winter. About 30*s.*, they admitted. He said, "I will give you 3*l.* to let them alone." He has from 120 to 130 men employed to see that the salmon are not disturbed during the winter. He himself was proud of having opened a river at Canterbury. This was famous for salmon, but there had been no salmon for many years—a net had been in the river. A deputation waited on the mayor and corporation, founded an association, and the result was, the salmon had increased. The Thames now is greatly vilified, but it used to be a salmon river. The Eton boys caught "skeggars," but now there are no eggs in the Thames, for the salmon are not allowed to go up, by the weirs erected on account of navigation. If they were allowed to go up, there would soon be sufficient eggs. He himself had hatched in his back kitchen 30,000 eggs. The cook wondered why he had all the eggs there; he told her it was a known habit of the salmon "to come back to the place where they were hatched." "One of the proudest moments of his life," as persons after dinner say, was when a salmon was brought to him which had been caught at Gravesend in a whitebait boat. He felt certain it was one of the eggs hatched in his kitchen. It could not have been hatched in the Thames.

He collected all the fishermen on the spot, and they said for more than thirty-three years a salmon had not been caught there before. He was certain that if the cultivation of salmon in the Thames were attended to, in ten years there would be an abundant supply.

The reading of Mr. Buckland's lively paper was followed by a discussion.

Mr. Lord said, the Indians depended on the salmon for food. If any accident happened to the salmon in Columbia or Fraser rivers, the Indians would perish. The Indians, however, asserted that four out of five salmon spawned in summer never returned to the sea.

Mr. Wright, in corroboration of what had been said respecting the increase of salmon, stated that, three weeks ago, he had been looking over the bridge at Galway, and saw the salmon in ranks like soldiers, from 300 to 400, waiting until the stairs opened. A dozen years since not half-a-dozen could be seen.

In connection with this subject we find the following common-sense remarks:—Great doubt has been expressed as to the possibility of making the Thames a fit *habitat* for the finny tribe. It would seem that they are anxious to return to its waters, and to brave the noise and turmoil of its banks. Whether they were erratic demented wanderers or sensible fish cannot be stated confidently; but this much may be said positively from ocular evidence of the fact, that during the current week bream, roach, and dace have been seen in the waters of St. Katherine's-dock, and specimens of each have been actually taken and preserved by the dockmaster. The last salmon caught in the Thames fetched 15*d.* per lb. It is to be hoped that the salmon fishing will be resumed soon, and that the take may justify prices much more in favour of the buyer. This is but little likely, it is to be feared, unless the sewage is carried much further down than Crossness-point or Barking-creek.

[We have lengthy reports and interminable contributions to "Salmon Culture," but the fishmonger's figure remains nearly where it was.]

OYSTERS.

A REPORT on Oyster Cultivation has been read to the British Association by Mr. F. Buckland. The author began by explaining that it was difficult to give, in a few minutes, the result of a whole year's information. He would confine his remarks principally to the history of the living spat of the oyster, the chemical analysis of the meat and the mother liquor of the oyster, to the adhesions of the various substances to which they loved to adhere, and to the marketable value of the oysters as tested by weight. He proceeded to describe the exceedingly interesting action and movements displayed by the young oyster when first emitted from its mother's shell, giving the reason why they sometimes floated on the surface of the water, and sometimes sank to the bottom, the use to which the young oyster places its ciliæ, expressing it as his opinion that these organs never dropped off, but were absorbed after the young oyster became fixed. He then exhibited a great variety of substances to which the oysters seemed to have a natural preference for adhering. Among these were several curiosities, such as a "plague pipe," to which an oyster had fixed itself, an ordinary pipe, presented to him by Sir Walter Trevelyan, in the bowl of which no less than three oysters had taken up their position; also some old-fashioned wine or spirit bottles, from the North Sea and Loch Ryan, presented by Sir William Wallace. He then proceeded to describe the result of the chemical analysis which he had instituted in conjunction with A. Pythian Tarner, Esq., giving the amounts of mineral matter, the animal, and also the fatty matter. The results obtained showed that the phosphates were more important in the composition of the meat of the oyster than any other of the ingredients, and hence their great practical use for invalids and in sea-sickness. He also gave practical deductions as to choice of proper places where oysters should be laid in order to obtain a good supply of these phosphates. He then described the process of the growth of the oyster-shell, and detailed the manner in which the oyster formed the shell from the mother-liquor, the mode also by which the little oysters were enabled to form their shell inside the mother-shell. His observations enabled him to come to the conclusion, as to the possible way in which the young oyster was enabled to attach itself to various articles. He had been enabled to collect samples of oysters from almost every part of the United Kingdom. These have been accurately weighed, and he gave a table, showing the relative value (commercially speaking) of oysters from oyster-beds, or proposed oyster-beds of England, Ireland, Scotland, and Wales. He stated that he was still carrying on his experiments at Herne Bay; and he was happy to be enabled to report that the French system of oyster-culture had been successfully carried out in a creek near Havant, not far from Portsmouth; and, although he had not yet seen the results of the experiments himself, he could not help congratulating the managers upon their well-deserved success. Determined that England should be well represented, and that her oyster-fisheries should not be entirely ignored by our neighbours in France, he had at this moment one set of specimens at the Fish-Culture Exhibition at Arcachon, in the south, and another at a similar Exhibition at Boulogne, in the north of that country, as well as his own collection at the Horticultural Gardens, South Kensington, where he trusted to make a complete series, illustrative of the culture of oysters, as well as that of salmon.

SUCCESSFUL OYSTER CULTURE.

It is satisfactory to find that the Oyster Culture system has been successfully carried out at Hayling Island. In the harbour there a company has become possessed of 900 acres of ground; this harbour being a great inlet of the sea, similar to that of Portsmouth harbour, and situated at a few miles to the east of it. A large portion of the harbour has been cut off by the embankment of the railway which runs from the mainland to the south of Hayling Island, and within this is situated the 900 acres referred to; the embankment, by the aid of sluices, giving the company a perfect command over the water supply. Parts of the ground have been divided off and set apart for various purposes: some for parcs and spawning grounds, some for growing and fattening grounds, others for the cultivation of other molluscs than oysters, or the more valuable crustacea, and others as viviers for fish. Hitherto, however, the company have only tried two branches of their undertakings—those which would be most likely to pay well if they succeeded. The one is oyster and the other lobster-breeding. For the latter purpose the company had a suitable reservoir constructed, and stocked it towards the end of the season with a score or two of breeding lobsters; and the result is, that they have now in their ponds thousands of small lobsters passing through the unprofitable stages of babyhood. The oyster parc has been made on the scale of the old Salterns, oysters being laid down, and collective tiles placed to receive the spat in the most favourable positions. Scarcely a month from the oysters' commencement to throw out the spat, the collecting tiles became covered with young oysters. The embryo taking to the tiles, and fixing itself firmly to them without difficulty, the tiles are covered with oysters; the number of which may be imagined, when we say that there are about twenty-six oysters to every square inch of tile. The experiment has been carried out at a small expenditure (four acres only of the 900 having been occupied by the present parc), and the produce promises to be considerable.—*Pall Mall Gazette.*

M. Soubeiran has reported to the Academy of Sciences at Paris that he has applied the principles of M. Coste respecting the culture of oysters with great success on the shores of the basin of Arcachon, near Bordeaux, to the extent of four hectares. From the 500,000 oysters planted he has collected about five million. This, he calculates, will produce 5000f. a year per hectare.

BRITISH SALPÆ.

Some observations on British Salpæ, comparatively rare swimming molluscoids, by Dr. W. C. M'Intosh, have appeared in the *Journal of the Linnean Society*, with engravings. The author paid much attention to these animals when visiting the Hebrides, near which they abound in the month of August, forming then a grand feature in the Western Ocean. On some days the easterly breeze drives in such quantities of them, that the hand cannot be held in the sea-water without coming into contact with chains of one form or another of these creatures, poured in to be destroyed, since they form an abundant feast to the fish which hunt for them in shoals. The climax of salpæ life is reached about August 22, when even the progress of the boats appears to be impeded. The chains of salpæ in sight vary from two and half yards downwards, and deeper ones may be longer. The bands move slowly through the water, seldom altering their curves to any extent. The animal is very transparent, and, when swimming, its aberrant form causes a lens-like condensation of the rays of light, their quivering bodies roughening the surface of the sea like tremors on molten glass.

NEW MOLLUSCOIDS.

A PAPER has been read to the British Association "On a New Molluscoid Animal allied to Pelonaia (Forbes and Goodsir)," by Dr. C. M'Intosh. The specimen was found on the beach at St. Andrews, after a severe storm, in 1861; it measured 1¾ inch in length, in shape like an elongated Florence flask with the bottom a little produced and the neck much elongated. Its test is constructed like sand-paper, the particles forming essential constituents of the mass; and at the wide end there is a series of hairs formed by prolongations of the basis structure, with sand particles and mud attached. Within this test lies a series of interlaced muscular fibres, which cross each other at right angles, and which muscular coat can be readily separated from the internal (and somewhat fibrous) surface of the test. The bronchial sac is elongated, has its meshes of a square or slightly oblong form, ciliated at the edges, and is continued along the narrow part of the animal to the terminal apertures, the oral one of which has no tentacular fringes. Its structure, so far as the specimen was preserved, was detailed, and it was mentioned that its digestive system agreed in general with Pelonaia. In conclusion, the species differs from Pelonaia, as described by Forbes and Goodsir, in the extreme production of the portion sustaining the apertures; and in the structure of the test, which in *P. glabra* is thin and diaphanous, like parchment, and in *P. corrugata* thick, cartilaginous, and transversely wrinkled, while here it is like sand-paper. The shelf or transverse ridge in the interior of the mantle, as shown in the figure of *P. glabra*, is absent. It differs also very characteristically from the Boltenia. The same author communicated some remarks on the Turbellaria and Annelida of North Uist, of which he had found about 110 species, including many rare and some new examples. He also exhibited numerous coloured drawings of new and rare marine animals recently got in the Hebrides and St. Andrew's Bay.

A short discussion followed this paper, relative to the ectoparasitic nature of the Polynoina. Dr. P. Wright had observed *Polynoë scolopendrina* in a tube formed by itself. Dr. M'Intosh and Mr. Lankester have met with many Polynoina in the tubes of other worms, on which they fed.

NEW PARASITIC CRUSTACEAN.

The *Annals of Natural History* contains a memoir on a new Parasitic Crustacean, which presents such remarkable characters that the author, M. Hesse, assigns it to a new family. It is found commonly beneath the scales of the young of a fish named the green-streaked wrasse (*Labrus Donovani*). The vitality of this crustacean is very great, since it has been kept for a fortnight without food. It possesses much power, being able to bore tunnels in the body of the fish forming its habitation.

INFUSORIAL ANIMAL LIFE.

Mr. Jabez Hogg has contributed an able paper to the *Intellectual Observer*, on "Phases in the Developmental History of Infusorial Animal Life," in which the results of the most recent investigations touching the theory of spontaneous generation are recapitulated and discussed. The doctrine of spontaneous generation at one time afforded the only visible explanation of the appearance of insects or vegetations in situations where the access of eggs or seeds was believed to be impossible; as in the case of Mr. Crosse's *acarus*, which was found in a solution of silicate of potash through which an electric current was passing. But it has almost invariably been found, on more careful examination, that such phenomena were due to the intervention of seeds or eggs which had not been excluded; and the organic germs are often found to have been floating in the atmosphere. Since, however, the concurrent testimony of all improved investigation is to show that a parent is necessary to the generation of organic life, it is concluded that this truth constitutes a universal law, or, at least, that the *onus probandi* of any departure from it lies with those who advocate the opposite hypothesis.

Mr. Samuelson has communicated to the Royal Society a summary of his experiments on the development of certain Infusoria, in which he expresses his disbelief in the doctrine of spontaneous generation, as understood by Pouchet and his disciples. He states that he and Dr. Balbiani have observed the regular occurrence of monads in pure distilled water which has been exposed some time to the atmosphere. These or their zoospores seem to be wafted by the air with the particles of dust to which they cling. During his experiments in the hot weather of last summer with pure distilled water and lettuce water cercomonades first showed themselves. In the pure water they remained unchanged for three weeks, but in the lettuce water they disappeared in six or seven days, being succeeded by ciliated infusoria. Mr. Samuelson gives reasons for believing that the cercomonades are larvæ or earlier forms of the infusoria which succeeded them, but desires that his experiments may be tested by others.

SCOTCH PEARLS.

It is curious that, just as our Eastern pearl-fishery began to fail, a considerable supply of excellent pearls was derived from the rivers of Scotland. Mr. Unger, of Edinburgh, the chief dealer in these Scottish pearls, which are very beautiful, and the instigator of the trade in Scotland as now carried on, pays a great deal of money annually, chiefly to the peasantry in the neighbourhood of the pearl-producing rivers, for these Caledonian gems, many of which are of great individual value, the best kinds ranging in price from 5*l.* to 50*l.*; as much as 100*l.*, indeed, has been obtained for a fine specimen. It is not unlikely, it is thought, from the impetus given to the fishery by the dealers, that the streams of Scotland will speedily be exhausted, for mussels in Scotland are not found in beds, as in the sea, but individually or in very small clusters, which, of course, are greedily seized upon and at once destroyed, in the hope of obtaining a few of the gems. As regards the productiveness of the Scottish pearl-mussel, a practical hand tells us that one pearl is on the average found in every thirteen shells; but as only one pearl in every ten is saleable, it requires the destruction of 130 shells in order to find that one gem. Of course, shells are occasionally found that contain a great many pearls, but these are an exception to the rule; and it may be easily calculated, how long the capital stock of any river will stand out against the determined efforts of the peasantry surrounding it, when they know that, by a little exertion, they can pay their rent by collecting pearls.—*Cornhill Magazine* for August.

VAST AQUARIUM AT ARCACHON.

One of the greatest attractions at the late Arcachon Exhibition was its large Aquarium. This is composed of twenty-two compartments, forming a total length of thirty mètres, and is, consequently, larger than those of London and Paris. As it is situated on the sea-coast, certain species, which could not bear being conveyed from place to place, may be found in it, coming directly from the sea, and perfectly satisfied with their new abode, built of marble slabs, the depth of each compartment being a mètre. Among the strangest tenants of this watery palace, the *Physalis Pelagica*, of the same family as what is commonly called the "Portuguese man-of-war," holds the first rank. Its body consists of a large air-sac of a beautiful bluish mother-of-pearl tinge, and surmounted with a crest presenting the various hues comprised between purple and a brilliant red. From the body there issue splendid blue peduncles, ending in violet tassels composed of little filaments, each of which is in constant motion; also long spiral fibres constantly going up and down, and others formed of transparent pearls presenting all the colours of the rainbow. Next to this most curious and elegant creature, we see the cuttle-fish, with its elephant's head and undulating mantle of various hues; and the *Aplysia* of the coast of Africa, with its head like that of a hare, and its fins bordered with purple. These three magnificent species were never exhibited in an aquarium before. The task would be too long to enumerate all the strange denizens of the deep that have found hospitality at Arcachon, such as rays, torpedos, sea-horses, lobsters, sea-spiders (*Maia*), crabs, &c. When the aquarium had not been in existence more than a month, various curious observations had already been made in it. Thus, the sea-spider cuts off a leaf from some aquatic plant at hand, chews it into a pulp, and afterwards puts the latter upon its back. The consequence is, that its prey, seeing this green stuff, which it takes for an island or a tuft of grass, gets upon it, and the moment after has cause to repent its act. Many similar scenes are witnessed by the naturalist in this interesting collection, which, it is to be hoped, will outlive the Exhibition.—*Galignani's Messenger.*

MOLOCH LIZARD.

Mr. F. Buckland, in *Land and Water*, describes a healthy half-grown specimen of that lizard from Western Australia, the *Moloch horridus* of Dr. Gray, just received by the Zoological Society. Though studded over with formidable spines, it is a most inoffensive creature, which permits itself to be handled with impunity; and its colouring, blotched or mottled black and tawny, and general appearance, assimilate it to that of its haunts—dead-looking prickly shrubs, upon which it must needs await its insect prey, for it seems to be capable of hardly more speed than a chameleon. A more singular-looking reptile, and perhaps an uglier, in the estimation of most visitors, does not exist; and its aspect reminds us of certain prickly toads, as also of certain toad-like fishes, in general similarly coloured; and we may add also certain spiny and mouldy-looking locusts we happen to have seen, which frequent similar thorny shrubs. But it is a remarkable animal to be exhibited alive, and exceedingly well worth having a look at. We may remark that it did not feed during the voyage, and certainly looked nothing the worse for its long abstinence—a hint for future shipments of *reptilia.*

MUSCULAR FORCE OF INSECTS.

Prof. Plateau has made a series of experiments on the Muscular Force of Insects, an account of which, published in the *Bulletin de l'Académie* (Brussels), exhibits remarkable results. Traction, burrowing, and flying, were included in the experiments; and it appears that, while an ordinary draught horse exerts a force equal to two-thirds of its own weight, the common cockchafer (*Melolontha vulgaris*) exerts a force equal to fourteen times its own weight, and the *Donacia nymphæa* to forty-two times. Analogous results were obtained with the burrowing insects, but with flying insects the results were on a much lower scale. Prof. Plateau believes that the facts may be expressed in a law, thus: "If, in the same group of insects, we examine two species which differ considerably in weight, the smallest and lightest will exhibit the greatest force."

In a note in the *Annals of Natural History*, on the muscular force of insects, M. Felix describes the measures which he adopted to ascertain their strength, such as making an insect draw horizontally a thread passing over a pulley, and having at its other extremity a pan containing weights, which were increased up to the maximum that the insect could move. He measured the force developed in flight by attaching to the posterior legs of the insect a small mass of wax, which was at first too large for it to move, and was diminished until it could barely support it in the air by the movement of its wings. From the results of his experiments (some of which are given in a table), he has deduced that, leaving flight out of consideration, insects have, relatively to their weight, an enormous strength in comparison with vertebrata; and that if in the same group (family or tribe) of insects, we examine two species which differ considerably in weight, the smallest and lightest will exhibit the greatest force; a conclusion corresponding with that of Prof. Plateau. M. Felix found that the common cockchafer (*Melolontha vulgaris*) and the *Donacia nymphæa* exert a force equal respectively to fourteen times and forty-two times their own weight. This subject deserves more profound physiological investigation than it has hitherto received.

DOG-TICK.

PROF. WESTWOOD has exhibited to the Entomological Society a pair of the dog-tick, *Ixodes plumbeus*, which he had kept without food in a glass tube for twelve months, having taken them away with him from the meeting of this Society held in February, 1865, when they were produced by Major Cox; shortly afterwards a number of young ones were observed in the tube, which, however, soon died; but the tube was now again thronged with young in the hexapod state; the female parent was no longer living.

BUTTERFLIES AND MOTHS.

MR. NAPIER has read to the British Association an interesting paper on "The Food and Economical Value of British Butterflies and Moths." He reviewed the different classes of Moths and Butterflies, and noticed the species most injurious to valuable plants and stores, as well as those which were beneficial. Of the nearly 2,000 British species he considered 1,712 too scarce to be worthy of notice. He only mentioned 284—or 32 butterflies and 252 moths; and stated that of the caterpillars of the butterflies, seventeen, or more than one-fourth of the entire British species, feed on plants valued by man; and fifteen, or less than one-fourth, on those that are either troublesome weeds or little regarded.

COLOUR OF BUTTERFLIES.

MR. W. W. SAUNDERS has exhibited to the Entomological Society a box full of Heliconiæ, all taken in the same locality at

Cayenne, and including forms which have been described under seven or eight specific names; the examination of these specimens had convinced him that all of them were to be referred to a single species, *H. Melpomene*, or at most to two species. The form of the insects was constant, whilst the colours varied enormously, so that if his conclusion was correct, colour must henceforth be considered as of small specific value amongst butterflies.

SILK SPIDER.

The *Boston Journal* states that Dr. Wilder, late surgeon of the 55th Regiment Massachusetts Volunteers, has lectured in that city on a species of Spider discovered by him on Folly Island, in Charleston harbour, while in camp there in August, 1863. He wound from its body in one hour and a quarter 150 yards of yellow silk. The next year another officer wound from thirty spiders 3,484 yards, or nearly two miles of the silk. A single thread of this was strong enough to sustain a weight of from 54 to 107 grains. In 1865 Dr. Wilder showed his specimens to Professor Agassiz, and others, to whom the species was new. Returning to Charleston, he succeeded in getting a number of the spiders. In the course of the season these all died, from lack of knowledge as to their habits, mode of living, &c. From the eggs deposited, however, many others were produced. It is the habit of the stronger to devour the weaker, so that out of several thousands only a few hundreds were raised. The fact, however, was clearly demonstrated that they could be raised and kept alive through a northern winter. Specimens of the silk were exhibited, which was of a golden yellow and a silver white, and as brilliant as the metals in appearance.

POISONOUS BLACK SPIDER.

Professor Brayley has communicated to the Entomological Society an extract from the Report of Mr. Consul Zohrab on the trade of Berdiansk for 1865, respecting a poisonous Black Spider which had appeared amongst the wheat at harvest-time, had bitten more than three hundred persons, and created such a panic among the labourers that wages rose to double their ordinary rate.

LEAF INSECT.

The Garden of Acclimatisation in the Bois de Boulogne, at Paris, has received three specimens of the Leaf-fly, an orthopterous insect, which derives its name from its resembling a leaf of the guava-tree so closely that the most attentive eye can with difficulty perceive the difference. The first live specimen of this singular fly seen in Europe was brought to England some years ago, and was kept alive for a long time. The three insects mentioned above, were in the larva state, and were presented to the Garden by M. Vandal, Director-General of the

Post-office, and had been brought to France from the Seychelles Islands.*

THE DEATH-WATCH.

At a late meeting of the Entomological Society, Mr. F. Smith said that the doubt he had expressed at a former meeting as to the tapping noise alleged to be made by the "Death-watch," *Anobium*, had induced Mr. Doubleday to write him a letter, which showed that his doubt was unfounded. Mr. Doubleday stated that the beetle produces the sound by raising itself up on its legs as high as it can, and then striking the head and under part of the thorax against the substance on which it is standing; the noise was evidently a call-note from one individual to another, and he had rarely heard it without its being immediately answered. He had repeatedly kept an *Anobium* in a card pill-box, and if the sound was imitated by tapping any hard material with a pointed pencil, the prisoner would instantly reply. Mr. Wallace mentioned, that on recently repairing the oak roof of an old church at Colchester, which had been attacked by *Anobium*, it was found that the damage was chiefly confined to the south side, the other side being but slightly affected.

THE TSETSE FLY.

Dr. John Kirk, in the *Journal of the Linnean Society*, has given an interesting summary of what is known of the "Tsetse" Fly of tropical Africa (*Glossina morsitans*), derived from the testimony of Livingstone, Burton, Harris, Oswell, and others. Horses, cattle, and other domestic animals perish by its bite; while man, the goat, the ass, and most wild animals escape. The stung animal swells, and becomes blind before death. Three or four flies are able to kill a large ox. Dr. Livingstone lost forty-three of his cattle by the bite of the tsetse, and he believes that there were hardly more than a score of the flies near them at any time. Even savages will not eat the flesh of the bitten animals. The fly frequents open forest and well-wooded country, being absent from extensive grass plains. In the morning it is dull and sluggish, and may easily be caught; but in the heat of the day it becomes a real annoyance to the traveller. The effects of its bite on man resemble those of the ordinary mosquito bite—redness, swelling, and local irritation for about an hour. What in the common fly is a soft, fleshy proboscis, becomes in the tsetse a straight, horny, smooth, and polished bristle, having beneath it a slender, glassy style, the formidable biting instrument.

PLAGUES OF INSECTS.

The year 1866 will be memorable for the mischief done by Insects in many parts of the world; the visitation of locusts in

* See a full account of Leaf Insects, in Strange *Stories of the Animal World*, by the editor of the Year-book of Facts.

Algeria has been the most terrible case recorded; but, from nearly all parts, extraordinary accounts arrived of the devastation caused by one kind of insect or another. In France, grasshoppers were unusually numerous and large, and some were seen of a size that recall the locusts of hotter countries. In many places in the south the mosquitoes are said to have become a perfect pest, and all over the country flies and other insects are vexatiously abundant; whilst accounts from Louisiana stated the cotton crop to be in danger of being eaten up by the army worm.

The *Nebraska City News* says a shower of minute insects visited that place. "The air was filled with winged insects resembling in their flight the blow of the cotton-wood borne by the winds of spring. When viewed in the rays of the sun a heavy fall of snow seemed impending. The curious little insects were in two strata—the upper stratum passed in a direct course to the west, impelled by the stiff east wind which had been prevailing for some days. The lower layer was moving in every direction. Some of them would strike against the house sides, others again would sail towards the earth, as if with the purpose of alighting, but if any lit upon the ground they could only be seen while looking towards the sun."

The Council-General of the Department of the Seine-Inférieure has declared war against the cockchafer and its progeny. Having voted some 650*l*. for the destruction of the larvæ of this insect, about 160 tons weight (?) were brought in and paid for. This mass was buried in ditches and covered with quick-lime, making, it is said, ultimately an excellent manure, the larvæ thus being made to contribute to the growth of the vegetation which they would otherwise have destroyed.

WHITE ANTS.

Mr. E. L. Layard called the attention of the Entomological Society to the fearful ravages of a species of White Ant in the island of St Helena. The insect was introduced in timber about twenty years ago from the west coast of Africa, but only within the last ten years had its numbers become serious; he believed that, unless some effective means could be found to check its ravages, it would ere long be impossible to employ wood on the island for any purpose whatever; it was at present confined to James Town, which may truly be said to be devastated by it; the whole of the Cathedral is destroyed, the books of the public library are devoured, and it was noticed that the theological works were eaten first, which he (Mr. Layard) attributed to their being less consulted than most others, and the insects therefore less disturbed in their work of destruction. Everything in the town made of wood was more or less injured; and in the Government stores it was found that the moist traces of these insects on the outside of tin cases caused very speedy corrosion of the metal, and enabled the insects to make their way in and devour the contents; damage to the extent of many thousand pounds had already been done, and anyone who could suggest some effectual method of destroying this pest would confer a vast benefit on the inhabitants of St. Helena.

Mr. John Sanford writes to the *Athenæum*, calling attention to the fact, that "in West Australia, where white ants abound and destroy buildings to a great extent, it is found that the jarrah, or mahogany, as it is usually called, the botanical name of which is *Eucalyptus robusta*, is perfectly proof against their attacks. The following experiment was tried by my friend Mr. Peirce Clifton, while I was in the colony. He had a box made of jarrah wood, and locked up in it a quantity of white ants and specimens of every sort of wood that he could provide, both colonial and foreign. At the end of some months he examined the box, and found that all the ants were dead, but all the wood eaten, except the block of jarrah, and another local wood, which, however, does not grow to sufficient size to be of commercial value. The only objections to this wood are, that it is somewhat heavy, rather difficult to work, and, unless carefully dried, it is apt to warp and twist; it is obtainable at a moderate cost, and of any size up to forty-eight inches square and forty or fifty feet long; trees of this length, and squaring twenty-four inches, are abundant within easy reach of the sea. It would probably be not more expensive at St. Helena than any other good timber, as more vessels take cargoes to the colony than bring them away."

NEW INSECTS.

M. PASCOE has exhibited to the Entomological Society a small collection of interesting Coleoptera, received by the Rev. H. Clark from the Rev. G. Bostock, of Fremantle, Western Australia; including two new species of Articerus, an entirely new form, perhaps belonging to the Paussidæ, or perhaps more nearly related to Gnostus, and of which a description was read under the name of *Ectrephes formicarum*; also several species of Anthicus found in ants' nests; and other novelties belonging to the genera Ptinus, Hyocis, Platynotus, Mecynotarsus, &c. Prof. Westwood exhibited drawings and read descriptions of various new species of Goliath beetles.

DISEASE OF THE SILKWORM.

THE French Minister of Agriculture and Commerce having commissioned M. Pasteur to undertake some researches on the Disease of the Silkworm, that *savant* has communicated the results of his labours to the Paris Academy of Sciences. M. Pasteur's first care was to examine the peculiar black spots which seem to be a characteristic of the disease, and which have been called *vibrating corpuscles*; and he arrives at the conclusion that, although the corpuscle is undoubtedly a symptom of the disease, the silkworm may be in an unhealthy state without it. There may be no corpuscles in the seed, none in the worm, when just hatched, nor in the chrysalis, and yet the butterfly may be affected with them; and in that case we may safely conclude that it has caught the disease during the rearing, and that it is not hereditary. It is quite certain that healthy seed can only proceed from non-corpusculous butterflies. But all seed proceeding from corpusculous parents is not necessarily bad in a commercial point of view, for it may yield a remunerating quantity of silk, though it would not do for breeding. Nay, even a diseased seed may produce butterflies in a perfectly healthy state; this result, M. Pasteur believes, may be attained by observing great cleanliness and carefully removing the carcases of the dead worms. In order to see whether a lot of cocoons are likely to give good seed, M. Pasteur takes away a few twigs, containing in all about 100 cocoons, and puts them into a room apart, kept at a temperature of a few degrees more than that of the whole lot. In this way the butterflies get out sooner, and may be examined under the microscope. If these are not corpusculous, then the lot may be relied on for breeding purposes; if they are, it should be taken to the spinning factory for the sake of the silk. Corpuscles abound in the dust of the rooms where diseased silkworms have been reared, and if the mulberry-leaves which are given to the worms be sprinkled with this dust a great mortality will ensue. And yet the worms that die of this food have no corpuscles. In fine, M. Pasteur is of opinion that the disease has always existed, and that it is now only in a state of great development, owing probably to great mismanagement.—*Mechanics' Magazine.*

The epidemic which has of late years wrought such ravage among the silkworms has led to a vast amount of searching for substitutes for silk, and M. Joly, a well-known chemist of La Rochelle, conceives that he has at length found one likely to become of practical importance. He has found it, singularly enough, in the *sea*—that is to say, within the bodies of certain marine fishes. The exterior envelope, he tells us, of the eggs of the fishes in question consists of a very fine tissue composed of an immense number of exceedingly delicate filaments, which admit of being readily separated, and then exactly resemble those of ordinary silk. The eggs are twenty-five centimètres in diameter one way by thirteen the other, and weigh 240 grammes each, and in their interior is a white albuminous matter, which M. Joly believes can be utilised in calico-printing; and a yellow colouring matter, which he imagines may prove valuable as a dye. The obtainment from the envelopes of the eggs of a material for textile fabrics, closely resembling ordinary silk, he declares to be economically practicable on any scale.

THE OAK SILKWORM.

M. Camille Personnat writes to the *Times* as follows, concerning two letters which had appeared in that journal on his experiments in the acclimatising and cultivation in Europe of the Oakworm, *Bombyx Yama-maï*:—

"The first letter, written by Mr. Ward, is very favourable to my attempts to introduce so great a source of fortune into the west of Europe, for which I sincerely thank Mr. Ward. My constant success in rearing this new species, the numerous rewards I have received in various exhibitions or societies, the enthusiasm of the rural populations for this culture, prove to me that my efforts answer a great purpose.

"In the second letter, Mr. Elphinstone P. Robertson asserts, against what Mr. Ward has said after me, that the *B. Yama-maï* is not a native of Japan; and that he has discovered in Matheran, Bombay Presidency, several worms which fed upon a tree of the oak family, and whose moths and the *Yama-maï* were identical.

"I beg leave to observe that Mr. Robertson is not, doubtless, thoroughly acquainted with the matter, and that he mistakes one species for another.

"We already, indeed, know three species of silkworms, which feed upon the oak tree.

"First, the *B. Yama-maï* of Japan, where it was always exclusively cultivated. It is the most precious for the produce. The cocoons are of a beautiful yellow-greenish colour; the silk is as thin, fine, and light-brown as that of the mulberry-worm. It is the one which I have acclimatised in Europe, and which I am now rearing at Laval.

"Secondly, the *B. Pernyi*, of the north of China, which produces the gridelin cocoon and silk.

"Thirdly, the *B. Mylitta* of the hills of the East Indies, which produces a large cocoon and gray silk, which silk, like that of the Pernyi, is greatly inferior to the Yama-maï's silk. Evidently this is the species Mr. Robertson has discovered in Matheran, and that he doubtless mistakes for the Yama-maï mentioned in Mr. Ward's letter.

"On the subject of my rearing I have received a great many letters from England, in which I am requested to give information about the oakworms, their cultivation, and the means of getting eggs. Would you be so kind, sir, as to make it known, by inserting this letter in the columns of the *Times*, that I am now publishing a Guide (*Le Ver à Soie du Chêne, Bombyx Yama-maï*), which treats of the history, rearing, habits, and products of this admirable insect?

"As for eggs, I have been so much asked for them that I have but a few left to sell, the price of which is 11f. a gramma, post or carriage paid.

"CAMILLE PERSONNAT.

"Sericiculture School, 19, Bretagne Street,
"Laval (Mayenne), Feb. 18."

A VALUABLE present from the Tycoon of Japan to the Emperor Napoleon has reached Marseilles. It consists of no less than 15,000 cases of Silkworms, the more prized inasmuch as it has been clearly proved that Japanese silkworms produce a superior quality of silk to those of any other country, and are, moreover, less liable to the disease which has of late years caused so much distress to the silk-growers of the south of France.

BOTANY.

BOTANICAL GEOGRAPHY.

In a note by M. E. Boissier on some new facts in Botanical Geography, he refers to the discovery, in Europe and Asia Minor, of some species of plants which are particularly interesting, inasmuch as their congeners inhabit very distant regions. A specimen of the *Dioscoreæ* (to which the edible yam of tropical countries belongs) has been found on the Pyrenees; and a pelargonium (of a genus which includes our geranium) has been found in Cillicia. M. Boissier refers to similar discoveries and their relation to fossil species, and expresses a hope that as our knowledge of the flora of preceding geological epochs becomes more complete, we shall be better able to understand the distribution of plants at the present time.

CONGRESS OF BOTANISTS.

The Scientific Congress of English and foreign Botanists, under the presidency of M. de Candolle, of Geneva, has held its sittings at the South Kensington Museum. The president, on the first day, delivered his inaugural address in French. He commenced by defining the relative positions of the horticulturist and botanist, and showing what assistance each could render to the other. Gardens might, he observed, be made more useful in physiological researches. With this view he proposed that an experimental greenhouse be constructed wherein the temperature might be regulated for a prolonged time, and be made either constant or variable at will, to answer the purpose of physiological inquiry. He afterwards descanted on the fact that horticulturists who obtain new varieties give them designations which tend to a confusion in botany. He suggested that new varieties should not receive Latin botanical designations, but merely different arbitrary names, in order to avoid confusion, and without reference to the scientific nomenclature.

The undermentioned papers, on subjects of detail, were read:—Mr. Rivers, "On the Culture of Fruit in Unheated Glass Structures." Dr. Moore, "On the Climate, Flora, and Crops of Ireland." Professor Caspary, of Königsberg, "On the Change in the Direction of the Branches of Woody Plants, caused by Low Degrees of Temperature.' Mr. J. E. Howard, "On the Present State of our Knowledge of the Species of Chinchona." Professor Karl Koch, of Berlin, "On Systematic Botany."

The Congress reassembled next morning. M. de Candolle presided, as before. The first paper was read by Dr. Moore, who continued the subject he had opened on the previous day. Professor Lecoq, of Clermont Ferrand, described Byzantine colchicum and the method of cultivating it. Afterwards the same professor read a dissertation on the "Migration of Alpine Plants." Mr. H. Howlett read a paper "On Night Covering and Shading of Plant and Forcing Houses." On this question some discussion ensued. Mr. James Anderson, of Meadow Bank, Glasgow, made some observations on the temperature of water, and its effects upon plant cultivation, A discussion followed, in which Mr. Bateman, Professor Daubeny, Professor Reichenbach, and others, bore part. Dr. Dickson, of Edinburgh, expressed certain opinions, with regard to the leaves of Sciadopitys, which were contested by Professor Caspary, of Königsberg. Mr. Krelage, of Haarlem, then read a paper on the names of garden varieties and the confusion of their synonymy, especially with reference to bulbous and tuberous rooted plants. The president exhibited a recent and exact measurement of the diameter of a great *Wellingtonia Gigantea*, demonstrating, by the annular growths of wood, the extraordinary age of the tree. This demonstration excited the most lively interest. Professor Reichenbach made a series of observations on certain varieties of plants, stating that, though he had examined thousands of specimens, he had never been able to meet with a branched spike in an orchis. This point was discussed at some length. Professor Horren, of Liège, read a paper "On the Influence of Gaslight on Plants;" and Mr. W. G. Smith one "On the Corona of the Narcissus."

FLORA OF PENNSYLVANIA.

At a recent meeting of the American Philosophical Society, it was stated that the native Flora of Pennsylvania was rapidly yielding to the inroads of a foreign flora. Plants which one of the leading botanists in the United States had described as rare were becoming plentiful, and had taken possession of the valley of the Susquehanna. Numerous plants, not indigenous, had appeared in the yard of the convict prison at Philadelphia. In this instance, the strangers were supposed to have been introduced in the wool brought in for manufacture by the convicts; but the change of the flora on the large scale was attributed to the spread of railways; and some of the botanists present at the meeting expressed their opinion that the "foreign" flora would supplant the native in a comparatively short period.

PRAIRIES.

Mr. A. Fendler, in a paper on Prairies, in the *American Journal of Science*, states that, in his botanical rambles, he has seen prairies, llanos, and savannahs, of different magnitudes, and in different stages of progress. Contrary to the opinion of some philosophers, he does not think that the prevalence of moisture, although generally, is always connected directly with the prevalence of forests. He describes the coexistence of an immense primeval forest and most extensive savannahs in one of the most rainy, humid regions on the northern coast of Venezuela. He considers that by far the most powerful and principal agency that gave prairies and savannahs their existence is fire, which is still extending them. He mentions that, in February, 1857, a boy, by means of a lucifer-match, set fire to one of the great primeval forests. Over whole tracts the trees now lie dead, as if uprooted by a whirlwind. The subsoil is very shallow, and rests on hard rocks; hence, the roots of the trees do not go down very deep, but extend laterally. When the spongy layer and the smaller roots are burnt, the trees lose their hold and fall, dying less from the fire than from being uprooted. Many kinds of tall reeds soon supply their place. These are intentionally burnt off, and give way to the growth of the smaller grasses; and thus savannahs and prairies are probably formed.

The origin of Prairies is the subject of an article by Professor James D. Dana, in the *American Journal of Science.* In his *Manual of Geology* he refers to the degree of moisture as the most influential of all the causes which tend to determine either the presence of forests or the absence of prairies, in which he is supported by Professor Guyot. As Professor Winchell and Mr. Lesquereux have recently propounded a theory which supposes that the soil of prairies is of lacustrine origin, produced during an epoch of a vast inland sea following the glacial epoch, Professor Dana has been led to give further details of the facts supporting his opinion, being the results of observations in various parts of the world. The following are the conclusions at which he arrives:—That a prevalence of moisture is connected directly with a prevalence of forests; that in a moist region soils of all kinds not under water may become forest-covered; that grass regions may encroach on forest regions, or the reverse, according to the dryness or moisture of the country; and that, consequently, if moistness be especially favourable to the growth of forests, a change in the moistness of a region, occasioned by geological events, would be attended by a change in the adaptedness to such growth.—*Illustrated London News.*

GUM COPAL.

Dr. Welwitsch's observations on the origin and geographical distribution of the Gum Copal of Angola, West Tropical Africa, read at a meeting of the Linnean Society, have appeared in their *Journal.* Large quantities of this resin are stated to be collected by the natives in the sandy soil of an extensive hilly tract of barren country, studded with thorny bushes, with no large tree except the *Adansonia.* The gum is dug out of the earth by the copal gatherers at various depths, from two or three to ten or more feet, in a manner resembling gold-digging; and great excitement appears when a good amount is discovered. The gum is found in various shapes and sizes, resembling a hen's egg, a flat cake, a child's head, &c. There are three kinds—yellow, red, and whitish; and the first furnishes the best varnish and fetches the highest price from the dealers. Many of the natives assert that the copal still grows on different trees, and that it acquires its excellent qualities as a resin by dropping off and sinking several feet into the soil, whereby it is cleansed and obtains, after the lapse of many years, its hardness, inflammability, and transparency; but Dr. Welwitsch, after considering the statements of travellers and his own observations, expresses his opinion that the West African copal, and probably all gum resin exported under this name from Tropical Africa, may be looked upon as a fossil resin produced by trees of periods long since past, and which are now nearly extinct or exist only in a dwarfed posterity. As evidence, he refers to the petrified crust on the surface of this copal, to its admitted occurrence in the earth, often at a considerable depth, and to its great resemblance to amber.—*Illustrated London News.*

VEGETABLE ASHES.

M. EUGENE MARCHAND has published, in the *Annales de Chimie*, the results of his laborious researches on the composition of Vegetable Ashes (of oats, potatoes, beetroot, carrots, peas, &c.). In addition to the carbon which they derive from the atmosphere, plants draw from the soil in which they grow or from the waters which bathe them all the principles which enter into their composition. Besides carbon the chief are oxygen, hydrogen, and nitrogen. In their ashes are found potassium, sodium, and other metals; chlorine, iodine, bromine, and fluorine, phosphorus, sulphur, carbon, silicium, and sometimes arsenic, but never aluminium, although alumina is nearly always diffused in great quantity in the different kinds of soil invaded by vegetation. The results of M. Marchand's experiments are given in a series of tables, which he presents with confidence, although the figures may differ from those given by other chemists.—*Ibid.*

THE SENSITIVE PLANT.

DR. SIGERSON writes to the *Athenæum*:—"Some months ago it occurred to me that the motion of the folioles of the Sensitive Plant, on being touched by the finger, might be due to the transmission or interchange of electricity between the two points in contact. Impressed with this idea, I took the opportunity a few days ago of putting the matter to the test, by using for the purpose of touching the folioles a non-conductor, a steel conductor and the finger. The experiment quite answered my expectations, as the subjoined letter from my friend, Prof. Divers, will testify. The plant, I should state, was in flower, and at this period it is probably more sensitive than at other times. On the 12th August I experimented three or four times; and on the 19th I again repeated these trials with a similar result, so that the care-taker spontaneously remarked upon the difference of the effects produced. They were these: on touching gently and even lightly pressing the folioles with glass they remained as they were; on touching them with steel held in the fingers, or (in other instances) with the fingers, they made their usual movement. Again, before I applied these tests, a gentleman asked me to explain how it happened that the plant moved more readily when touched by any of his children than by himself. He had seen this take place several times, and could not account for it. I thought it harmonised exactly with my theory, and have since had reason to believe that with the same individual the action will be more evident when he is in a tonic state (if I may use the expression) than when he is exhausted and weary. Although what I have shown goes to prove that the passage of electricity between the points in contact will account for the movement of the folioles in such instance, I do not mean to say that whenever the foliole moves there must be contact with a conductor. For I hold it possible that the plant may be capable of developing within itself sufficient of such force to close its folioles (a seemingly protective movement) if roughly handled. From what I had observed with regard to the sensitive plant, it appeared to me probable that the fly-trap movement of the processes of the *Dionda muscipula* was due to the same cause. Having gently touched these exteriorly, I was disappointed to find no result produced. Laying the tip of the little finger (in two cases) softly within the expanded processes, I found them to close, whereupon I immediately withdrew it, that there might be no possibility of injury to the plant. I thought the fact almost valueless, as there was no opportunity of testing what would be the action with a non-conductor. However, but a few moments had elapsed, when my attention was drawn to a distinctly painful sensation in the ulnar nerve at the right elbow—it being the little finger of the right hand I had used. This sensation persisted for some time; then imperceptibly passed away. I admit that the subject is capable of many more tests and much more development than I can give it in this letter, or at this time. Now, when the rigid limit drawn by the old naturalists between the animal and vegetable kingdoms has been found untenable, there will be many, I presume, to admit that, *à priori*, there is no absolute reason why individuals of the former kingdom should be endowed with power of generating electricity essentially denied to all members of the latter; few, also, I believe, will assert the antecedent *impossibility* of any of those plant-organs, termed 'vessels' and 'ribs,' subserving, in a very restricted sense, it may be, the purpose of nerves.—I am, &c., "GEORGE SIGERSON, M.D."

The following is a copy of the letter from Dr. Divers, referred to above:—

"Charing-cross Hospital, London: August 15, 1866.

"My dear Dr. Sigerson,—At your request I am very glad to be able to acknowledge witnessing the interesting fact you showed me at Kew, on the 12th of the present month, concerning the sensitive plant. The fact was this, that while the leaves of the plant proved highly sensitive to the slight contact of your finger, or of a piece of steel held in your hand, they were not sensitive to the similar contact of glass. This fact was new to me at the time.—Yours, my dear Dr. Sigerson, very truly,

"EDWARD DIVERS, M.D."

From Greytown, Nicaragua, Mr. W. E. Hamilton writes:—"In a letter of Dr. Sigerson's to the *Athenæum*, he states that the folioles of the sensitive plant were touched by him with a non-conductor, and exhibited no movement. The sensitive plant is a common weed here, and is at present, as in his experiments, in flower. I touched it with glass, sealing-wax, iron, and the hand, and in all cases found the usual movement, which also took place when the plant was gently blown on with the breath. No such difference as, on any electrical hypothesis, we should expect, existed between the sensitiveness of the ends and middles of the folioles. Another fact about the sensitive plant, which the electrical theory does not explain, is the closing of the leaves at night. Perhaps the more hopeful question would be, not "why do they shut?" but "why do they open?" And I may be permitted to guess that the solar rays in the morning, or the solar diffused light, throws the molecules of the folioles into some new condition, the result of which is their opening, and that such a molecular condition is destroyed by the vibration caused by touch. What this molecular condition is, perhaps we shall never know, or, if ever, through microscopic analysis. Dr. Sigerson's observation, that children affect the sensitive plant more than adults, I confirmed by comparing the effects of my own touch with that of a child of seven years old, who affected the plant more powerfully than I could do.

"W. E. HAMILTON."

THE SUGAR-CANE IN PERU.

THE Sugar-cane flourishes in Peru, and the manufacture is conducted on the most approved principles. The sugar is very fine in quality, and white in colour, with small crystals, and worth, in the opinion of good judges, 27*s.* to 28*s.* in bond. The flavour more resembles date than sugar-cane. If such fine sugar be produced to any extent, there can be no doubt that a large trade will result; but it is doubtful whether the great distance of Peru from Europe would not, by heavy transport charges, partially shut the produce out from our markets.

VEGETABLE PARASITES OF THE HUMAN SKIN.

THE *Quarterly Journal of the Microscopical Society of London* contains a valuable paper, by Mr. Jabez Hogg, on "The Vegetable Parasites of the Human Skin." The object of his paper is, to show that vegetable parasites do not produce different varieties of skin disease; but that when certain diseases already exist the fungi, finding a suitable soil, greatly aggravate and often change the type of the disease; that these diseases are always associated with neglect of person, dirt, bad air, want of light, and deficient nourishment; that the spores of fungi are always floating about in the atmosphere, and are ever ready to be deposited and take root in a favourable soil. Of this Mr. Hogg gives many illustrations, and shows that, although yeast, and other well-known fungi have been separately classed, nevertheless, they could be made to pass through the same changes, and produce ferments that could not be recognised one from the other; and, therefore, difference of form he believes to be entirely due to the soil or nourishment supplied, and dependent on such circumstances as whether the growth of the fungi takes place in a sickly plant, a saccharine solution, or an animal tissue.

VEGETABLE POISONS.

Professor Schnetzler has reported, in the *Bibliothèque Universelle* of Geneva, the results of his experiments on the action of the Curare, and other Poisons, on Plants, which have led him to conclude that plants die under the influence of poison in the same manner as the inferior animals, whose bodies are principally composed of sarcode. In both cases the poison produces in the protoplasma, or living matter, changes which destroy its contractility and power of moving. Plants and animals resemble each other in very many incidents of their lives; and this analogy extends also to the manner of their death under the action of poisons. Professor Schnetzler describes the effect of poisons upon the sensitive plant, barberry, nettle, &c.

PHYSIOLOGY OF TREES.

Mr. Arthur Gris has reported to the Paris Academy of Sciences the following results of his latest researches into the Physiological History of Trees. He asserts that nutritive substances occupy the amyliferous (starch-bearing) tissues of the trunk during the greater part of the year, the time when they are wanting being very short, and to be reckoned by days rather than by months; that the starch secreted in the summer seems to remain immovable during the ripening of the fruit; and that there are only two great movements of nutritive matters in the interior of the trunks of trees—the production of these matters in summer and their re-absorption in the spring.

HUNGER PLANT.

The *Erythoxylon Coca*, a Peruvian plant, has been found to possess the property of quelling the sensations of hunger and thirst for several days. M. De Rossi reports the fact from experiments on himself. The decoction of a hundred grains produced the effect for forty-eight hours, the muscular powers being preserved. The plant appears to narcotise the nerves of the stomach and suspend the digestive functions, without affording any nutriment. It may become a useful medicine.—*Cosmos.*

THE TALLOW-TREE.

The Tallow Tree, of China, which gives rise to a vast trade in the northern parts of that empire, has been introduced into India. It grows with great luxuriance in the Dhoons and in the Kohistan of the North-Western Provinces and the Punjab, and there are now tens of thousands of trees in the Government plantations of Kowlaghir, Hawul Baugh, and Ayar Tolie, from which tons of seeds are available for distribution. Dr. Jameson prepared from the seeds 100 lb. of tallow, and forwarded 50 lb. to the Punjab Railway, in order to have its properties as a lubricator for railway machinery tested. For burning, the tallow is excellent; it gives a clear, bright, inodorous flame, and is without smoke. The tree fruits abundantly, both in the Dhoons and plains, and grows with great rapidity; many trees raised from seeds, introduced eight years ago, being now 6 ft. in circumference and 3 ft. from the ground. The timber is white and close-grained, and well fitted for printing-blocks. The leaves, too, are valuable as a dye.

THE GRASS-TREE.

There are few who have ever travelled any distance in Victoria but have met with the Grass Tree (*Xanthorea*), which is to be found in nearly all parts of Australia. Up to a very recent date it was supposed only to be a useless growth, encumbering the land. A few knew from the blacks that it contained a very tenacious gum—the blacks used it as a glue for joining parts of their weapons; but it is only within the last few months that the following valuable articles have been obtained, after great labour and expense, by a Mr. Dodd. St. Ronan's, the place where Mr. Dodd has erected his works to carry on the experiments, is situated about eighteen miles in a southerly direction from Colac, and here for some months past experiments have been carried on in connection with the grass-tree. The root is the portion used in these experiments, and usually weighs from 10 lb. to 50 lb. The root is composed of the stems growing in a close mass around the inner portion or kernel. From the outer portion of the root gum-shellac in large quantities is obtainable; the refuse contains a large quantity of gas, and can be made available for lighting the works. From the inner portion is extracted, by pressing or distilling, a spirit equal to the best brandy, also alcohol; after distilling, a quantity of saccharine matter remains, from which sugar can be extracted. The present supply of grass-tree in the neighbourhood of St. Ronan's is computed to be equal to a supply of 600 tons per week for the next ten years. Great quantities of young grass-trees abound, which will keep the supply up, and doubtless cultivation would greatly enlarge the roots.—*Melbourne Herald.*

CULTURE OF TRUFFLES.

MR. BROOME has communicated to the Royal Horticultural Society a paper on Truffles and their Culture, containing important hints and recommendations for increasing the production of these delicate articles of food. Mr. Broome shows good reason for encouraging their cultivation in our parks and plantations, and states that as the districts especially suited are those situated on the great band of calcareous beds which run diagonally across the island from the S.E. corner of Devonshire to the mouth of the Wash in Norfolk, it is to the proprietors of lands in these districts that we must look for any successful attempts to cultivate these fungi.

THE FUNGI OF GREAT BRITAIN.

AMONGST the recent additions to the Food Department in the South Kensington Museum are thirty large drawings (of a series at present incomplete), by Mr. W. G. Smith, of the principal edible and poisonous fungi of Britain. Although similar drawings to a smaller scale are found in some of the Continental museums, this is the first time any reliable drawings from nature, with the necessary sections, have been made for educational purposes for any museum in this country. A reference to the portraits of these equivocal productions will show what weird and curious aspects some of these plants, so common in our pastures and woodlands, present—so valuable, when understood as additions to the table, and so dangerous, when the poisonous species are by accident substituted for the esculent.

We trust this series of drawings will tend to prevent repetition of the cases of poisoning we constantly read of every autumn. The real *seeds* (or spores) of various species also exhibited, call to mind the mysterious brown powder poison of the gipsies, called "drei," confessedly extracted from fungi, and of which we heard so much a few years ago with no final result.—*Mechanics' Magazine.*

WATER IN HORTICULTURE.

IN the *Journal of the Royal Horticultural Society* we have the conclusion of Professor Schultzenstein's paper on the constituents of Water, in which he asserts positively that pure pump, spring, or river water contains an inexhaustible supply of nutriment; that it is the real staple food for plants; and that the knowledge of this is calculated to throw light on many puzzling phenomena in vegetable physiology and culture. The art of making water nutritious should be the true aim of horticulture and agriculture. The Rev. W. Kingsley gives an illustrated note, describing his method of border-heating. By placing pipes for the circulation of hot water among drain-tiles under the earth, near the roots of trees, he maintained a temperature equal to that of a very gentle hotbed, during the winter months. He thus (at South Kilverton) obtained fruit of excellent flavour, which otherwise could not have been ripened. He considers his system as yet as merely an experiment.

REPORT ON KEW GARDENS.

Dr. Hooker has presented the Annual Report on the Botanic Gardens; he describes the influx of visitors as exceeding that of the year 1864 by nearly 50,000 persons. Of the whole number who went to Kew Gardens during the last year, 260,040 arrived on Sundays, and 269,201 on week-days; the total was 529,241. The greatest monthly attendance was in June (115,815), the smallest in February (2,792); the greatest week-day attendance (June 5th) was 19,849; the smallest (October 26) 9 persons only; the greatest number who presented themselves on a Sunday (July 30) was 16,842. In the Botanic Gardens Dr. Hooker reports, that a rapid improvement is visible, which is partly due to official arrangements, but mainly to the skill of the Curator, especially in the orchid and fern collections, the palm-house, the cacti, and other succulents. Among desiderata are types of the vegetation of South Africa and Australia, the old plants being worn out; also, new orchids, palms and tree-ferns, a stock of useful plants for exchange, improvements of lawns, flower-beds and shrubberies by the introduction of new and uncommon ornamental plants. No alterations of consequence have been made in the grounds. A very important alteration was the conversion of the "Victoria-house" into an "economic plant-house," to be devoted henceforth to the display of a selected set of tropical plants, which are useful for food, or as drugs, or in the arts. This will save visitors the trouble of searching the large collections in the palm-house, &c., for what they most wish to find readily. The success of the Victoria Regia, in the larger house built for it, renders it inexpedient to devote another to it. Space is needed for water-plants; it is desired to heat a small tank in the open air for this purpose, in which even tropical water-lilies may be seen to flower freely. A small collection of Japan plants has been brought together near the heat-house No. 14. The collection of cacti, aloes, succulents and bulbs, in No. 7, has been materially increased, chiefly through the liberality of W. Wilson Saunders, Esq., whose almost annual contributions are both the most valuable and the most numerous the establishment has received since its foundation. From India and the colonies satisfactory accounts continue to be received of the progress of botany under the various colonial botanists and heads of botanic gardens, who were, for the most part, sent out from Kew by Sir W. Hooker. From Ceylon ripe seeds of cinchona have been transmitted, *viâ* Kew, to Jamaica, Trinidad, the Mauritius, Cape of Good Hope, Queensland, &c. As the first fruits of the introduction of cinchona into our eastern possessions, this event marks an epoch in the history of the drug, and reflects credit on the able manager of the Indian plantations. That officer reports favourably of the condition of various plants transmitted to the island of Ceylon, and continues to send most valuable collections of economic plants, ferns, and orchids. In India proper the cinchona plantations are flourishing, also in Trinidad. The Governor of Queensland reports the discovery, by Mr. W. Hill, Director of the Botanic Gardens, Brisbane, of a most valuable tract of well-watered land in the neighbourhood of Rockingham Bay, which is admirably suited for the cultivation of sugar, cotton, indigo, &c. At Brisbane, coffee, cinnamon, mango, tamarind, cotton, all-spice, ginger, indigo, tobacco, and *Cinchona calisaya* have been cultivated with complete success.

No important change has been made in the museums at Kew. The herbarium has received two most valuable additions by means of the collections of orchids of Dr. Lindley (by purchase), and the gift, by his sister, of the South African and South American collections of the late Dr. Burchell; these were two of the most important private collections in Europe. The former is the key to the nomenclature of the vast and important variety of orchids, and contains 3,000 specimens in perfect condition, mounted, and copiously illustrated with sketches and dissections by Dr. Lindley. Dr. Burchell's South African collection comprises 12,000 specimens, ticketed; that of South America (Brazil) comprises 52,000 specimens. Dr. Hildebrand, of the Sandwich Islands, has presented a most important collection (580 species) of plants of those islands. The plants collected during Lieut.-Col. Pelly's Arabian journey have been presented by him to Kew. Of publications connected with the herbarium and library at Kew the following are the most important; the second part of the *Genera Plantarum*, by Mr. Bentham and Dr. Hooker; the third volume of Mr. Bentham's "Flora Australiensis" is nearly completed; the third volume of Drs. Harvey and Sonder's "Flora Capensis" is published; the fourth volume is in progress; a very valuable and laborious work on the African *Leguminosæ*, by Mr. Bentham, has been published by the Linnean Society. "The Flora of Tropical Africa" is being prepared by Prof. Oliver. The number of donors, &c. to the herbarium has been unprecedented, comprising eighty persons and institutions; the number of specimens received is nearly 100,000.

MOUNTAIN SILK OF NORTH CHINA.

In this country the best Silk is produced by nourishing the worms on the leaves, not of the oak, but of the "Tseen-tso-tsze," which exists, however, only in small quantities. The chrysalids which are not kept for breeding are used by the Chinese as an article of food. Not a tenth of the hillsides suitable for the oak-bushes are at present planted with them. But considering the quantity of silk already produced, it may be taken that the trade could be developed into one of appreciable importance even for our great manufacturing interests, unless exactions and jealousies of the local mandarins interposed to repress it.

PROBABLE EXHAUSTION OF COAL.

At page 77 we have given an abstract of Prof. Jeavons's views on this important question, as stated by him to the Scientific Students' Association, at Manchester.

It was during the Meeting of the British Association at Nottingham that public attention was drawn to this question by the following letter in the *Times*:—

"Permit me briefly to comment upon the following extract from your report of Mr. Grove's Inaugural Address to the British Association now assembled at Nottingham:—'At a moment when the prospective exhaustion of our coalfields, somewhat prematurely, perhaps, occupied men's minds, there was much encouragement to be derived from the knowledge that we could at will produce heat by the expenditure of other forces.' You interpret this passage as a promise, on the part of the author, that there will result 'an inexhaustible stock of heat for our railways from the creative powers of science, when our coalfields give way;' and such, assuredly, will be the interpretation of the public in general.

"Now, while the doctrine of the mutual convertibility of various forces may be received as established on satisfactory evidence, it should be clearly understood that man has no power to create even an infinitesimal quantity of any force. The creation of force is the sole prerogative of the Great First Cause. The power of man is limited to the application of pre-existing forces by the action of his muscles under the direction of his brain; and the exercise of his muscles, as well as the function of his brain, is wholly dependent upon the evolution of force from his food. That food is matter which has been elaborated under the influence of solar light; or, in other words, it represents a store of force derived exclusively from the sun. Although the food of man consists partly of vegetable and partly of animal substances, yet both owe their existence directly or indirectly to that light. Purely carnivorous animals form no exception to this universal law; for they prey upon other animals which are herbivorous. Let the sun be extinguished, and every living thing would speedily die. Hence it appears, that man is, as it were, only a vehicle of pre-existent natural force, to be applied as his inscrutable will may determine. However humiliating this view may be to proud spirits, it is nevertheless undeniably true.

"The black thing which we call coal may be dug out of the earth by the expenditure of an amount of muscular force excessively minute compared with the force which it is capable of evolving when burnt. The force is in the coal, and coal is, so to speak, an accumulation of sun force, inasmuch as all coal may be shown to have been derived from plants, and all plants from solar influence. Although Mr. Grove has laboured earnestly and successfully in the investigation of the electric forces, yet never has he generated an atom of those forces, except from some other pre-existent force. Like Franklin, he may have conducted lightning from the clouds, but that is irrelevant. By a simple system, of which he tells us, he has directly converted mechanical force into heat; and, conversely, every one knows how, in the steam-engine, heat is converted into mechanical force. It was Mr. Grove who contrived the compact energetic little battery bearing his name, which enables us so easily and so quickly to produce intense heat from electric force. That force, however, proceeds from the oxidation of a metal which occurs in nature, either in combination with oxygen or another element, from which it is separated by the action of the strong heat of burning coal or other fuel.

"It is fair to expect that a philosopher of sound reputation like Mr. Grove, especially when speaking to the world in the capacity of President of the British Association, would not hazard even a conjecture as to the future probable discovery of a substitute for coal without some reason. Yet no reason has he assigned; and allow me, sir, through your columns, to challenge him to produce one. Should he respond triumphantly, no one will rejoice more than yourself, I am sure, and more than the writer of this letter. If he fail to do so, then the 'encouragement,' of which he speaks, will be regarded as groundless and delusive, not to say mischievous."

Professor Rogers, President of the Section of Economic Science and Statistics, has expressed his opinion that the material wealth of Great Britain is owing more to its geographical position than to its manufactures, and consequently to the possession of coal, upon which those manufactures largely depend; and he predicts that "so long as its people are industrious and resolute" it will be "the highway and the mart of nations." But, supposing our manufactures greatly to decline, as inevitably will be the case when our coal either is exhausted, or, what is equivalent, has become much dearer than the coal of other manufacturing nations, to what, it may be asked, is the industry of our people to be devoted? Not to agriculture exclusively, for our population at present is greatly in excess of what is needed for the cultivation of the land. What is happening at this moment in Cornwall, from the exhaustion of its tin and copper, will infallibly happen to Great Britain generally, from the future exhaustion of its coalfields. Emigration is the only alternative, sad as it may seem, and accordingly the process of comparative depopulation has begun in Cornwall. There may still be plenty of tin and copper in that county; but if, in these days of free-trade, they cannot be raised at a remunerative price, owing to foreign competition, then, in a commercial point of view, they may be regarded as worthless; and just so will it hereafter be with respect to our coal, when a similar condition arrives.

The statements published in the *Times* were repeated, and more fully detailed, in the very able and comprehensive speech with which Mr. Hussey Vivian prefaced his motion in the House of Commons on the 12th of July, for an address to the Crown for the appointment of a Royal Commission to investigate the present state of the coalfields of Great Britain, and questions connected with the present rate of consumption, and probable duration of that supply. The honourable member referred to the introduction of the subject some years ago by Sir William Armstrong, then President of the British Association, who spoke in a manner calculated to awaken grave fears. Subsequently, the works of Mr. Hull and Mr. Jeavons appeared; the member for Westminster brought the matter under the notice of the House of Commons, and the Chancellor of the Exchequer dwelt on the subject on one of the gravest occasions on which he was called on to address the House. The importance, therefore, of a clear and distinct statement of all that science can teach us on the subject, cannot admit of question. The main points of enquiry are, the depths at which coal can be worked, the effect of depth in increasing the cost of working, the quantity existing or calculated to exist in our present coalfields within a practicable depth, and the contents of those fields which as yet are undiscovered, but of which the possible existence is indicated by geology. The question of the rate of consumption would remain after all the others were disposed of.

"With reference to the future supply of coal in this country," (says another Correspondent of the *Times*,) "we must all naturally look with some impatience to the Report of the Royal Commission appointed to inquire into the question; but I must confess that when I see the scientific and coal-owning elements alone represented in that Commission, and the commercial element absent, I do not look for an entirely disinterested and comprehensive Report; especially when it is the interest of every coalowner to work out as much coal as he can during his lease, leaving the future to take care of itself; and therefore few coalowners will be led to believe that the supply is failing, and should be restricted to national purposes, or that coal will not be eventually found under the Permian strata, the chalk, or London clays. It is contrary to the teachings hitherto of our most practical geologists and coal viewers, if such should be the case. At all events, to my mind, coal will have been imported into this country from America long before coal shall have been worked at the extraordinary depths required to reach it under such circumstances.

"In conclusion, I think that few will deny that coal is being wrought excessively in this country, and for its growing needs must still continue to be worked; but while a conscientious disciple of the free-trade doctrine, I am thoroughly convinced that there are limits and exceptions to it, and that no coal should be allowed for export, except under a heavy duty—say of 5*s.* per ton. Wine free of duty is no equivalent for our coal. Grapes are reproducible; coal is not. Hence the difference.

"The export of coal is 9,000,000 tons, representing one-tenth part of all that is wrought and raised in the United Kingdom. Surely this is a saving worth making in the interest of the present and the future."

At the meeting of the British Association, Sir Roderick Murchison read a paper "On the various Tracts of England and Wales in which no productive Beds of Coal can reasonably be looked for." He began by referring to the ingenious theory of Mr. Godwin Austen, that coal might be found under London and in the south-east of England. Mr. Austen argued that, as coal was worked under the chalk of Valenciennes, and had been found to a certain extent in recent sinkings under the cretaceous deposits ranging westward towards Calais, it might further extend across the Channel, and be found under similar rocks in the south of England. But reflection on the order and nature of the rocks in the south-eastern counties led him to the opposite conclusion. He thought that no productive coal-measures could be looked for in Essex, Kent, Sussex, Middlesex, Hertford, Berkshire, Oxfordshire, Suffolk, Norfolk, or the eastern counties. In this hopeless list Nottinghamshire was happily not included; but to it must be added all the numerous tracts wherein rocks older than the carboniferous rose to the surface, as in the greater part of Wales and Herefordshire, in all of which, of necessity, no coal could be found. A great portion of Lincolnshire and the East Riding of Yorkshire would be equally unproductive. The district between Croft, Middleton, One Row, and Middlesborough was also destitute of coal. At the last-named place Mr. Vaughan had sunk to a depth of 1,800 ft., and had there come to a bed of rock-salt. Mr. Webb, of Newstead, was now making borings on his estate near Northallerton. There was no proof that the Newcastle and Durham coalfields extended beyond the mouth of the Tees. He admitted, however, the possibility of sinking those beds at greater depths. There was no coal in the district between Barnard Castle and Harrogate. Sir R. Murchison said he would give no opinion on the duration of our coalfields until the Royal Commission on the subject had completed their inquiry. In 1865 the consumption in this country was 100,000,000 tons. Most judiciously, therefore, had Sir W. Armstrong aroused attention to the subject at the Newcastle meeting of the British Association, and he had now simply to inculcate on the public not to believe in the almost boundless range of our coalfields which some would assign to them.

The Director of the Geological Survey of India, Dr. Oldham, states, in his last Reports on the coalfields, that about 400,000 tons are raised annually in Eastern Bengal, while the large deposits in other parts of the empire appear to be neglected. The great beds in the valley of the Nerbudda, and in the Kurhurbari district, still lie undisturbed; but the latter will soon be traversed by a railway—a chord of the East Indian line. Another extensive deposit is the Peuch coalfield, discovered in 1852 by a missionary, the Rev. J. Hislop, in the Chenduara district of the Central Provinces, which is described as the thickest in India. Assam, too, besides its plantations of tea, abounds in coal of "rich" quality. Hence it is expected that, in course of years, there will be a great coal-trade in India. The demand for consumption on railways must necessarily increase; and when once a steady coal traffic is established between the mines and the coast, the Peninsular and Oriental, and other trading companies, will take their supplies from thence, and save the heavy expense of sending out coal from England. Among the advantages that may naturally be anticipated, will be a reduction in the cost of travelling in Indian waters, and between India and Egypt.

THE SOUTH WALES COALFIELD.

In a paper read to the South Wales Institute of Engineers, the Duration of this Coalfield is treated of by Mr. Bedlington, of the Rhymney Works. He estimates that the upper and lower seams of the district, of 2 ft. and upwards in thickness, contain a total of 21,374,976,000 tons of workable coal, and, after deducting the comparatively small quantity already worked, there is left the enormous total of 21,000,000,000 tons. This calculation is based on the Ordnance surveys and other recognised authorities, which show, that the aggregate area of the coal basin is 866 square miles, and Mr. Bedlington, in his paper, estimates that each acre will yield 1,200 tons, after making due allowance for faults, loss in working, and other drawbacks. The lower seams contain by far the largest quantity, and, in order to work the coal, it will be necessary to go down a depth of 1,000 yards, which is believed to be the greatest depth in the centre of the basin. In Lancashire there are now pits 700 yards deep, which are successfully managed, and from the constant improvement that is taking place in mechanical appliances there is every probability that long before the coal of the lowest strata is required, the difficulties of going down or working 1,000 yards deep will be entirely removed. The present yield of Monmouthshire and South Wales is about 11,000,000 tons annually, and at this rate the basin will not be exhausted for 1,918 years, and it will supply the total consumption of the United Kingdom for 229 years. The increase of temperature in working the lower measures will be considerable, as heat increases about one degree in every 55 feet, but with adequate ventilation no difficulty is anticipated under this head. As to the probable increase in the consumption, Mr. Bedlington believes that the *maximum* has been nearly reached. Looking at all these facts, which it may be said are the embodiment of the opinions of the leading mining engineers of South Wales, there is not much cause for alarm as to the predicted exhaustion of our coalfields.

RECENT DISCOVERY OF COAL IN SHROPSHIRE.

The works in connection with the New Stafford Coalpits, near Shiffnal, have been commenced; the successful sinking having been celebrated by a banquet, presided over by Lord Granville. It is computed that the mine contains ten million tons of coal, the estimated yield being at the rate of 27,000 tons per acre. It has hitherto been an article of belief among geologists, that the line shown upon the official geological maps as bounding the Shropshire coalfield on the east, and representing what is known as the "Great Shropshire Fault," marks the extreme limit of the bed on that side; and that beyond it, as far as the South Staffordshire field, there is an entire absence of coal. The New Stafford Pits are sunk at a point some distance to the east of the "fault," and the result of the experiment having demonstrated the fallacy of the geological dogma, the question is now being raised as to whether coal may not be found in other portions of the proscribed district. A pair of pits has already been sunk in the reputed "dead ground" a little to the south of the New Stafford Mine; and if the result prove equally successful, there is a prospect of a considerable change taking place in the aspect of East Shropshire, at present a purely agricultural district.

ANTHRACITE COAL.

Hitherto the difficulty of Smelting Iron in South Wales with Anthracite has proved nearly insuperable, owing mainly to two causes—decrepitation and the consequent production of refractory agglomerations of anthracite dust and slag, whereby the working of the furnace has been either greatly deranged or actually stopped. The late Mr. Crane was the first person who attempted, many years ago, to use anthracite in the smelting of iron, at Yniscedwin Works; and it is at the same works that this important problem seems to have been at length satisfactorily solved by Mr. S. H. Blackwell. Many failures had to be encountered, and the project was about to be abandoned as hopeless, when, fortunately, it was decided that a final experiment should be made. The internal form of the furnace having been adequately modified, ever since the several results are stated to have been entirely satisfactory. The ton of pig iron, of the qualities known as Nos. 2 and 3, is now produced in the furnace with a consumption of less than one ton of coal. The report for the week ending June 10 shows that in that week 128 tons 4 cwt. of pig iron were made with 112 tons 10 cwt. of coal, in the proportion of 1 to 0·88. This is a great achievement, and one which may be justly regarded as of national importance. In the United States there is fine quality of anthracite, which has been largely applied to the smelting of iron, but with a consumption of nearly two tons of coal to one ton of pig iron. Weight for weight, anthracite contains more heat-giving power than any other kind of coal; but as it does not directly yield volatile inflammable gas, like ordinary bituminous coal, it has not been used in reverberatory furnaces, where flame is required. It is, however, demonstrable, that, by suitable arrangement, copious and intensely hot flame may be generated exclusively from anthracite. From constant experience in its use in furnaces during the last fifteen years, the writer has no hesitation in asserting that this beautiful and smokeless fuel is capable of being applied as a perfect substitute for smoky bituminous coal, both in houses and manufactories.—*Correspondent of the Times.*

THE BELGIAN COAL MEASURES.

There has been read to the British Association a paper "On the Anglo-Belgian Basin of the Forest-bed of Norfolk and Suffolk, and the Union of England with the Continent during the Glacial Period," by the Rev. J. Gunn. A question of the greatest importance had been raised by Mr. Godwin Austen with reference to the extension of the Belgian coal-measures to this country. It was evident that in the mesozoic period, the continuous ranges of chalk in Belgium, France, and England formed a basin, in which tertiaries were deposited. The writer of the paper, after researches carried on upwards of thirty years, had come to the conclusion that the forest-bed was the estuarine deposit of some great river or rivers flowing westward, closed on the south by a ridge of chalk-hills, and open to the sea on the north; and that such ancient river or rivers were now represented by the several rivers flowing into the German Ocean between the mouths of the Scheldt and the Rhine. Thus there might be said to be on the English coast the remains of an estuary without a river, and on the Belgian side of a river or rivers without an estuary. The rev. gentleman followed up a description of the deposits by a remark that he strongly suspected the disruption of this country from the Continent took place at a more recent period than was assigned to it by geologists generally. His impression was, that the forest-bed and the crag-series which preceded it could only be studied to advantage in connection with, and as part of, the corresponding beds of the Continent.

In the discussion upon the questions raised in this paper, the President said he began to strongly suspect, that even the valley of the Thames might be filled with glacial drift, showing that it was submerged during the glacial period.

SOURCE OF PETROLEUM.

In a communication to the American Philosophical Society at Philadelphia, Mr. J. P. Lesley states that, from facts collected in Eastern Kentucky, he is further confirmed in opinion that the coal-measures are the Source of the springs and wells of Petroleum which have there been recently opened. The plants of the Great Conglomerate, he remarks, have been converted into thick oil, which reaches the surface by horizontal drainage over the water-bearing shales of the false or lower coal-measures. There is still another "horizon," or deposit of oil, but that is far down in the Devonian series. Mr. Lesley mentions further, that he has seen "petroleum trickling from Upper Silurian limestones at Cape Gaspé, Canada East, the surfaces of the limestone bed being almost covered with the vestiges of cocktail fucoids, coralloids, bivalves, and trilobites."

A BURNING OIL-WELL.

Fifteen miles below Franklin, in Western Pennsylvania, an Oil-well has been accidentally set on fire, and the flame is said to defy all attempts to extinguish it. The *Meadville Republican* gives the following account of the extraordinary spectacle presented:—"Imagine a space, perhaps 40 ft. square, sending up a solid sheet of flame nearly 60 ft. in height. It lights up the country for miles around, so that one can see to read a newspaper at a distance of four or five miles. The heat of the fire has started vegetation to growing, and grass can be plucked there as green as that found in summer time. The well is owned by parties at Rochester, and was struck four years ago. It commenced flowing oil and water with a very strong force of gas, and the owners were confident they had a good well, but two weeks ago last night, the men going to supper, the well took fire—it is supposed from the engine—and has been burning ever since. The flame, when first discovered, was coming out of the driving pipe, and was not more than three or four feet in diameter; but, after burning two or three days, the driving pipe was melted off two or three feet, and thus allowing the gas and oil to separate before reaching the top, spread over a surface of 30 or 40 feet square. It has burned ever since without cessation. Sometimes the flames will reach to a height of 100 ft., and livening the trees which crown the summits of the surrounding hills, and the reflections against the sky produce an effect which no pen can describe or pencil do justice to."

CARBONIFEROUS SLATE.

A paper, by Mr. J. Beete Jukes, has been read on the Carboniferous Slate (Devonian rocks) of North Devon and South Ireland. He gave a sketch of the geological structure of South-West Ireland, tracing the old red sandstone and carboniferous limestone from Wexford through Waterford into Cork, and showing that some thin beds of black shale which intervene between those groups on the east expand westward until they acquire a thickness of two or three thousand feet, when they receive Sir R. J. Griffith's appellation of "carboniferous slate." In North Devon, Mr. Jukes considered the dark slates and sandstones near Barnstaple and Dulverton as identical with the carboniferous slate of Ireland, and the red and variegated sandstones and slates as identical in character with the old Irish red sandstone. Finally, Mr. Jukes adduced reasons for proposing that geologists should no longer include the old red sandstone among the Devonian beds, but confine the term "Devonian" to beds containing undoubted marine fossils lying between the top of the old red sandstone and the base of the coal measures.

IGNEOUS ROCKS.

AT the late meeting of the British Association, the President of the Geological Section, Professor Ramsay, reviewed the progress of scientific opinion respecting the supposed igneous production of the oldest rocks, and expressed his own inclination to the hypothesis of slow and gradual processes, instead of sudden catastrophes, having brought about the great changes of the earth's surface.

GEOLOGICAL CHANGES UPON THE BRITISH COAST.

IN a discussion at the late meeting of the British Association, Dr. Foster, Mr. King, and Mr. Pengelly gave instances of the Destructive Action going on around our Coasts, owing to the action of the sea upon the land; houses, and even villages, being destroyed, and towns compelled to migrate. Mr. Patterson reminded the Section, however, that there was also a process of compensation going on, in the formation of new land by silting, &c., at various points. Mr. J. Wyatt instanced the recovery of land in this way in Lincolnshire, where a company had been formed for the purpose. The President remarked, that the great permanent source of compensation was not surface deposits of that kind, but the elevation of land from below, which was also known to be going on. Having made allusion to the connection which existed, long geological ages ago, between the British Isles and the Continent, he said that this connection probably existed about the time of the glacial epoch. A vast plain appeared to have been the connecting link, across which, no doubt, had travelled those animals of huge size, and reptiles, whose remains were found in the British Islands, having migrated thither from the East. The connection between England and Ireland had probably been severed at an earlier period than that between England and France; and to this circumstance and to the comparatively limited number of reptiles which had reached Ireland before the separation, he was disposed to attribute the present freedom of the country from those intruders, an exception proverbially attributed to the influence of St. Patrick. As to the mode of severance, he was disposed to look for it more in a gradual wasting away than in any sudden submersion. A compensating system, however, existed in that gradual upheaval taking place at different parts of the coast of which he had already spoken. Arguments were put forward in support of the assertion, that since the Roman period parts of the Scotch coast had risen as much as 25 feet. Unquestionably remains of whales and submerged canoes had been found at a level above the present high-water mark, which it was difficult to suppose they could have reached except on the theory thus propounded.

GEOLOGICAL FORMATION OF THE SAHARA.

We find in the *Revue Française* a very interesting article on the above subject, by the pen of Baron Aucapitane. The author states, that formerly, in the prehistorical ages, a vast sea, parallel to the Mediterranean, covered the immense space which now constitutes the desert of Sahara and the basin of the Niger. The Tell mountains, everywhere surrounded with water, constituted the Atlantis, which Plato speaks of as a tradition derived from the Egyptians. One of those gradual upheavals of the soil, of which the north of Europe and the coasts of South America offer such striking instances in our days, by degrees reduced the waters of this sea to so shallow a depth that it soon dried up by evaporation. "While this sea existed, there were to the south high mountains of the country of the Touaregs and the archipelago of the Ahag'g'ar, the abrupt cliffs of which were beaten by the waves, as they now are by the sands; to the south-east, the western table-land of the Fezzan; and to the north, from west to east, another elevated table-land, now inhabited by the Republican Confederation of the Beni-M'zab, south of Laghouat." Traces of erosion, and of old coasts, downs, and gravel banks, are still visible; the fish of this sea, which communicated with the Mediterranean, were of the same kind as those now found in the latter. This upheaval must have occurred in the quarternary period; one of the old communications with the Mediterranean is still recognisable in the centre of the Gulf of Gabes, where it bears the characteristic name of Terf-el-Ma (a piece of water). To the east there is a line of salt lakes; but even certain vast districts, though perfectly dried up, will be found covered with saline efflorescences at certain periods of the year. To the west, south of the province of Oran, there are numerous circular depressions, where rain-water occasionally accumulates, and a little vegetation makes its appearance in the spring. These depressions are called Daya; their surface is covered with a thick crust of salt, covering layers of mud, sand, and shells of sea and fresh-water fish. These dayas and various agglomerations of cardium edule mark the line of the old sea-shore.—*Galignani's Messenger*.

THE BASIN OF THE AMAZON.

Professor Agassiz, in a lecture at Boston, on the river Amazon, has stated that the whole Amazonian basin is a vast plain. There are no hills, but an immense expanse of woods and water. The distance from the source of the Amazon in the Andes to the Atlantic Ocean is 2,000 miles in a direct line, but, by the course of the river, 4,000 miles. The plain through which the river and its tributaries flows is 1,200 miles wide, and in some places 1,800. It is so low that the whole slope from the Andes to the Atlantic is not over 250 feet. It cannot be compared to an ordinary river valley, and the river itself is different from all others in the world. Its mouth is 160 miles wide, and its mud tinges the ocean for a distance of 50 miles. With all this there is no formation of a delta—on the contrary, the Atlantic is eating into that part of the coast of South America, and at one time the river extended 300 miles beyond its present mouth. The Professor has great hopes in the commercial prospects of the Amazon and its basin.

LAKE-BASINS IN NEW ZEALAND.

At a meeting of the Geological Society a paper, by Mr. W. T. Locke Travers, was read on the mode of the formation of certain Lake-basins in New Zealand—a subject on which the opinions of the most eminent geologists and physicists are much divided. Mr. Travers stated his firm belief, that all the lakes which lie in the valleys of the rivers debouching on the Canterbury plains owe their existence to moraine-dams, which have the same foundations as the post-pliocene shingle of which the plains themselves are formed; and that, therefore, the sites of these lakes were occupied by ice at the commencement of the period of depression, and so continued for some time after the re-emergence of the upper part of the plains above the level of the sea.

BLACK EARTH OF SOUTHERN RUSSIA.

The scientific importance of the Tschornozome, or Black Earth of Southern Russia, is the subject of an article, by M. P. Ruprecht, in the *Archives des Sciences* of Geneva. In his opinion, the immense tracts of this earth, sometimes 20 ft. in depth, have been formed, and are still being formed, by the gradual elevation of the turf, the level of which is raised on the débris of the grass of each year, and probably also by the dust which is brought to it by the winds. This earth differs entirely from peat in its character and formation. M. Ruprecht, by the profound examination of the various facts connected with the position of this earth, the vegetation, &c., endeavours to decide several interesting problems in the geological history of Russia.

LOWER GREEN SAND OF BEDFORDSHIRE.

A paper, by Mr. J. F. Walker, on "The Lower Green Sand of Bedfordshire," has been read to the British Association. It had been previously submitted to the Chemical Section, who had referred it to the Geological Department, as having a more direct relation to its inquiries. The value of the paper, it appeared from the subsequent remarks of Mr. Etheridge and Dr. Foster, was, that it proved the occurrence of Wealdon fossils in the green sand deposits, thus showing unconformability in those beds; and also that it added to previous knowledge as to the extension of those beds northwards, which was of value, as the phosphoric deposits are being used in the manufacture of artificial manure.

GEOLOGY OF NORTH WALES.

PROFESSOR RAMSAY'S memoir on the Geological Structure of North Wales (forming the third volume of the Memoirs of the Geological Survey of Great Britain) has been issued. The Director-general of the survey, Sir Roderick I. Murchison, in his introductory notice, says that, as the author of the Silurian System, he begs to express his sincere admiration of the successful labours by which Professor Ramsay and his associates carried out, over a very rugged, mountainous, and complicated region, the clearest proofs of the many great folds and dislocations which the silurian strata have undergone, as well as for the great ability displayed in the delineation of all the various rocks of igneous origin. By those researches the relative ages of the great dislocations were fixed. The appendix on the fossils, with plates, is the work of Mr. J.W Salter, late palæontologist to the survey.

MAMMOTH OF ARCTIC SIBERIA.

A LETTER has been read to the Royal Society from Carl E. von Baer, one of the Foreign Members, announcing the discovery, by a Samoyed, of another Mammoth in the frozen soil of Arctic Siberia. The place of this interesting find is described as in the neighbourhood of the Bay of Tas, or Tax, the eastern arm of the Gulf of Obi; and as the animal was but partially exposed, and had its skin and hair complete when first seen, in 1864, it is hoped that but little change may have taken place in its condition on the arrival of the naturalist sent by the Imperial Academy of Sciences at St. Petersburgh to make an examination. It is fortunate that Mr. F. Schmidt, appointed for this errand, is also a palæontologist; for should the circumstances prove favourable, we shall have, in due time, a trustworthy description of the locality, of the external appearance of the mammoth, and, in all probability, of the contents of its stomach—which particulars will turn to good account in palæontological science.

The naturalists of Europe will have a better opportunity than any yet afforded them of forming a conclusion as to the nature and habits of the Siberian mammoth; and in one particular, namely, change of climate, the subject is one of especial interest for physical science. The former discovery of a mammoth in Arctic Siberia took place at the beginning of the present century, near the sea-shore at the mouth of the great river Lena. It was not heard of by any naturalist until 1806, when Mr. Michael Adams travelled to the spot from Yakoutsk, but found nothing left but the skeleton, a portion of the skin, and about a pound of the bristles. The tusks, flesh, and other portions had been carried off by the natives or devoured by wild animals. We are informed that the natives of that hyperborean region regard the mammoth as an animal not extinct, but fond of burrowing, and that on exposure to the air it immediately dies.—*Athenæum.*

AMERICAN MASTODON.

A New York paper states, that workmen excavating a foundation for a mill at the manufacturing village of Cohoes, near Troy, found the remains of a complete skeleton of a huge Mastodon 83 feet below the surface, and about 100 feet from the Mohawk River. The remains were carefully gathered together, cleaned, and oiled. The jaw is 4 ft. 9 in. in length, from the mouth to the cranium, to which a portion of the backbone and jaw are still connected. The cranium rises very much like that of an elephant. The two tusks each measure 8 ft. in length, and their true position is well marked on the upper jaw. The hip-bone is 5 ft. long, and weighs 100 lb., while the shoulder blades measure 10 ft. 9 in., and weigh about 50 lb. each. The under jaw, found some weeks since, precisely fits the upper jaw now exhumed, and the ribs are found to be 4½ ft. in length. The measurements show that the animal must have stood at least 15 ft. in height, and have been a little upwards of 20 ft. in length, independent of the tusks, already stated to be each 8 ft. in length. Professor Marsh, of the Yale College Scientific School, gives it as his opinion that the remains discovered are those of a great North American mastodon, agreeing in all its parts fully with the description of the animal given in the scientific works as follows:—"The animal has the vaulted and cellular skull of the elephant, with large tusks in the upper jaw and heavy form. From the character of the nasal bones and the shortness of the head and neck, it has been concluded it had a trunk."

ANTIQUITY OF MAN.

There have been read to the Geological Society two papers relating to the Antiquity of Man. One, by Mr. J. W. Flower, related to some flint implements exhibited by him which had been found in the sands and flint gravel on the right bank of the River Ouse, at Thetford, at from twelve to fourteen feet below the surface. Mr. Flower pointed out the exact correspondence as regards geological position between the Thetford gravels and the flint implement bearing beds of Amiens, Abberville, Hoxne, &c., and noticed the close resemblance which these implements and others discovered in England bear to those of the valley of the Somme. He concluded by expressing his dissent from Mr. Prestwich's conclusions, and stating his own views on their mode of accumulation, remarking, that, in his opinion, these implements were manufactured prior to the severance of this island from the Continent. In the other paper, Mr. J. S. Wilson described remains discovered in terraces which rise above the Esmeraldos River on the western slope of the Cordilleras in Ecuador. In one were found articles of human art, broken pottery, earthen figures, and fragments of gold ornaments. The pottery stratum is traceable along a line of eighty miles of coast, and by partial observations is determined to occur under corresponding conditions for a distance of two hundred miles more.

FOSSIL ORGANIC REMAINS DISCOVERED IN 1866.

British Oxen.—Mr. W. Boyd Dawkins has read to the Geological Society a paper on Fossil British Oxen. Mr. Dawkins considers that the problem of the origin of our domestic races of cattle is only capable of solution by a careful examination of each of the three fossil species of oxen—the *Bos Urus* of Cæsar, the *Bos Longifrons* of Owen, and the *Bos Bison* of Pliny. In the present paper the first of these is examined. Mr. Dawkins considers that between the *Bos Urus* and the *Bos Taurus*, or common ox, there is no difference of specific value, though the difference of size and some other characters of minor value render the bones of the two varieties capable of recognition. The *Bos Urus* was a contemporary in Britain with the mammoth, elephant, rhinoceros, &c., and probably existed here in the wild state till the middle of the twelfth century. Mr. Dawkins endeavoured to explain its gradual diminution in size by the progressive encroachment of cultivation on its old haunts; and, in conclusion, stated his belief that at least the larger cattle of Western Europe are the descendants of the *Bos Urus*, modified in many respects by restricted range, but still more by the domination of man.

British Lynx.—A paper has been read to the British Association "On the Occurrence of Felis Lynx as a British Fossil," by Dr. W. H. Ransom. Prof. Phillips said the discovery of this fossil (which has been made in a cave in Pleasley Vale) makes a positive addition to the list of pleistocene fossils, and is also of value as evidence of the distribution of temperature in past times. He added, that he thought they would have to widen their ideas as to the range of quadrupeds in past times.

Wealden Saurian.—The Rev. W. Fox, of the Isle of Wight, who discovered his *Polacanthus Foxii*, has brought to light another new Wealden Saurian. The discovered parts of this animal are limited to the bones of the sacrum, consisting of five cemented vertebræ with the sacral ribs and portions of the other iliac bones. The remains, therefore, are quite sufficient to show that the reptile to which they belonged was of the Dinosaurian order. It is small compared with the other monsters of the world of efts, the sacrum being only six inches in length; yet, apart from its size, it has as much of novelty about it as any of the previously discovered dragons. The bones are more hollow, light, and compact in structure than the bones of birds, and quite as much so as those of the pterodactyls, with foramina for the admission of air into them, like the bones of the last-named reptiles. Such a formation was evidently given for the purpose of leaping from tree to tree, or for bounding from the grasp of other reptiles with an elasticity of spring equalling that of the grasshopper. With the approval of Prof. Owen, who has examined the bones, this new reptile has been dedicated to him by its discoverer, who has given it the descriptive name of "*Calamospondylus Oweni*," from the fact of its backbones being hollow, smooth, and compact *like a reed.*

Sauroid Fish.—In the *Geological Magazine* we have an illustrated paper, by Professor Owen, on a new Sauroid Fish, from the Kimmeridge clay, discovered by Mr. C. B. Rose at Downham, near King's Lynn, Norfolk; and which the Professor names *Thlattodus suchoïdes*, from its resemblance to a crocodile and its bruising teeth.

Oxford Fossils.—The *Geological Magazine* for March opens with a paper by Professor John Phillips on Oxford Fossils, with a plate exhibiting fossil insects' wings, testifying to the existence of waterside insects in early geological times. Professor Owen describes a new sauroid fish (*ditaxiodus impar*) from the Kimmeridge clay of Culham, Oxfordshire, and gives engravings of its maxillary bone and teeth. He terms it a most instructive and characteristic specimen.

Kent's Cave.—The Second Report of Committee for exploring Kent's Cave, Devonshire, by Mr. W. Pengelly, shows that in the past year specimens obtained from the black earth, evidently belonging to the pre-Roman period; next from the stalagmite floor beneath, and then from the red loam under the stalagmite. Among these were bones of extinct animals (many crushed and gnawed) and very fine specimens of flint implements of various kinds. Mr. Pengelly expressed his own conviction that hyenas had inhabited the cavern after it had been deserted by man, and stated that no evidence had yet been obtained at all conflicting with that of the early explorers.

Cheshire.—At the Geological Society has been read a description, by Professor W. C. Williamson, of a cheirotherian footprint, exhibited by Mr. J. W. Kirkham, who had discovered it at the base of the keuper sandstone, at Daresbury quarry, Cheshire. It differs from all footprints hitherto obtained from this district, it being more quadrate and distinctly that of a scaly animal; the separated toe is also less recurved, and approaches nearer to the other toes. The arrangement of the scales corresponds very closely with that seen in the foot of the living alligator; many of them run across the foot in oblique lines, as is common amongst living crocodilians, leaving no room to doubt that they represent true scales, and not irregular tubercles, such as are seen on the skin of some batrachians. Traces of other impressions of feet occur on the slab, particularly an imperfect one, with much larger and more oblong scales, especially under the heel; and this difference is so very similar to what is seen in the fore and hind feet of many saurians, that Professor Williamson believed that they did not belong to a batrachian animal at all, but that they were saurian, if not crocodilian, in every feature.

Malta.—Dr. Leith Adams has reported further discoveries in the ossiferous caves and fissures of Malta; being remains of the fossil elephant, river tortoise, lizard, various frogs, and several species of dugong, which gave evidence of their having been conveyed into their situations by the agency of large bodies of water.

Earliest Fossil.—We learn by a note that Professor Hochstetter, of Vienna, after long and laborious search, has succeeded in finding in the calcareous limestone of Krummau agglomerations of calcareous spar and serpentine which have been declared by Dr. Carpenter, to whom specimens had been sent, to be undoubted remains of Eozoön, *the earliest fossil which has been yet discovered.*

Pikermi.—M. Albert Gaudry, having terminated his examination of the fossil bones excavated under his superintendence at Pikermi, in Greece in 1855 and 1860, undertaken at the charge of the Paris Academy of Sciences, has reported to that body the results of his researches in relation to intermediate forms, several of which have been found to be very remarkable. Among these is a new species of Ape, very abundant; a carnivorous animal, partaking of the nature of the bear, dog, and cat, which is named Simiocyon, and various transitional forms of the rhinoceros, antelope, horse, wild boar, &c. The fossil giraffe of Attica unites the existing giraffe with the ruminants.

Whale.—A party of miners engaged in sinking for gold up the Kanieri, Hokitika, have discovered the fossil skeleton of a Whale, perfectly entire, and measuring 150 feet in length. It was covered by alluvial soil, and only a few feet below the surface. The fact that the locality is ten or twelve miles from the present seashore, and about 100 ft. above its present level, renders the discovery a very remarkable one, and goes to prove the assertion of geologists, that a great part of New Zealand has been raised from the bed of the sea.—*Nelson Colonist.*

Porlock Bay.—The *Quarterly Journal of the Geological Society* contains a paper by Mr. Godwin Austen on the submerged forest-beds of Porlock Bay, where, at low tides, appear the stumps of trees, chiefly oaks, standing in the positions in which they grew, the action of the sea having bared them. Mr. Godwin Austen gives details of the character of the shingle at this place, the marine silt, the surfaces of plant-growths, many of which seem to resemble an iris (such as the yellow flag); the blue mud deposit (which is very tenacious, resisting the action of the sea); and the accumulated angular detritus, indicative of a condition of the surface presented everywhere by that portion of this country and of Europe which was not submerged during the great subaqueous depression of the northern hemisphere.

GLACIAL CONDITION OF THE MOON'S SURFACE.

A LETTER from Dr. Samuel Birch, of the British Museum, on the Glacial Condition of the Moon's Surface, gives the results of his observations. He says that, when looked at attentively, all the luminous parts of the moon present the appearance of a country resembling the wintry Alps or Polar regions, and he refers to the remarks of Arago and Frankland on this subject.

EARTHQUAKES.

IN a paper on Earthquakes, &c., Mr. R. Edmonds describes some extraordinary agitations of the sea on the coasts of Cornwall; and after giving Mr. R. Mallet's hypothesis, which ascribes these phenomena to the transmission of great sea waves from a distant submarine earthquake or volcano, opposes it by reasoning based on facts, tending to show that these agitations are due to local submarine earthquakes.

EARTHQUAKE IN FRANCE.

ON Sept. 14, 1866, Paris was visited by an Earthquake. It was preceded by an aurora borealis of unusual magnificence, which was seen in great brilliancy from the heights of Montmartre between eight and ten on the previous night. In Paris the shocks of the earthquake seem to have been felt with particular distinctness in the 16th *arrondissement* (Passy), chiefly on the road to Versailles and in the streets Boileau and Molière. No. 4 in this last street was so shaken that the inhabitants, awaking in a panic, and thinking the end of the world at hand, ran out into the street in the greatest consternation. The shocks, however, were felt in several *arrondissements*, as is proved by letters in the papers. Also, and very plainly, in various provincial towns, among others at Tours and Angoulême, in which last two shocks, from east to west, were felt at an interval of some seconds, accompanied by a cracking sound like the splitting of wood. At St. Marc, in the department of the Loiret, two persons were thrown down by the shock in front of the church, windows were broken, doors opened, tiles fell off the roof. A letter from Jarjean to the *Journal de Loiret* says:—

"It appears that in houses where there were birds, the shocks were announced beforehand by these animals, which did their utmost to get out of their cages. This induces a belief that this succession of phenomena occurred under the influence of electricity. Schoenbein's iodurated paper, called *ozonomètre*, gave a dark tint, announcing a decided electric state of the atmosphere."

At Riom and at Clermont there were five shocks. From Riom a M. Leboyer writes that the furniture in his room actually danced, that his bed was lifted up, and that that of a friend of his was displaced five centimètres, that in another house a crack more than a mètre long had been made in a partition wall, and that the servants were frightened by the clatter of the kitchen utensils. A multitude of incidents of this kind are related. The *Constitutionnel* says that similar shocks have been felt before in Paris, and that on the 19th of February, 1822, Arago observed the magnetic needle violently agitated at half-past 7 o'clock, A.M., and that at 8 o'clock several shocks took place.

The range and intensity of the above earthquake is shown in a chart compiled by M. Rayet from numerous authorities, which has been laid before the Academy at Paris, and which is given in the *Comptes Rendus*, No. 12, accompanied by a *résumé* of the results of a great many letters to the secretary. According to the largest number of observers, the shock was felt at 5h. 10m. A.M. There were two undulations, the first from west to east, the second from south to north, after an interval of several seconds. No remarkable meteorological phenomena seem to have accompanied this shock, and the magnetic needle and electric telegraph do not appear to have been notably affected. The noise at Perigueux was compared to that of a heavy railway train entering a tunnel. At some places the houses were shaken severely, parts of the exterior broken off, the furniture displaced, and the street pavement disjointed. The neighbourhood of Blois and Tours appears to have experienced the maximum of the shock.

EARTHQUAKE IN NORWAY.

MR. KIRWAN J FERNIE, writes from Orkedal, near Drontheim, March 10, 1866:—On the 9th inst., exactly at 2 A.M., a rather severe shock of Earthquake shook my house. It appeared to take the motion of a sine, and, at the same time, a kind of rolling motion from east to west; all the timbers in my house creaked similar to the noise heard on board a steamer when labouring in a heavy sea. The shock lasted one minute or more, or about twice as long as the heaviest gust of wind that often comes upon us here in the night. The shock was felt more severely by my neighbours, even those not far distant. It appeared at first to come as a mighty rush: the weather was calm and the sky cloudy. The night before, at 11 o'clock, was calm and bright starlight, but little or no "northern lights." Some few days previously the weather had been very cold—the greatest cold we have had this winter. The sea (as is always the case here when the thermometer is about 27 deg. below freezing) appeared as if boiling, and a thick steam, about 200 ft. thick, lay on the surface. On the 1st inst., just before sunrise, the thermometer was 67 deg. below freezing, but on the 8th (the day before the earthquake) the thermometer was only about 7 deg. below freezing, and consequently no steam upon the water. There had also been brilliant sunshine during the last few days; but yesterday, the 9th (after the earthquake), at 10 A.M., for a short time there was a great storm of wind from the north; however, the rest of the day was cloudy and calm; to-day, the 10th, 9 A.M., driving snow; 1 P.M., thaw and rain, and strong westerly wind; 8 P.M., no "northern lights," rain. The "northern lights" had been very brilliant for some time past every evening. On the 3rd inst., and also on the 7th, there was a very strong beam of light, nearly as wide as our usual rainbow, stretching over the heavens through the zenith from east to west horizon; this was seen on both occasions at about 8 P.M., and remained steady for some time. On the evening of the 7th inst. the heavens were lighted up brilliantly in every direction, north, south, east, and west, for several hours—all light of a yellow cast. The peasants here call the "northern lights" "wind lights," because, whenever they are red, or assume the colours of the rainbow, and the rays of light, so to speak, roll after each other, then are we certain to have more or less wind in a few hours after.

EARTHQUAKE IN NEW ZEALAND.

A SLIGHT shock of Earthquake was felt in Dunedin on the evening of the 28th of October. A few minutes before the shock there was a bright flash of lightning, and shortly afterwards a strong gust of wind from S.W. The shock lasted about three seconds, the motion being of a vibratory nature, just as if a very heavy wagon had been driven rapidly over a hard road, from west to east.—*Otago Daily Times.*

VOLCANIC ERUPTIONS IN THE GREEK ARCHIPELAGO.

A NEW Island began to rise above the level of the sea in the Bay of Thêra (Santorin) on the 4th of February, and in five days it attained the height of from 130 ft. to 150 ft., with a length of upwards of 350 ft., and a breadth of 100 ft. It continued to increase, and consisted of a rusty, black, metallic lava, very heavy, and resembling half-smelted scoriæ, which boiled up from a furnace. It contained many small, whitish, semi-transparent particles, disseminated through the mass like quartz, or felspar. Close by there are three islands, which have arisen from the sea during eruptions recorded in history—Palaia, Nea, and Mikrê Kaïménê, or Old, New, and Little Burnt (Island). The present eruption began on January 31. A noise like volleys of artillery was heard, but without any earthquake. On the following day flames issued from the sea in a part of the bay called Vulkanes, where the water is always discoloured and impregnated with sulphur from abundant springs at the bottom. The flames rose at intervals to the height of 15 ft., and were seen at times to issue from the south-western part of Nea Kaïménê. The island was soon rent by a deep fissure, and the southern part sank considerably. On the 4th of February the eruptions became more violent, and the sea more disturbed. Gas forced itself up from the depths with terrific noise, resembling the bursting of a steam boiler; flames arose at intervals, and white smoke, rising steadily, formed an immense column, crowned with a curled capital of dark, heavy clouds. The new island was visible next morning, increasing sensibly to the eye as it rose out of the sea at no great distance to the south of Nea Kaïménê. The heat of the sea rose from 62 deg. Fahr. to 122, as near the vicinity of volcanic action as it was safe to approach. The bottom of the sea all round Nea Kaïménê appears to have risen greatly. In one place, where the depth is marked on the Admiralty chart 100 fathoms, it was found to be now only 30; and at another, where it was 17, it is now only 3 fathoms. The new island grew, as it were, out of the sea, the mass below pushing upwards that which is already above water. The lower part was hot, its fissures where they were deep being 170 deg. Fahrenheit, and the upper part, after four days' exposure, was found to be still 80.

At a meeting of the Paris Academy of Sciences, a letter has been read from Father Secchi, of Rome, in relation to the recent Volcanic Eruptions and the appearance of the new Greek islets; in which he states that several rather violent shocks of earthquake took place in the valley of Umbria, near Spoleto, about the same time. M. Charles Ste. Claire Deville thereupon made some remarks, and referred to a list of these phenomena, showing that during the previous two months the south of Europe had been evidently the theatre of a great number of these manifestations, which derive their origin from the eruptive forces within our globe. A letter was also read from M. Fouqué, from Santorin, describing the third of these isles, which appeard on the 10th of March, and which has been named Reka. It is situated very near Aphroïssa, being separated from it by a canal between thirty and forty mètres wide. It is composed of blocks of lava identical with those of the other isles, and will, probably with them, be eventually united to the main land. At the same meeting, MM. Faivre and Dupré reported their researches, with details of their elaborate experiments on the gases which exist in the mulberry and the vine, the parts which contain them, and the changes which are determined in them by vegetation.

At a meeting of the Geological Society have been read some additional documents on the Volcanic Eruptions at the Kaïménê Islands, by Commander Brine, communicated by the Lords of the Admiralty. The active volcano of Nea Kaïménê Island contains the crater of a second volcano, 30 ft. in height, with a circular base of 300 yards; and, judging from the soundings obtained at Palaia, Kaïménê, and St. George's Bay, it is thought probable that the island will eventually fill up the bay. By a report from M. Fouqué, read to the meeting, we learn that since the eruptions earthquakes were less frequent. His observations also tend to support M. Ste. Claire Deville's law, that there exists a certain relation between the degree of intensity of a volcano in action and the nature of the volatile elements ejected. In an eruption of maximum intensity common salt and salts of soda and potash predominate; in one of the second order, hydrochloric acid and chloride of iron; in one of the third degree, sulphuric acid and salts of ammonia; and in the fourth, or most feeble phase, steam only, with carbonic acid and combustible gases. The eruption at Nea Kaïménê has never exceeded the third degree of intensity; and, when it excited the greatest alarm, gave off only sulphuric acid, steam, and combustible gases.

THE VOLCANO OF MAUNA LOA,

On the island of Hawaii, has recently been the scene of a huge Eruption, of which the *Honolulu Friend* of February, gives the following account:—"A new crater opened near the summit of the mountain at an elevation of 10,000 ft., and for three days a flood of lava was poured down the north-eastern slope. The eruption then ceased, and all was quiet for thirty-six hours. Another crater then opened on the eastern slope. It would seem that the summit lava had found a subterranean tunnel; for half-way down the mountain, when coming to a weak point, or meeting with some obstruction, it burst up vertically, sending a column of incandescent fusia 1,000 ft. high into the air. The fire-jet was about 100 ft. in diameter, and was sustained for twenty days and nights, varying in height from 100 ft. to 1,000 ft. The disgorgement from the mountain side was often accompanied by terrific explosion, which shook the hills with detonations which were heard for forty miles. This column of liquid fire was an object of surpassing brilliancy, of intense and awful grandeur. As the jet issued from the awful orifice it was of a white heat. As it ascended higher and higher it reddened like fresh blood, deepening its colour, until, in its descent, much of it assumed the colour of clotted gore. In a few days the cone of the crater was raised to a height of 300 ft., and became one vast heap of glowing coals, flashing and quivering with restless action, and sending out the heat of 10,000 furnaces in full blast. The struggles in disgorging the fiery masses, the upward rush of the column, the force which raised it 1,000 vertical feet, and the continuous falling back of thousands of tons of mineral fusia into the throat of the crater and over a cone of glowing minerals one mile in circumference, was a sight to inspire awe and terror, attended with explosive shocks which seemed to rend the ribs of the mountain. From this fountain a river of fire went rushing and leaping down the mountain, filling up basins and ravines, dashing over precipices, and exploding rocks, until it reached the forests at the base of the mountain, where it burnt its fiery way, consuming the jungle, evaporating the water of the streams and pools, cutting down the trees, and sending up clouds of smoke and steam, and murky columns of fleecy wreaths to heaven. Night was turned into day. Mariners at sea saw the light at 200 miles' distance. In the daytime the atmosphere for thousands of square miles was filled with a murky haze, through which the sunbeams shed a sickly light. Smoke, steam, gases, and cinders floated in the air, sometimes spreading out like a fan, sometimes careering in swift currents upon the wind, or gyrating in everchanging colours in fitful breezes. It was such a scene as few mortals ever witnessed. There was no sleep for the spectator. The fierce, red glare, the subterraneous mutterings and strugglings, the rapid explosion of gases, the rushes and roar, the sudden and startling bursts, as of crushing thunder—all were awe-inspiring, and all combined to render the scene one of indescribable brilliancy and of terrible sublimity. The rivers of fire from the fountain flowed about thirty-five miles, and stopped within ten miles of Hilo."

MUD VOLCANOES.

In a lecture given by Professor Ansted, at the Royal Institution, "On the Mud Volcanoes of the Crimea," an attempt was made to show a connection between this peculiar form of volcanic action and the existence of petroleum, and the relationship of both to great lines of geological disturbance. In Sicily, during the commencement of the late eruption in the Bay of Santorin, a jet of muddy water, at a high temperature, was thrown out on the flanks of Etna, containing a slight quantity of petroleum, or naphtha. This was an instance of the outburst or first stage of the mud volcano. The great district of the Crimea, extending over 2,000 square miles, was next described, some of the mud volcanoes being of considerable age and of great size; one near Kertch, described by Strabo, and in eruption 70 years since, being a mile and a half round at the base, and 250 ft. high.

A SALT ISLAND.

Near Vermillion Bay, on the coast of Louisiana, there is an island called Petit Anse Island, which was mentioned by early explorers of the Gulf of Mexico as an Island of Salt. During the late American war, when Southern ports were blockaded, the Confederates looked after this island, and found that almost anywhere beneath its surface, which has an extent of 5,000 acres, there is, at an average depth of 15 ft., a stratum of hard rock-salt, nearly pure, and of unknown but practically inexhaustible quantity. The statement is now put forth on the authority of Professor Spencer F. Baird, of the Smithsonian Institution at Washington, that there has been received at that Institution a piece of matting wrought of the bark of a cane (*Arundinaria macrospermum*) by a human hand, which was certainly found in that island 2 ft. below a stratum in which the fossil remains of an elephant of the remotest period were embedded.—*Pall Mall Gazette.*

Astronomical and Meteorological Phenomena.

METEOROLOGICAL DEPARTMENT OF THE BOARD OF TRADE.

THE Royal Society, having been consulted by the Board, concur generally in the measures recommended by the committee. With regard to the issue of Storm-Warnings, the president and council of the Royal Society are of opinion that "at present these warnings are founded on rules mainly empirical," and therefore should not be issued under the superintendence of the scientific body to whom the discussion of meteorological observations will be committed. The president and council think, however, that "in a few years they may probably be much improved by deductions from the observations in land meteorology which will by that time have been collected and studied; and that the empirical character may thus be expected to give way to one more strictly scientific—in which case the management of storm-warnings might be fitly undertaken by a strictly scientific body." Under these circumstances the Board of Trade have been compelled to suspend "Cautionary Storm-Warnings," which have from time to time been issued by the Meteorological Department of the Board of Trade. It is hoped that the warnings may be resumed by the new Meteorological Department at no distant time, upon an improved basis. In the meantime the daily "Weather Reports" will be received and published as heretofore. If at any port or place there is a desire to have these reports, or any part of them, communicated by telegraph on the morning on which they are received, they shall be so communicated on a request to that effect being sent to the Board of Trade, accompanied by an undertaking to pay the expense of the telegram from London to the port or place. This resolve of the Board of Trade has excited much discussion; they are urged to reconsider their decision, and persevere with the warnings, notwithstanding their empirical origin. It appears to be forgotten that a Blue Book was published by the Board of Trade, containing the correspondence that had taken place with the Royal Society, and the report of a committee, in which, after very careful investigation and comparison of the series of warnings with the facts of the weather, it was shown that the warnings were no more trustworthy than if they had been derived from the tossing-up of a halfpenny. Of course, there were a few lucky hits, and these having excited the imagination of the public, all the failures have been quietly ignored. If the Board of Trade will only carry out the great scheme of meteorological observations by sea and land, as recommended by the Royal Society, it is to be hoped that in a few years such a knowledge of meteorological laws will be obtained as will enable the Board to resume their system of storm-warnings with some approach to scientific certainty.—*Mechanics' Magazine.*

AERONAUTICAL SOCIETY.

MR. GLAISHER has thus explained the views of the Aeronautical Society, established in January 1866. The first application of the balloon as a means of ascending into the upper regions of the atmosphere has been almost within the recollection of men now living, but, with the exception of some of the earlier experimenters, it has scarcely occupied the attention of scientific men; nor has the subject of aeronautics been properly recognised as a distinct branch of science. The main reason of this may have been, that from the very commencement balloons have been, but with few exceptions, employed merely for exhibition, or for the purpose of public entertainment; and the first wonder having ceased, sundry performances have been resorted to in order to pander to the public taste for the grotesque and the hazardous, which have tended so far to degrade the subject that it has been, till very recently, looked upon with contempt by scientific classes in general. It is confidently hoped that, by the organisation of the Aeronautical Society of Great Britain, the subject may take its standing among the sciences, for it has been found that societies formed for the study and advancement of special branches of science, if properly conducted, have invariably been productive of most important results, and have been the means of developing and bringing forward much that is valuable in the way of invention and discovery. It remains to be seen under what conditions of altitude and temperature the air, more or less charged with moisture at the earth's surface, by its expansion and consequent fall of temperature, parts with that moisture for the formation of clouds; what alteration of temperature arises from the mere separation of vapour; and whether the same air, thus partly relieved, is capable, by a still higher ascension, of forming a second and upper stratum of clouds. Information is also much needed concerning the direction of varying currents of air in the upper and lower regions of the atmosphere, and whether there is any indication of a true, persistent, equatorial current from east to west at the highest altitude. It is further desirable to ascertain the existence and prevalence of oblique ascending currents of air, and the influence of level local temperature, and the nature of the subjacent country in causing such currents. The balloon, in its present form, is no doubt capable of determining these questions. A chief branch of inquiry by the Society will be the department relating to the mechanical expedients and inventions for facilitating aërial navigation and obtaining or aiding a change of locality at the will of the aeronaut. Nearly all contrivances for this purpose have hitherto failed, or have only been successful to a very limited extent. The causes of these failures have been the utter absence of a correct theory of the action of surfaces at different velocities upon elastic and yielding media, and the requirements needed to obtain a power for a lever upon an unstable fulcrum. When we consider that the act of flying is not a vital condition, but purely a mechanical action, and the animal creation furnishes us with models of every size and form, both single and compound wings —from the minutest microscopic insect to the bird that soars for hours above the highest mountain range, it seems remarkable that no correct demonstration has ever been given of the combined principles upon which flight is performed, nor of the absolute force required to maintain that flight. In the absence of an established principle, much time and money have been wasted in attempts to adapt aërial propellers, and it would be the office of the Society to bring forward any information or successful experiment illustrative of a theory, and, with the aid of the eminent mechanicians and men of science that the Society may reasonably expect to number amongst its members, a fair hope may be entertained that this may be accomplished.

Sub-committees have been formed for the consideration of subjects connected with the Society's operations, and the under-mentioned gentlemen have been nominated thereto, with power to increase their number from among the members. 1. For the best means of causing a balloon to ascend and descend, either by mechanical or chemical aids, so as to economise the use of gas and ballast:—Mr. W. Fairbairn, Mr. Wenham, Dr. Diamond, Mr. A. Follott Osler, Mr. Beverley Fenby. 2. To consider the law of resistance of inclined surfaces moving in elastic and non-elastic fluids, as air and water, and the result and force obtained at right angles to the direction of motion. Experiment has shown that, as the velocity is increased, and the angle of inclination diminished, the centre of effort of the plane approaches forward, until nearly the whole effect of reaction or support is transferred to the front edge. It therefore follows that in very acute angles with the line of motion, a given extent of reacting surface at high velocities will be most effective if disposed in a narrow plane extended transversely to its direction. An investigation of this principle will determine the best ratio of surface to speed in the long and narrow wings of birds of extended flight, in the blades of reciprocating and screw propellers, and in the sails of vessels for sailing near the wind:—The Duke of Argyll, Lord Dufferin, Mr. James Nasmyth, Mr. J. M'Connell, Mr. Glaisher, and Mr. Wenham. 3. To consider upon the best means of procuring a balloon for experimental purposes:—The Duke of Sutherland, Mr. Glaisher, Mr. Westcar, Mr. Wright, Mr. Magnus Ohren, and Mr. J. M'Connell.

MAGNETIC DISTURBANCES.

There has been read to the British Association an extract of a Letter on Magnetic Disturbances, from Senhor Capello, of the

Observatory, Lisbon, to Balfour Stewart, of the Kew Observatory. The author sent three tables, representing graphically the most important results deduced from the curves of our magnetograph for the year 1864. He had followed the plan of General Sabine, in separating the greatest disturbances of the three elements. Thus he had considered as a disturbance of the declination every ordinate which differed from the monthly mean by 2·3′ or upwards, while the separating value for the horizontal force was ·0011 of the whole horizontal force, and that for the vertical force ·00032 of the whole vertical force. The instruments were at work during the whole of the year 1864; and of the 8,760 hourly observations of each instrument, the observers only failed in measuring 97 for the declination, 139 for the horizontal force, and 159 for the vertical force instrument. The number of disturbances have been, for the declination, 1,043; for the horizontal force, 810; for the vertical force, 982. From a diagram exhibited, giving the hourly variations yearly and half-yearly of the three elements, it was seen that the progress of the declination for each period is very regular. The mean daily range of declination during the six months from April to September, when the sun is north of the equator, is 9·20′; while, during the six months from October to March, when the sun is south of the equator, this range is less, being barely 6′. For the dip the corresponding curves are much disturbed from 6 P.M. to midnight, especially for the six months when the sun is north of the equator. The total force gives a well-pronounced minimum at 11 A.M. during the six summer months, and 11.30 A.M. during the six winter months. The daily range is greatest for the six summer months, and least for the six winter months. The diagram of disturbances gives for the declination a maximum of the westerly disturbances at about 8 A.M., and a minimum about 10 in the evening. On the other hand, the maximum of easterly disturbances is about 10 in the evening, and the minimum about 6 in the morning. The curves for the horizontal force disturbances are irregular. The maximum of disturbances tending to *increase* the horizontal force takes place about noon, while the minimum is about 1 A.M. But here one is much struck with the great disproportion between the disturbances tending to *increase*, and those tending to *diminish*, the horizontal force, the latter being both the most numerous, and the greatest in amount. The maximum and minimum of these latter disturbances take place a little later than the maximum and minimum of the disturbances tending to increase the force. With respect to the vertical force, the curve of disturbances tending to increase the element resembles, to some extent, the curve of easterly disturbances, or disturbances tending to diminish the westerly declination.

In this diagram, *blue* and *red* curves were made to represent the whole effects of the perturbations, or the quantities which it is necessary to apply to the line of no disturbance, reckoned a straight line, in order to reconstruct the curves with the perturbations. Thus, the effect of disturbances upon the declination is to cause the needle to deviate towards the west during the hours of the day, but towards the east during the hours of the night. The effect of disturbances upon the vertical force is of a reverse kind, tending to diminish the element during the hours of the day, but to increase it during those of the night. With regard to the horizontal force, it appears that the disturbances tend to diminish this element almost during the whole of the twenty-four hours. A third diagram represented the mean hourly movements of the north pole of the freely-suspended needle, in a plane perpendicular to the direction of such a needle, both for the whole year, and also for the winter and summer seasons.

TOTAL SOLAR ECLIPSE SEEN AT LA CONCEPCION, CHILI.

The total Eclipse of the Sun on the 25th of last April, though invisible in England, was visible as a partial eclipse at the Cape of Good Hope, and as a total eclipse in Chili, where it was observed by Padre Cappelletti, who has communicated a portion of his observations to Padre Secchi, of Rome, to whom we are indebted for their publication. The weather, it appears, was rather unfavourable at the commencement of the phenomenon, but Father Cappelletti had a very good view of the eclipse during the complete obscuration, which lasted 2m. 20s. During this period he saw an immense mountain of fire, cone-shaped, 57° N.W. from the zenith. Nearly opposite a smaller protuberance of the same kind appeared. Both were rose-coloured, but the second was the palest. After the lapse of 38 seconds a series of coloured flames appeared, so that the sun seemed to be on fire, giving the idea of trains of powder igniting successively and with great rapidity. No protuberances were observed on the eastern side of the sun. At the moment of the sun's disappearance three pencils of light became visible in a direction perpendicular to the moon's limb. The most luminous of the three, which was so bright as almost to dazzle the eyes, was in the same position as the larger protuberance. Its western side coincided with the duration of the lunar radius, but its opposite side was inclined. The second pencil was almost diametrically opposite to the former, making an angle of about 15° with the second protuberance, but it was less luminous than the other, and its borders were rounded off. The third pencil was at equal distances between the other two. Observers at Rio Janeiro saw five of these pencils. The darkness is described as having been similar to that of an hour after sunset. The country assumed an ugly greenish tint. An arc, presenting the colours of the rainbow, appeared at a distance of 30° from the sun, and disappeared as soon as the eclipse ceased to be total. Several stars of the first and second magnitude became visible. Nothing remarkable was observed among animals, except that cocks crowed at the beginning of the totality, and again when the sun reappeared. Poultry went to their roosting-places, and left them on the reappearance of light. At this moment the sun's limb had an undulatory appearance like the ocean at Cape Horn with its immense waves. During the totality the moon was surrounded by a ring of silvery light, which was followed by a crown of rays. Her border was somewhat indented, causing the irregularities of the sun's crescent when it reappeared. The state of the weather did not, unfortunately, enable any photographs of the phenomena to be taken.—*Athenæum*.

HAILSTORMS.

At a meeting of the Paris Academy of Sciences, M. Becquerel has communicated a memoir on the zones of Hailstorms in the department of the Seine and Marne, based on the meteorological reports of several societies. It is very remarkable that in some spots (*e.g.* the forest of Orleans) hailstorms should have been so very rare, while other places have suffered much and frequently from them. M. Becquerel acknowledges ignorance of the causes of this difference, but considers that they are terrestrial and atmospheric.

THE METEORIC SHOWER IN AMERICA.

The Meteors observed in America were not so numerous as those seen in England. Arrangements had been made in several cities to ring the bells, in order to arouse the people, if the spectacle should be such as was expected; but it was not. Professor Loomis, of Yale College, makes the following report:—"On Monday night, November 12, a company of observers at this place counted 696 shooting stars in five hours and twenty minutes, which is about four times the average number visible for the same period throughout the year. On Tuesday night, November 13, another company counted 881 shooting stars in five hours, which is five times the average number. On Wednesday night the sky was overcast, so that no observations could be made. We conclude, that the number of shooting stars visible about the 13th was very remarkable; nevertheless, this display is not to be compared with that of the 13th of November, 1833, in which the number of meteors was variously estimated at from 10,000 to 30,000 per hour. The grand display, therefore, which it was supposed might possibly occur this year has not been witnessed in the United States. . . . If we receive no accounts of an unusual display of meteors this week in any part of the world, we shall look with considerable confidence for such a display on the 14th of November, 1867."

THE NOVEMBER METEORIC SHOWER.

The Fiery Shower (*Humboldt's Meteors*), first stated by him to occur at intervals of every 33 years, and foretold for the night of the 13th and 14th of November, 1866, was seen in full splendour on the morning of the 14th, between the hours of 12 and 2. It is thus described in the *Times*, by observers in the metropolis:—From about 11 o'clock occasional meteors might be seen gliding along the sky from east to west, but these were only the *avant-couriers* of the great legion that followed at a later hour. The numbers .increased after 12 o'clock with great rapidity. From Paddington-green, a fairly open position, 207 meteors were counted between 12 and 12.30, and of these the greater number fell after 12.20. The next hundred was counted during the six minutes that succeeded the half hour. Soon after this it became impossible for two people to count the whole that were visible from this station; and doubtless from positions with a purer atmosphere, and a wider horizon, the spectacle must have been one of surpassing splendour. Indeed, from a window at Highgate looking N.N.E., but with a circumscribed view, an observer counted 100 meteors in the four minutes between 12.32 and 12.36, and no less than 200 in the two minutes between 12.57 and 12.59.

As the consellation Leo rose over the houses north of Paddington-green and cleared itself of haze, the divergence of the meteor-paths from a point within it became obvious, not merely in the directions of the streams that shot from or through the zenith, but in those that left their phosphorescent-seeming trails in the sky towards every point of the compass.

Sometimes these rocket-like lines of light would glide out like sparks flying from an incandescent mass of iron under the blows of a Titânic hammer; but with the distinctive features, first, of those lingering lines of illuminated haze in their track, and secondly, of their rarely appearing as if they originated in the region of the sky from which their courses evidently diverged.

Sometimes the meteor was orange and almost red in its colour; whereas the luminous trail seemed almost always, probably by contrast with the surrounding light, of a blueish hue. In one splendid instance the trail, after having nearly disappeared, together with the rocket-head that had produced it, became again lit up and visible coincidently with a sort of resuscitation of brightness in the body of the meteor. Now and then a little illuminated puffball would appear in the middle of the constellation Leo, generally more or less elongated or elliptic in form, as it seemed to be more or less distant, and at the same time convergent from an imaginary point that seemed about 3° S. by E. of the star γ Leonis; and one, as near as could be estimated to such a point, was simply a star that waxed, and waned, and disappeared as one looked at it.

Sometimes a minute point of light, like a firefly, would dart, with an angular jerking motion and zigzag course hither and thither, but still as if away from Leo.

Only about three meteors were seen during an hour and a half to take a direction manifestly opposed to that of these diverging multitudes. The meteors which shot towards the western horizon seemed more brilliant and larger in their courses than those which dropped into the eastern; indeed, very few seemed even to reach the roofs of the houses from behind which Leo had arisen. This was possibly only an effect of perspective, or it may have arisen from the curtailment of the view. As regards the long lines of light that lingered in the paths of the meteors, it seemed that generally they were more dense and brightest towards the middle of the visible path of the meteor, while the meteor itself seemed brightest just before its extinction, an effect possibly due to an obscuration in the middle of its course by matter thrown off from it. The meteors seemed also to lose velocity as they went, but this might have been the result of perspective in those passing through the zenith.

One singular feature in these celestial fireworks was the rapidity with which the *maximum* of frequency came on and went off again. About 2 o'clock the meteors seemed to have become as scarce as they were at 12, though they continued in smaller numbers till the verge of daybreak.

From half-past 12 or a quarter to 1 until about a quarter-past or half-past 1, the heavens seemed veritably alive with stars rushing in many parts of the sky, in groups of two or three together or in immediate succession on each other, seeming as though racing over the blue vault, except that their courses so rapidly diverged. The cloudless beauty of the night near London was a happy circumstance, on which we may congratulate every "watcher of the skies."

Not only in the metropolis and in its suburbs was this magnificent sight observable, but in all parts of the country. Mr. Hind, at Mr. Bishop's Observatory, Twickenham, whose observing force included M. Chaillu, writes:—"From midnight to 1 o'clock A.M., Greenwich time, 1,120 meteors were noted, the number gradually increasing. From 1 A.M. to 1h. 7m. 5s. no less than 514 were counted, and we were conscious of having missed very many, owing to the rapidity of their succession. At the latter moment there was a rather sudden increase, to an extent which rendered it impossible to count the number, but after 1.20 a decline became perceptible. The *maximum* was judged to have taken place about 1.10, and at this time the appearance of the whole heavens was very beautiful, not to say magnificent. Beyond their immense number, however, the meteors were not particularly remarkable, either as regards brilliancy or the persistence of the trains, few of which were visible more than three seconds; indeed, M. du Chaillu observed that, in these respects, the meteors fell far short of those of the April period, which he had witnessed under a fine sky in equatorial Africa. From 1.52 to 2.9, 300 were registered; from 3.9 to 3.24, 100; from 4.42 to 5, the number seen was 12, and these mostly faint; and from 5.45 to 6, only five were counted."

Mr. G. J. Symons, Camden Road, from 1.15 to 1.20 A.M.

records the flight of no less than 276, the eyes keeping one direction of sight, remarking:—"Meteors most numerous at 1.12 A.M., when they were falling at the rate of 100 per minute—in fact, the sky was scored in all directions with their trains; the largest was not twice the apparent brilliancy of Sirius; the trains were, in some instances, visible in a 2½-in. telescope for two minutes. From 2 to 3 A.M. the meteors were not so large as before and after that hour, nor did they appear so uniform in direction—two passed in parallel lines, but opposite directions. No lightning was seen, unless it was at 0h. 35m., when two flashes of light were seen, but they were supposed to be from meteors in the north. I estimate the total number visible at about 7,000 or 8,000."

The Radcliffe Observer, at Oxford, writes:—"This great display began about 13h. (or 1 o'clock in the morning), and reached its *maximum* at about 13h. 24m., after which time it gradually began to slacken. The watch, however, was kept up till 18h., though after 15h. there were not many meteors seen. In all, there were observed not fewer than 3,090 during the night, of which about 2,000 fell between 13h. and 14h., or between 1 A.M. and 2 A.M. As to the general appearance of the meteors, it was noticed that the majority of them were of a whitish or yellowish colour. Some, however, were reddish or orange-coloured, and one meteor was noticed to be bluish. The brightest left generally a train behind them, which was to be seen for a few seconds after the meteor had disappeared."

Professor Phillips writes from Oxford:—"Our sky-rocket dance began to be interesting by 11.30 P.M., grew brilliant by midnight, and enthusiastic by 0.30 A.M. From this time till 2, incessant shots were made from the covered battery in Leo, now striking the Bear's head or tail; anon crossing the belt of Orion; at times flying over our heads, and, as the hours advanced, falling in sweeps to the western horizon. It was easy to see that of the hundreds, and indeed thousands, of bombs which came from the eastward, or diverged from the eastward, or merely flashed through the shortest imaginable arc there, or showed no arc at all but a mere globe of light, few or none manifested obedience to any other centre of discharge except that in Leo. Earlier indeed, at about 12, the radiant point was certainly marked several times between the pointers of the Bear and the stars of Leo, then just above the horizon; and later, at 2.30, when the flight of the stars was overhead and Leo was 40° above the horizon, few were seen near enough to Leo to be obviously referred to that centre. The general type of the meteor was that of a rocket, ending in a globe of reddish light, with a long train of bluish, seemingly curdled, or *resolved* light; such that this train constituted a very long lanceolate gleaming mass, very often separated from the leading globe of light. The globe was seen once to divide itself, 12h. 42m. 10s. northward: often to expand like the end of an iron wire heated in oxygen gas;

magnitude often far exceeding anything now in the sky, as Sirius; very many times brighter and larger than Mars; larger and brighter by far than Jupiter at his best; looming larger and immeasurably brighter than the Oxford Commissioners' street lamp, at a distance of eighty yards. In two or three cases the bursting of large globes gave so much light around as to be entered by one observer, who did not see the meteor, 'lightning,' *e.g.* at 12h. 30m., 1h. 3m."

Mr. Hind writes:—"Professor Newton, of Newhaven, United States, has shown that the principal recorded showers of meteors at this epoch accommodate themselves to a cycle of 33¼ years, and that these bodies in all probability emanate from a vast group extended round the sun in the form of a ring of unequal density, nearly circular, and with an annual period of 365·27 days for the meteors composing it, which revolve in a retrograde direction, or opposite to the earth's motion in her orbit. The inclination of the ring to the plane of the ecliptic is about 17°, and its point of intersection therewith has an annual progressive motion from the mean equinox of about 1·7; in consequence of which movement the shower takes place on a later date now than formerly.

"The splendid display on the 13th of November, 1833, was seen over a great extent of the North American continent. It was in this year that the radiant in Leo was first established.

"It has been found that the average height of the November meteors above the earth's surface is, in round numbers, 95 miles at first appearance and 60 miles at extinction. Extraordinary showers may occur in at least two consecutive years, and the year 1867 may also bring a very unusual shower."

A comparison of the whole number of meteors observed, with the numerical results of previous star-showers, shows that the shower of 1866 was far less significant than some of its predecessors. Whether other parts of the world witnessed a grander phase in the display than we in England did we cannot say, for there is at present no authentic information on the point. M. Coulvier Gravier, who ought to be an authority, at a sitting of the Paris Academy of Sciences, suggested that the *maximum* display of the epoch might be expected in November 1867; because, he said, the really great showers are 34 years apart instead of 33, and the last of these was 1833. Moreover, he called attention to the fact that every grand shower is preceded by one not so grand in the year before it. This was the case in the year 1832-33; whether it will be so this time we must wait till next November to learn.

METEOROLOGY OF 1866.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, and Remarks on the Weather, by James Glaisher, Esq., F.R.S.

1866. Months.	Mean Reading of Barometer.	Temperature of Air. Highest by Day.	Lowest by Night.	Range in Month.	Mean of all Highest.	Mean of all Lowest.	Mean daily Range.	Mean for Month.	Departure from average of 25 yrs.	Mean Temp. of the Dew Point.	Mean Tension of Vapour.	Weight of Vapour in a cubic ft. of Air.	Mean additional Weight required for saturation.	Mean Degree of Humidity, Saturation=100.	Mean Weight of a cubic foot of Air.	Relative proportion of Wind. N.	E.	S.	W.	Mean Amount of Cloud 0 to 10.	Rain. No. of Days it fell.	Amount collected.
	In.	°	°	°	°	°	°	°		°	In.	Grs.	Grs.		Grs.							In.
Jan. ...	29·701	54·3	23·7	30·6	47·8	36·7	11·1	42·6	+4·5	38·4	·234	2·7	0·5	86	548	3	1	9	18	7·5	17	3·5
Feb. ...	29·529	57·0	24·2	32·8	47·1	34·7	12·4	40·5	+1·9	35·9	·211	2·4	0·5	85	547	6	1	7	14	7·2	18	3·9
March	29·527	64·0	22·5	41·5	48·4	34·5	13·9	40·5	−1·2	34·8	·202	2·3	0·6	81	547	9	6	8	8	8·1	15	1·6
April.	29·743	79·0	34·2	44·8	58·2	40·8	17·4	47·9	+1·1	41·5	·262	3·0	0·8	79	543	4	11	6	9	6·3	13	2·4
May ..	29·813	73·1	32·6	40·5	61·4	40·8	20·6	50·1	−2·9	40·8	·255	2·9	1·2	71	542	8	10	5	8	6·1	8	2·0
June..	29·774	86·5	42·2	44·3	73·2	52·0	21·2	60·9	+1·9	53·5	·410	4·6	1·4	77	529	3	6	10	11	6·9	14	3·6
July ..	29·770	87·2	46·0	41·2	72·6	52·5	20·1	61·0	−0·7	53·7	·413	4·6	1·4	78	528	7	7	5	12	7·0	9	1·6
Aug...	29·637	78·5	45·0	33·5	69·4	52·3	17·1	59·4	−1·8	52·7	·399	4·5	1·2	79	528	6	3	9	13	7·7	18	2·4
Sept.	29·581	71·0	41·3	29·7	65·1	50·6	14·5	56·4	−0·7	51·5	·381	4·3	0·8	84	530	3	3	13	11	7·8	19	3·9
Oct. ..	29·933	68·1	31·0	37·1	58·2	45·7	12·5	51·3	+0·8	48·2	·338	3·8	0·4	90	542	10	9	7	5	7·3	10	2·1
Nov...	29·792	59·6	26·5	33·1	50·5	38·0	12·5	44·3	+0·3	39·7	·244	2·8	0·5	84	548	3	2	10	15	6·1	13	1·5
Dec...	29·790	56·3	27·7	28·6	47·6	37·4	10·2	42·9	+2·5	39·3	·240	2·8	0·4	87	549	0	1	13	17	7·4	18	1·8
Means	29·716	69·6	33·1	36·5	58·3	43·0	15·3	49·8	+0·5	44·2	·299	3·4	0·8	82	540	62	60	102	141	7.1	172	30·3
																Sums					Sums	

NOTE.—In column 10 the sign + implies above, and the sign − below the average.

EXPLANATION.—The cistern of the barometer is about 159 feet above the level of the sea, and its readings are coincident with those of the Royal Society's flint-glass barometer. The observations are taken daily at 9 A.M., noon, 3 P.M., and 9 P.M.; the means of these readings are corrected for diurnal ranges by the application of Mr. Glaisher's corrections, in the *Philosophical Transactions*, Part I., 1848; and from the readings of the dry and wet bulb thermometers, thus corrected, the several hygrometrical deductions in columns 11 to 16 are calculated by means of Mr. Glaisher's Hygrometrical Tables. *Third Edition.*

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of a column of mercury which balanced the whole weight of atmosphere of air and water; the numbers in column 12 show the length of a column of mercury balanced by the water alone; and if the numbers in this column be subtracted from those in column 2, the result will be the length of a column of mercury balanced by the air alone, or that reading of the barometer which would have been, had no water been mixed with the air.

[*Concluded on next page.*

The Mean Temperature of the air was 49°·8, being 0°·5 above the average of the preceding 25 years; the temperature of the dew point was 44°·2. The Mean Degree of humidity was 82, complete saturation being represented by 100. Rain fell on 172 days during the year, being 59 days more than in 1864, and 27 days more than in 1865. The amount of rain collected was $30\frac{3}{10}$ inches, being 6½ inches above the average amount.

The Weather at the beginning of the year was stormy, with gales of wind. The temperature was high for the season. On the 11th day there fell an unusual fall of sticking snow, of very great specific gravity. The street traffic in London was extremely difficult; the telegraphic wires were so loaded with snow, and the wind was so violent, that many poles gave way, and telegraphic communication all round London was greatly interrupted. The snow was of that unusual dense character that 6 inches in depth produced water to the depth of 1½ in. nearly. A very rapid thaw set in, and within two or three days all the snow disappeared, followed, however, by rivers overflowing their banks. All the low-lying lands along the valley of the Thames were under water. The weather continued changeable throughout January, with heavy rains and gales of wind. The characteristic feature of this month was its extraordinary warmth, it being 6¼° above its average value from 50 years' observation. This unusual temperature continued till February 12, and the average daily excess of temperature up to this time was 6° daily. From February 13 till March 15 the weather was cold, and nearly constantly below the average for the season of the year. The average daily defect of temperature for this period was 2°·9. From March 16 to April 9 the weather was changeable, but mostly cold.

The extreme mild weather in January and the first part of February stimulated vegetation to a very unusual activity at this season. Hedges and early fruit trees were budding, and some were ready to burst into blossom.

The change in the middle of February, from so mild and damp to a colder and dryer atmosphere, prevented vegetation advancing too rapidly, and was otherwise beneficial to agricultural operations, by enabling farmers to do much field and farm work, which, in many places, owing to the soddened state of the ground, were in a very backward state.

On April 10, a sudden change to heat set in, continuing till the 28th day, during which time the weather was unusually fine, and very hot for the season, and but little rain fell. This sudden drying weather caused large tracts of land at all parts of the country to be in such a heavy state that spring operations, particularly sowing, were much impeded, and in fact agricultural purposes generally were in a backward state. The budding of trees was in general late, but in places, where they had not already shot forth their leaves, the effect of this weather was extraordinary, the leaves appearing and fruit trees blossoming so suddenly, that the whole aspect was changed in a few hours. On

April 29 a cold ungenial period set in, continuing to June 1, with only an occasional day of somewhat warmer character intervening. The mean daily deficiency of temperature during this time amounted to 3°·1, and at night the thermometer frequently fell to below 32°.

This weather seriously affected all the crops, and cut off much of the blossom from fruit trees. The growth of wheat, barley, and oats was much retarded, although on some very rich lands the cereal crops had in a measure recovered by the end of May. Pasture land made little or no progress.

On June 2, the weather again changed, and became much warmer, and a mean daily excess over the average temperature occurred to the amount of 4°·2, till the 11th day. A similar cold period followed, but on the 21st day the temperature again increased considerably, and fine weather followed till the end of June, the mean daily excess of temperature amounting to nearly 5°.

At the beginning of July the weather changed to cold, with rain falling almost daily in every part of the country. The mean temperature of the first eight days was below their average daily by 5°. On July 9 the weather changed to fine and hot, which continued till the 17th; the average daily excess of this period was 6½°. From July 18 till September 27, the temperature was nearly always cold; the exceptions were August 24 to August 28, and a few days at the beginning of September, whose mean temperatures either just reached their averages or were slightly in excess. The mean daily deficiency of these 72 days was 1¾°.

In July rain fell frequently all over the country. In the first week wheat in the southern districts passed the flowering stage, and in northern appeared in ear. Towards the end of the month some wheat in extreme south districts was cut. In August, till the third week, the weather was very unsettled, with low atmospheric pressure and frequent rain, which greatly interrupted harvest work. During dry intervals a large portion of the crops in the south of England were stacked, but in some cases in a damp condition. The month of August was not favourable to agricultural pursuits; the absence of sunshine retarded the crops ripening, the frequent rain injured them, but to a less extent than was feared, in consequence of the heavy drying winds. In some places the crops were beaten down by the rain and twisted by the wind, so that reaping machines could not be used.

In September the weather was unsettled; the atmospheric pressure was always low. Rain fell all over the country in excess, amounting, in Guernsey and in the western parts of England, to 8 in. and 9 in., gradually decreasing in amount proceeding eastward to 3 in. near the east coast; about London near 4 in. fell.

In the midland counties, owing to the heavy rain, there were great floods, the waters of the Trent, the Soar, and the Derwent overflowed, and covered thousands of acres of corn land, and caused great damage.

The month of September was very bad for all agricultural pursuits.

The co-existence of cholera with coincident meteorological phenomena, which were experienced during the three preceding visitations in the years 1832, 1848, and 1854, viz., great atmospheric pressure, high temperature, small diurnal range (owing mostly to high night temperature), deficiency of rain, very little wind (and consequently a stagnation of the atmosphere, and prevalent mist), a deficiency of electricity (as evidenced by the few electrical disturbances), and in 1854 the presence of a remarkable blue mist, which prevailed night and day.

Nearly all the circumstances of the year were directly opposite to those mentioned above, as being present at the previous visitations of cholera.

One of the most remarkable Atmospheric Phenomena during the past quarter has been the prevalence of a peculiar Blue Mist, first seen by myself on July 30, but which had been remarked by other observers in the preceding week. This blue mist, since that time, has been generally present; on some days no trace of the mist has been visible, and on other days it has been seen for parts of a day only. It has extended from Aberdeen to the Isle of Wight, and of the same tint of blue everywhere. This mist increased in intensity when viewed through a telescope; usually no mist can be seen when thus viewed; it increased in density during the fall of rain; usually mist rises after the fall of rain. Its density did not decrease when the wind was blowing moderately strong, but did decrease when a gale was blowing, but increased again on its subsidence. I do not know the nature of this blue influence, but the fact of its presence not having been noticed since the cholera-period of 1854 till now points out a possible connection, but, independently of this, it is of high meteorological interest.

The Mean Temperature of January was 42°·6, being warmer than any January since that of 1851; the preceding month, December, was 42°·7, being 2°·4 of higher temperature than the average; usually January is 2°·8 colder than the preceding month, yet on this occasion it was 0°·1 of lower temperature only. It was 4½° above the average of the preceding 25 Januaries, and 6°·3 above the temperature of January 1865.

The mean temperature of February was 40°·5, being 1°·9 above the average of the preceding 25 Februaries, and 3°·9 above that of last year. Every month from September to this month inclusive has been of higher temperature than their averages, to the mean amount of 3°·9 nearly.

The mean temperature of March was 40°·5, the same as in February, being 1°·2 below the average of the preceding 25 years, and 3°·9 above that of last year.

The mean temperature of April was 47°·9, being 2°·0 above the average of the preceding 95 years, 1°·1 above the average of 25 years, and 4°·4 below the temperature of last year.

The mean temperature of May was 50°·1, being 2°·9 below the average of the last 25 years, and lower than any other May, excepting in 1845, 1855, and 1856, when the values were respectively 49°·5, 48°·8, and 49°·4.

The mean temperature of June was 60°·9, being 1°·9 above the average of the preceding 25 years, and higher than any other year since 1859.

The mean temperature of July was 61°·0, being 0°·4 below the average of the preceding 95 years, 0°·7 below the average of 25 years, and lower than any year since 1863, when the temperature was 60°·8.

The mean temperature of August was 59°·4, being 1°·3 lower than the average of the preceding 95 years, 1°·8 lower than the average of 25 years, and 1°·8 below that of last year.

The mean temperature of September was 56°·4, being 0°·1 lower than the average of the preceding 95 years, 0°·7 lower than the average of 25 years, and lower than the temperature of last year to the amount of 7°·5.

The mean temperature of October was 51°·3, being 1°·6 above the average of the preceding 95 years, 0°·8 above the average of 25 years, and higher than any year since 1863, when the temperature was 51°·6.

The mean temperature of November was 44°·3, being 1°·9 above the average of the preceding 95 years, 0°·3 above the average of 25 years, and 1°·5 below that of last year.

The mean temperature of December was 42°·9, being 3°·8 above the average of the preceding 95 years, 2°·5 above the average of 25 years, and higher than any year since 1863, when the temperature was 43°·2.

KILLED BY AN AEROLITE (?).

In November 1866, a police-officer, at Edinburgh, was found drowned in Dunsappie Loch, with no trace of violence upon his person beyond a slight discolouration of the forehead. There was no evidence to show how the deceased met his death; and Mr. E. Monson, in a letter to the *Times*, suggests that it being on the night of the periodical visitation of aerolites, the deceased may have been struck by one of them, and have been precipitated into the water and suffocated. Mr. Monson adds that a few years since his brother, driving an open carriage in Tuscany, was suddenly half-stunned by a blow on the head by a small aerolite, which was picked up immediately after the accident. Lately, an aerolite fell at Florence, when some persons had a narrow escape from being struck. The specific gravity of the missile was found to exceed that of a bullet.

Obituary.

LIST OF PERSONS EMINENT IN SCIENCE OR ART, 1866.

WILLIAM THOMAS BRANDE, F.R.S., the eminent chemist, author of the *Manual of Chemistry*, which has passed through several editions, and has been translated into French, German, and Italian. In 1813, Mr. Brande succeeded Sir Humphry Davy as Professor of Chemistry in the Royal Institution, and was, from 1820, associated with Mr. Faraday. In 1825, Mr. Brande was appointed Superintendent of the Die Department in the Royal Mint: he died at the advanced age of 81.

THE REV. WILLIAM WHEWELL, D.D., Master of Trinity College, Cambridge. Dr. Whewell was an able and voluminous writer. His principal works are:—*A History of the Inductive Sciences, The Philosophy of the Inductive Sciences, The History of Scientific Ideas, Novum Organum Renovatum, The Philosophy of Discovery; The Elements of Morality, including Polity; the Bridgewater Treatise on Astronomy, Notes on the Architecture of German Churches, Lectures on the History of Moral Philosophy in England; Indications of the Creator*, in answer to the *Vestiges of Creation.* He also wrote many educational books. Another production of his was *The Platonic Dialogues for English Readers;* and he is supposed to have been the author of *The Plurality of Worlds.*

DR. JOHN CONOLLY, experienced writer on Lunacy.

JACOB SCHWART, Dutch geographer.

JARED SPARKS, American historian.

PROFESSOR W. DICK, veterinary surgery.

THOMAS MUSGRAVE JOY, artist.

DR. GUY BABINGTON, medicine.

M. DE VAUX, Belgian mineralogist.

JOHN M'DOUALL STUART, Australian explorer.

JOHN HAYES, painter.

REV. J. M. NEALE, Theology and History.

SERJEANT JAMES MANNING, Law and Philology.

CHARLES MACLAREN, Politics and Geology.

WILLIAM GRAVATT, F.R.S., the eminent Civil Engineer. The liberality of Mr. Gravatt, in the encouragement of the Messrs. Scheutz, with their Difference Engine, deserves mention. In the winter of 1854, the inventors brought their Machine from Stockholm to London, where Mr. Gravatt showed and explained the invention to the Royal Society. It was next placed in the Great Exhibition at Paris, where Mr. Gravatt again kindly worked and explained the machine to many scientific gentlemen, and a jury unanimously awarded to it a gold medal. In 1856, the machine was brought from France, and was set to work in an apartment in Mr. Gravatt's house, at Westminster. It was subsequently purchased for the Dudley Observatory at Albany, U.S. (See *Stories of Invention and Discovery*, by the Editor of the *Year-Book of Facts*, 1860, page 144.) Mr. Gravatt, who was in his 59th year, took an active part in the railway mania of 1845-6, and his name was brought before the profession somewhat prominently in subsequent litigation growing thereout.

R. Garrett, of Leiston, Suffolk, the eminent agricultural implement manufacturer. In 1778, when Mr. Garrett succeeded to the Leiston Works, sixty men and eight or ten horses were employed, but no steam-power had yet been called into play. The once insignificant village has now become a town of more than 2,000 inhabitants, all dependent on the Leiston Works. The sixty workpeople have increased to 600; the horse-power has given place to steam-power, and the name of Garrett has become known throughout Europe, in Egypt, Australia, and almost all over the world. The house of Garrett, at the International Exhibitions of London, Dublin, Paris, Hamburg, Vienna, and Madrid, won no fewer than sixty gold medals and sixty silver ones, together with 1,200*l.* in cash. When the East Suffolk Railway, now merged in the Great Eastern system, was brought forward, Mr. Garrett found capital to the amount of 10,000*l.*

Hall Maxwell, 20 years Secretary of the Highland and Agricultural Society of Scotland. The annual shows of the Society under his great administrative talent showed an equal improvement, alike as to the quantities and quality of stock, and the number and superiority of workmanship and finish of agricultural implements. One of the greatest benefits which Mr. Hall Maxwell conferred upon Scottish agriculture was, in superintending the collection of the agricultural statistics of stock and crops from 1854 to 1857.

William Harvey, the graceful draughtsman on wood.

Dr. Camille Montague, botanist.

Sir John M'Gregor, physician.

John Gibson, R.A., sculptor.

Nordenskiold Nils, Swedish geologist.

William Hookham Carpenter, who for more than twenty years filled, with great advantage to the public, the post of keeper of the prints and engravings in the British Museum.

Dr. Thomas Hodgkin, one of the founders of the Aborigines' Protection and the Ethnological Societies; an honorary secretary of the Geographical Society, a member of the senate of the University of London, and intimately connected with many other scientific bodies. He was a member of the Society of Friends.

Dr. George Petrie, the well-known writer on Irish archæology, and author of the *Round Towers of Ireland*, for which work he received the gold medal of the Royal Irish Academy about the year 1837. He subsequently wrote an Essay on the Military Antiquities of Ireland, which also obtained its prize; in which he showed that works of Cyclopean architecture remained in Ireland, the relics of a primitive race in a remote age. He was afterwards engaged on the historical and antiquarian sections of the Ordnance Survey of Ireland. Dr. Petrie was an ex-president of the Royal Hibernian Academy, a vice-president of the Royal Irish Academy, &c.

George Rennie, the eminent Civil Engineer. He was the son of John Rennie, the engineer of Waterloo, Southwark, and London Bridges. Mr. George Rennie assisted his father in early life in the construction of the London and East India Docks, the Plymouth Breakwater, the Bell Rock Lighthouse, &c. He was a Vice-President of the Royal Society, and had contributed several papers to the *Philosophical Transactions.* He was a member of the Royal Irish Academy, and a Fellow of the Geological Society. Mr. George Rennie was brother of Sir John Rennie, the civil engineer.

William Fisher Hobbs, distinguished agriculturist.

Samuel Reynolds Solly, who, for a long series of years, devoted himself to the advancement of science. He was an active and energetic member of the Society of Arts, and was a Fellow of the Royal Society.

Edward Ash Hadow, for many years Demonstrator of Chemistry in King's College, London. Mr. Hadow's labours in photography, and his admirable researches upon the composition of gun-cotton and the platinum basis will secure for him a wide reputation.—*Mechanics' Magazine.*

Dr. Robert Kaye Greville, of Edinburgh, well known as one of the most accomplished botanists of Scotland; and few men have done so much for the advancement of the study of cryptogamic plants. He was a most accurate and skilful artist: before he was nineteen he had prepared carefully-coloured drawings of upwards of 250 of the native plants. Lately he had devoted himself to the description and figuring of the *Diatomaceæ.* A change having taken place in his circumstances, he took up landscape-painting as a profession, and several of his pictures are to be seen in well-known collections. Dr. Greville published *Flora Edinensis, Scottish Cryptogamic Flora, Algæ Britannicæ*; and in conjunction with Sir W. J. Hooker, *Icones Filicum,* besides numerous papers in various scientific journals. He was honorary secretary of the Botanical Society, and a fellow of the Royal Society of Edinburgh, an honorary member of the Royal Irish Academy, of the Imperial Academy Naturæ Curiosorum, and of the Natural History Society of Leipzig, &c.

Dr. William Henry Harvey, Professor of Botany to the Royal Dublin Society. In 1845 he projected the first of his great works, the *Phycologia Britannica,* the first part of which was published in January, 1846. The whole of the plates in this work, 360 in number, were drawn on stone by Dr. Harvey himself. In every respect, pecuniarily and otherwise, the publication of the *British Seaweeds* was a great success, and established its author as one of the first living authorities on this subject. Dr. Harvey next delivered a course of lectures on Algæ before the Lowell Institute of Boston, U.S.; he left Dublin for America in July, 1849, returning early in May, 1850. In the meanwhile he visited many places on the coast of North America, and made large collections of Algæ. He also at this time made a tour around the shores of the Pacific, visiting Oregon and California, the result of which labours was published by the Smithsonian Institution, in a large 4to. volume. In August, 1853, he left for Ceylon, stopping at Aden to collect on the way. From Ceylon he proceeded to Australia, visiting Sydney, Melbourne, Adelaide, and several parts of Tasmania and New Zealand. Taking advantage of the visit of a missionary ship, he went to the Fiji and Friendly group of islands. Returning to Sydney, he went to Valparaiso, and came home in October, 1856. This extended tour cost Dr. Harvey more than 1,200*l*. The Algæ collected on the Australian coast amounted to more than 20,000 specimens and 600 species; and in 1857 the *Phycologia Australica* was published in five volumes, each volume containing sixty plates, of which the first 200 were drawn on stone by the author. The work was completed in 1863. The *Flora Capensis* was next commenced. In this Dr. Harvey was joined by Dr. Sonder, of Hamburgh. This great work, of which three large 8vo. volumes are already published, unfortunately is still incomplete. Dr. Harvey commenced at the same time a series of illustrations to this Flora, under the title of *Thesaurus Capensis*: two volumes of this work, containing 200 plates, are already published.—*Abridged from the Athenæum.*

Samuel Roffey Maitland, D.D., an able writer on theological history, and Librarian at Lambeth Palace.

John Lee, of Hartwell House, in Buckinghamshire, the admirable astronomer and eccentric politician. His original name was John Fiott; he assumed the name of Lee on succeeding to the Hartwell estates left by his uncle, Sir George Lee, Bart. Dr. Lee was a Fellow of the Royal, the Astronomical, and the Geographical Societies. Of the Astronomical Society he was President for two years.—*Athenæum.*

Godfrey Sykes, artist, of the Kensington Museum.

Professor Hupfeld, the celebrated Hebrew scholar.

Francis Mahony (*Father Prout*), a great master of languages.

Charles James Hargreave, eminent mathematician.

Professor George Lillie Craik, of Queen's College, Belfast, Editor of the *Penny Cyclopædia.*

William Bewick, artist, son of the famous draughtsman and engraver on wood.

Robert Buchanan, Scottish journalist.

C. H. COOPER, of Cambridge, archæologist, well known for *Memorials of Cambridge*, his *Annals of Cambridge*, and his *Athenæ Cantabrigienses*.

F. W. FAIRHOLT, A.S.A., the truthful antiquary and antiquarian artist.

THE REV. JOHN KEBLE, author of *The Christian Year*.

PARKIN JEFICOCK, Civil and Mining Engineer, of Derby, who lost his life with an exploring party at the Oaks Colliery, after a terrible accident there.

JOHN BARNETT, architect of several works in the City of London.

JACOB SNIDER, the inventor of the breech-loading rifle which bears his name, and which is now being introduced into our army. Mr. Snider had for some time past been suffering from an illness brought on by mental anxiety and overwork, and to which he eventually succumbed. Mr. Snider was spared to see the system of breech-loading which he had spent so many years in perfecting adopted by the Government, but unfortunately he did not live to enjoy the fruits of his ingenuity and perseverance, which were just within his grasp.—*Mechanics' Magazine.*

W. M. HINDMARCH, L.C., the eminent Patent Counsel, author of an admirable treatise *On the Law of Patents*. He will perhaps be more generally known by his recent labours on behalf of inventors, as a member of the Royal Commission appointed to inquire into the working of the Patent Laws. Mr. Hindmarch dissented from the report of the other Commissioners, and embodied his views in a separate report, which contains suggestions of an eminently practical and valuable nature.

JOHN FREDERICK GODDARD, the discoverer of the use of bromine in photography.

DR. JULIUS VON DEM FISCHWEILER, the learned physician of Magdeburg, who, in his will, has left the world the following scientific secret, viz. that his own great age, 109, is entirely to be ascribed to his constant habit of sleeping with his head towards the north, and the rest of his body in a direction coinciding as closely as possible with that of the meridian—that is, with his heels to the south. From persisting in this habit the learned doctor considered that the iron contained in our system, finding itself in the direction of the magnetic currents which are constantly flowing over the surface of the globe towards the north pole, becomes magnetized, and thus increases the energy of the vital principle.—*Mechanics' Magazine.*

DR. CHARLES G. RITCHIE, a young physician, having considerable practice, especially in obstetric cases, in London. He was found in his consulting-room, in the middle of a scientific experiment, apparently suffering from the effects of some poisonous ingredient. After some hours, during which every effort was made to restore him, he finally succumbed, as is believed, to the effects of the poison.

C. Wye Williams, the well-known Engineer. He did much to develop the steam-shipping trade of the country, and especially of Liverpool, both commercially and by improvements in steam-boilers. He devoted much of his time to the laboratory, and was hence little known personally, even in Liverpool; but his writings on *Heat, and its Relation to Water and Steam*, and on *The Combustion of Coal and the Prevention of Smoke, chemically and practically considered*, are well known. He gained the prize of 500*l.* at Newcastle, for improvements in marine steam-boilers, and the Society of Arts' 25*l.* gold medal, for his essay on smoke prevention. Mr. Williams was an Associate of the Institute of Naval Architects, and of the Institution of Civil Engineers.

E. B. Spence, of Rome, sculptor.

Frank Howard, artist, son of the Royal Academician.

Joseph Robertson, Scottish journalist and antiquary.

R. D. Hay, of Edinburgh, scientific decorator.

Dr. Conquest, surgeon and biblical student. The manual which he wrote for students in obstetric medicine was translated into many languages, including Hindustani and Chinese.

The Rev. Edward Hincks, D.D., the profound philologist. His talent for deciphering texts in unknown characters and languages was wonderful. It was applied to the study of Egyptian hieroglyphics, and to the inscriptions in the cuneiform character found in Persepolis, Nineveh, and other parts of ancient Assyria.

Henry Chawner Shenton, the historical line-engraver.

Gavarni, the accomplished French artist.

S. Stone, student of natural history, and a distinguished archæologist.

Herman Goldschmidt, an amateur astronomer of note. It is curiously said of him:—"Though only an amateur in science, he has discovered fourteen telescopic planets, and the only instrument was a common opera-glass."

Dr. G. H. Barlow, Editor (for many years) of *Guy's Hospital Medical Reports*, and a hard-working and eminent medical man.

John Thompson, for more than half a century ranked at the head of British wood engravers.

W. H. Leeds, architectural writer and an acute critic.

GENERAL INDEX.

THE END.

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