3-OH
Year

W. J. Whitlock, Photo.

John Phillips

Dr. JOHN PHILLIPS, F.R.S.

Professor of Geology in the University of Oxford.
President of the British Association 1865.

THE

AR-BOOK OF FACTS

IN

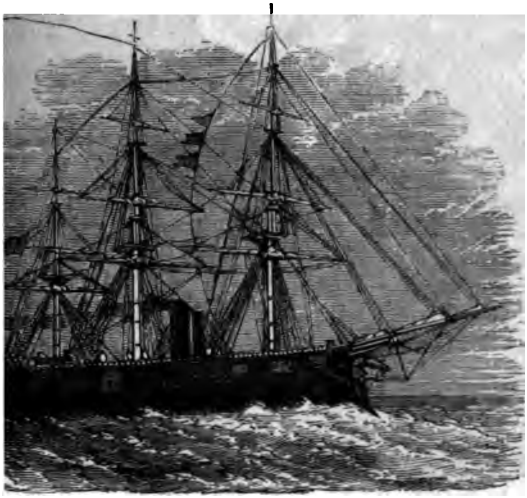
Science and Art:

EXHIBITING

ST IMPORTANT DISCOVERIES AND IMPROVEMENTS
OF THE PAST YEAR;

HANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY;
TRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY
AND MINERALOGY; METEOROLOGY AND ASTRONOMY.

BY JOHN TIMBS, F.S.A.
OF "CURIOSITIES OF SCIENCE," "THINGS NOT GENERALLY KNOWN," ETC



The Iron-clad Screw Steam-ship *Pallas*.—(See p. 15.)

LONDON:
VOOD AND CO., 7, STATIONERS' HALL COURT.
MDCCCLXVI.

LONDON:
SAVILL AND EDWARDS, PRINTERS, CHANDOS STREET
COVENT GARDEN.

DR. JOHN PHILLIPS, M.A., LL.D., F.R.S.,

PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF OXFORD.

(With a Portrait.)

This eminent Geologist, who so efficiently filled the office of President of the Meeting of the British Association at Birmingham in September last, has held the post of Assistant General Secretary to that Association since 1832, and he was one of its earliest founders. His inaugural Address upon the above occasion is regarded as a most felicitous composition, skilfully grouping the happy combinations of Science and Art which characterize "the young life of the British Association, one-third of a century, illustrated by discoveries and enriched by useful inventions in a degree never surpassed." "Assembled for the third time," said Professor Phillips, "in this busy centre of industrious England, amid the roar of engines and the clang of hammers, where the strongest powers of nature are trained to work in the fairy chains of art, how softly falls upon the ear the accent of Science, the friend of that art, and the guide of that industry! Here, where Priestley analysed the air, and Watt obtained the mastery over steam, it well becomes the students of nature to gather round the standard which they carried so far into the fields of knowledge. And when, on other occasions, we meet in quiet colleges and academic halls, how gladly welcome is the union of fresh discoveries and new inventions, with the solid and venerable truths which are there treasured and taught! Long may such union last—the fair alliance of cultivated thought and practical skill; for by it labour is dignified and science fertilized, and the condition of human society exalted!"

John Phillips was born on the 25th of December, 1800—"a year which may be held to pre-date the birth of the science to which he has so zealously devoted himself. Prior to that time Geology can scarcely be said to have taken form as a positive and distinct branch of knowledge, or to have advanced beyond the domain of ingenious speculation." "The first in order of time and merit of practical British geologists, true men of the field and hammer, and to whose labours science owes so much, was William Smith,*

* In 1769 was born, the son of a yeoman of Oxfordshire, William Smith. When a boy he delighted to wander in the fields, collecting "pound-stones" (*Echinites*), "pundibs" (*Terebratulæ*), and other stony curiosities; and receiving little education beyond what he taught himself, he learned nothing of classics but the name. Grown to be a man, he became a land-surveyor and civil engineer, and was much engaged in constructing canals. While thus occupied, he observed that all the rocky masses forming the substrata of the country were gently inclined to the east and south-east,—that the red sandstones and marls above the *coal-measures* passed below the beds provincially termed lias-clay and limestone—that these again passed underneath the sands, yellow limestone, and clays that form the table-land of the Coteswold Hills; while they in turn plunged beneath the great escarpment of chalk that runs

'the father of English geology.'" This pioneer of a host of explorers was the uncle of Professor Phillips, who, as his pupil and assistant, was more or less associated with him in all his undertakings from 1815 until his death in 1839. In the memoir of William Smith, written by Professor Phillips, and published in 1844, he refers to himself as "an orphan who benefited by his goodness, a pupil who was brought up under his care." At an early age, it appears, the nephew became an inmate of his uncle's home, and shared with him in all the vicissitudes of his fortunes. Not unfrequently do we meet in the writings of our author an appreciative and affectionate notice of his uncle's labours and kind-heartedness. To him he dedicates his *Illustrations of the Geology of Yorkshire*, referring to his uncle as having spent his life in establishing the philosophical principles of Geology, and in applying them when established to practical use, and subscribing himself "his affectionate nephew and grateful pupil, John Phillips."

It is interesting to know that, early as 1800—the year in which his nephew was born—Smith had framed and coloured a map connecting the structure of the north of England with the structure of the south-west districts, and delineating the whole Ooolite series through England, in some places very correctly, and in others with a general approach to accuracy. This historically valuable map remains in possession of his nephew. After the publication of the "great map" in 1815, Mr. Smith was engaged in constructing maps of counties and geological sections, in surveying for which, and in their actual production, he was largely assisted by Mr. Phillips. According to an established custom on all such tours, he was employed in sketching parts of the road, and noticing in maps the geological features of the country.

In these surveys, and in the production of the twenty-one geolo-

from the coast of Dorsetshire northward to the Yorkshire shores of the German Ocean. He further observed that each formation of clay, sand, or limestone, held to a very great extent its own peculiar suite of fossils. The "snakestones" (*Ammonites*) of the lias were different in form and ornament from those of the inferior oolite; and the shells of the latter, again, differed from those of the Oxford clay, Cornbrash, and Kimmeridge clay. Pondering much on these things, he came to the then unheard-of conclusion that each formation had been in its turn a sea-bottom, in the sediments of which lived and died marine animals now extinct, many specially distinctive of their own epochs in time.

Here indeed was a discovery—made, too, by a man utterly unknown to the scientific world, and having no pretension to scientific lore. "Strata Smith's" find was unheeded for many a long year; but at length the first geologists of the day learned from the land-surveyor that superposition of strata is inseparably connected with the succession of life in time. Hooke's grand vision was at length realized, and it was indeed possible "to build up a terrestrial chronology from rotten shells" imbedded in the rocks. Meanwhile he had constructed the first geological map of England, which has served as a basis for geological maps of all other parts of the world. William Smith was now presented by the Geological Society with the Wollaston Medal, and hailed as "the Father of English Geology." He died in 1840. Till the manner as well as the fact of the first appearance of successive forms of life shall be solved, it is not easy to surmise how any discovery can be made in geology equal in value to that which we owe to the genius of William Smith.—*Saturday Review, No. 140; quoted in Curiosities of Science.*

gical maps, in which their results were graphically recorded, the uncle and nephew were associated from 1819 to 1824; and thus was acquired by the latter that intimate acquaintance with the physical structure and stratification of England, and that practical knowledge of geology which have rendered him so acceptable and valuable a teacher.

Mr. Phillips's earliest contribution to geological literature appeared in the *Philosophical Magazine* in 1827: it was an essay "On the Direction of Diluvial Currents in Yorkshire," and was first read as a paper before the Yorkshire Philosophical Society, in November, 1826. This Society had been instituted by scientific men belonging to the city and county of York a few years previously. The acquirements of Mr. Phillips, and his success as a lecturer, brought him into notice. In 1824 he was entrusted with the task of arranging the fossils of the Society's Museum, and in the following year he was appointed its keeper. In 1829 the collections of the York Museum were removed to a new building erected in the grounds of St. Mary's Abbey, and Mr. Phillips then resided in the house which had formerly been the gate of the Abbey. In an address delivered on opening the new Institute at York, he calls attention to the locality of the city and character of the county, as "especially destined to direct and encourage the study of nature and researches into the history of man." To the student of British history he commends York as offering unrivalled memories. "Around us," he says, "still remain the walls which guarded the Roman legions; here died the Roman emperor; within those walls the Saxon earl opposed the Norman conqueror; the city yet possesses some of her splendid abbeys; and still we may walk round the battlements from which Newcastle and his Royalists defied the Cromwellians under Fairfax before the fatal field of Marston Moor."

About this time Mr. Phillips published his *Illustrations of the Geology of Yorkshire*, in obtaining the materials for which he incurred an immense amount of labour, having ascended almost every high mountain of the county, explored every valley, and ascertained the thickness of the strata by above one thousand barometrical observations. In his *Rivers, Mountains, and Sea-coast of Yorkshire*, will be found a most accurate and graphic account of the principal features of the physical geography, the climate, antiquities, and ancient races of the county of York. He describes as his aim—"to win from the hasty traveller an hour's delay at the railway-station, a day's wandering by the waterfalls, a week's rambling over rocky hills, and to plead with the residents of Yorkshire for a better knowledge of its natural beauties and the memorials of its old inhabitants."

In the preface to this work he tells us of his affection for York and Yorkshire from childhood:—"Long before my eyes rested on the mountains of the north of England," he writes, "the mighty form of Ingleborough was engraved on my imagination by many a vivid description; and when I crossed the old Gothic bridge, and beheld the glorious church which is the pride and veneration of Yorkshire, it was but the realization of a long-indulged dream of boyhood."

In 1831, Mr. Phillips, as Secretary to the Yorkshire Philosophical Society, took a leading part, with Sir David Brewster and others, in establishing the British Association, which held its preliminary meeting in the theatre of the York Museum, in September of that year. Mr. Phillips then acted as secretary to the committee of management; and at the second meeting at Oxford, in 1832, he was chosen Assistant General Secretary. In that official capacity he has edited the numerous volumes of Reports and Transactions since published under his name, besides discharging the many duties connected with its stated annual gatherings—duties general, official, and scientific—involving a large correspondence and frequent communications with local officers; and to these services must be added his numerous original and valuable papers read from year to year before the different sections.

Sir Henry Delabeche, the founder of the Geological Survey of Great Britain, attached to his staff Mr. Phillips, whose ability as a palæontologist he rightly appreciated; and he examined and described, for the purpose of publication, the organic remains of the older strata observed in the strata of the survey, the results of which he published in *Figures and Descriptions of the Palæozoic Fossils of Cornwall, Devon, and West Somerset*—a work involving patient care and labour; for which Mr. Phillips visited many localities in Devonshire and Cornwall, to make drawings on the spot, when, from the disintegrated condition of the stone, the fossils could not be removed. Previously to these labours there had been scarcely any original determination of Devonshire fossils. To 277 animal structures in these Palæozoic strata, Mr. Phillips has applied names, and has illustrated them by about 750 figures. Reckoning the number of the species at from 300 to 400, he observes: "upon a basis so ample, there ought to be no unusual difficulty in founding satisfactory conclusions touching the geological age of the deposits which contain them, the circumstances under which the animals were introduced into this part of the ancient sea, and the conditions of their existence therein."

In 1840, Mr. Phillips resigned the charge of the York Museum, but continued to superintend the geological collection as one of the honorary curators until 1844. He then devoted himself to the examination of the Malvern district, the result of which will be found in the second volume of the *Memoirs of the Geological Survey*, under the title "The Malvern Hills Compared with the Palæozoic District of Abberley." In the same year he was appointed Professor of Geology in the University of Dublin. Previously, from 1835, he had filled the chair of Geology at King's College, London. Upon the death of Mr. Strickland, in 1853, who had performed the duties of the chair of Geology, in place of Dr. Buckland, at Oxford, Mr. Phillips was appointed to the vacant post; and later, on the demise of Dr. Buckland, he became his successor, as reader or Professor of Geology in the University of Oxford.

In Yorkshire, Mr. Phillips early became popular as a lecturer on Natural Science. In the metropolis, he has delivered lectures at the Royal Institution and London Institution; as early as 1831, at University College, he gave an extensive course of Lectures on Geology to students.

"His knowledge," says a well-informed writer, "of the allied departments of science—of general physics, chemistry, mineralogy, and natural history—renders his lectures, as well as his printed works, of great value, in conveying comprehensive views of the earth's structure and physical history; while the skill in drawing which is shown by the graphic illustrations both of his lectures and publications (and in which the late Thomas Webster was his only rival among English geologists) has imparted to him great advantages in describing natural phenomena, and forcibly recommends the practice of drawing to all students of natural history."

In the year 1845, the Wollaston Medal was awarded to Professor Phillips, by the President of the Geological Society, in consideration of his valuable works on Geology. One of Phillips's most recent works is entitled *Life on the Earth, its Origin and Succession*, which is the substance of the Rede Lecture delivered by him to the University of Cambridge, in May 1860. "In dealing with this theme the author prefers the terms Palæozoic (ancient life), Mesozoic (middle life), and Cænozic (recent life) to the ordinary titles Primary, Secondary, and Tertiary, as more accurately indicating the three great divisions of the strata of the earth which represent the three corresponding portions of geological time. Embraced in the Palæozoic formations are the stratified groups of rocks known as the Silurian, Devonian, Carboniferous, and Permian systems. The Mesozoic strata include the Triassic, Oolitic, and Cretaceous systems, and the Cænozoic, the Tertiary and Post-Tertiary systems. When referring to the lower Palæozoic strata, and to what he terms 'the beautiful system of life which they contain'—strata which for many years engaged the attention of Murchison and Sedgwick—he prefers to use the compound term Siluro-Cambrian, or Cambro-Silurian, as if by way of reconciling the claims of geologists so distinguished, and to bury the recollection of the keen discussions connected with the nomenclature of these ancient rocks."*

In his views on the conditions and limitations of life, Professor Phillips accords with the eminent *savant* who fills the chair of Geology in the University of Cambridge. Thus, in referring to the theories of the author of the *Vestiges of the Natural History of Creation*, Phillips conveys his own repudiation of them in the words of Sedgwick: "Geology, not seen through the mists of any theory, but taken as a plain succession of monuments and facts, offers one firm accumulative argument against the hypothesis of development." There is also a like concurrence of opinion between the geological professors of the sister universities in their rejection of the Darwinian hypothesis of the origin of species: a rejection as thorough as that accorded to the conclusions of the

* *From a well written Memoir of Professor* Phillips, in the Leisure Hour.

author of the *Vestiges*. "No one," he says, "who has advanced so far in philosophy as to have thought of one thing in relation to another will ever be satisfied with laws which had no author, works which had no maker, co-ordinations which had no designer."

"The theory of geology," said Professor Phillips, in his Address to the Geological Society in 1859, "is nothing less than the physical history of the globe, and this history is to be extorted from the archives of nature by question upon question, after doubt upon doubt. When geologists cease to inquire, when a dogma is quoted to relieve a doubt, when faith in the dictum of some favourite author outweighs the evidence in the book of nature, we may, indeed, have much of form in our geology, but little of truth and energy: 'Ipsique cæci, aliorum oculis videmus, si quid.'"

The consideration of the great subject of the Origin and Succession of Life on the Earth is approached by Professor Phillips thus reverentially:—

"Nature," he says, "in a large sense, is the expression of a DIVINE IDEA—the harmonious whole of this world of matter and life. Man, included in this whole, is endowed with the sacred and wonderful power of standing in some degree apart, so as to observe the course, investigate the laws, and measure the direct and inexhaustible powers which surround him and penetrate him. The knowledge thus slowly acquired is contained in two great HUMAN IDEAS: the idea of *force* as producing phenomena, and of *time* as determining the succession and duration of these." . . . . "The rich variety of the earth's surface as it is now possessed by man is the legacy of many long ages of busy nature labouring to upheave the mountains and depress the seas, and carefully storing up the treasures of those distant years for the enjoyment of the present period. No coal-fields, to last even a single century, are now growing at the mouths of our rivers; no metallic veins are spreading through the rocks that we can explore; no great catastrophe breaks down the barriers of seas or opens picturesque glens through the ridges of the mountains. Yet the forces whose accumulated effects seem to us so mighty are still alive, and still give proof of their power to make further change in the condition of the globe."

The writings of our author are very numerous. In the fourth volume of the *Bibliographia Zoologiæ et Geologiæ*, published in 1854, Agassiz enumerates thirty-one works, papers, or collections of articles, by Professor Phillips: now, they amount to fifty, without counting articles on Electricity, Magnetism, Meteorology, and Astronomy; for in all these subjects he has entered as an inventor of instruments and an observer of new phenomena. Some of his latest papers are Telescopic Notices of the Sun and the Planet Mars, in the *Proceedings of the Royal Society*. Nor are these communications of the nature of compilations, but are in most cases the records of original researches. These works are the result of a lifetime of unwearied labour in the prosecution of his chosen studies, and entitle the author to rank as the most accomplished geologist of his time. The very wide plan of his education and training has, however, induced Professor Phillips to make excursions into other branches of study, as we have already mentioned. To these may be added Archæology, more especially in its relation to Geology and Mineralogy. Thus we find among Professor Phillips's papers, *Thoughts on Ancient Metallurgy and Mining among the Brigantes*, 1848; and

On some of the Relations of Archæology to Physical Geography, 1853. His very able volume on Yorkshire (pp. 312) not only treats of its Natural History, but of the memorials of its old inhabitants—"the roads, and camps of the Romans, and the earlier sites of Brigantian tribes," which are treated with scholarly accuracy and pleasant antiquarianism.

How beautiful is this passage from his Inaugural Address last autumn:—

"And what is the latest term in this long series of successive existence? Surely the monuments of ever-advancing art—the temples whose origin is in caverns of the rocks; the cities which have taken the place of holes in the ground, or heaps of stones and timber in a lake; the ships which have outgrown the canoe, as that was modelled from the floating trunk of a tree, are sufficient proof of the late arrival of man upon the earth, after it had undergone many changes and had become adapted to his physical, intellectual, and moral nature.

"Compared with the periods which elapsed in the accomplishment of these changes, how short is the date of those yet standing monoliths, cromlechs, and circles of unhewn stone which are the oldest of human structures raised in Western Europe, or of those more regular fabrics which attest the early importance of the monarchs and people of Egypt, Assyria, and some parts of America! Yet, tried by monuments of natural events which happened within the age of man, the human family is old enough in Western Europe to have been sheltered by caverns in the rocks while herds of reindeer roamed in Southern France and bears and hyænas were denizens of the south of England. More than this, remains of the rudest human art ever seen are certainly found buried with and are thought to belong to races who lived contemporaneously with the mammoth and rhinoceros, and experienced the cold of a Gallic or British winter, from which the woolly covering of the wild animals was a fitting protection."

His descriptions of scenery abound with poetic feeling, and there is throughout his works a reverential spirit, which is comparatively rare in these times of factious controversy. Thus, in his letter to the Provost of Worcester College, in reply to a question touching the bearing of geological discovery on religious belief, Professor Phillips emphatically says: "On the whole, I believe, I am satisfied, that Geology has added to the defence of Natural Theology, established no results hostile to the evidences of Revelation, and encouraged no disposition of mind unfavourable to a fair appreciation of those evidences. In this faith I cheerfully abide." This declaration well bespeaks the writer's simplicity of character, which, conjoined to an amiable disposition, endears Professor Phillips to all who know him or are familiar with his works; while his energy, industry, and courtesy, uniformly shown in his secretaryship of the British Association, are remembered with the warmest appreciation.

The accompanying Portrait of Professor Phillips is copied, by permission, from a photograph, taken by Whitlock, at Birmingham, in 1865.

CONTENTS.

PORTRAIT OF GENERAL SABINE, PRESIDENT OF THE ROYAL SOCIETY.

In the YEAR-BOOK OF FACTS, 1865, *it was omitted to be stated that the Frontispiece Portrait of* GENERAL SABINE *was engraved from a very fine Plate, the property of, and published by, Messrs. Graves & Co., Pall Mall.*

THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

BLACKFRIARS NEW BRIDGE.

In the *Year-Book of Facts*, 1863, pp. 74, 75, we described Mr. Cubitt's design for the New Bridge at Blackfriars. We now detail the progress which has been made in the works during the past year. A well-constructed temporary bridge has been erected by Messrs. Rennie and Logan; and, after much trouble and outlay in preliminary preparations for the removal of the old and the construction of the new bridge, Messrs. Thorne and Co. made a visible commencement of New Blackfriars-bridge. The chief engineer superintending this great and important undertaking is Mr. Bryant, who is skilful, assiduous, and experienced, having spent several years at Westminster-bridge, and also been connected with the formation of piers, docks, &c., elsewhere. The first step taken by Messrs. Thorne was the construction of gautries—as they are technically called—which present to non-professional eyes the appearance of double scaffoldings, on which travellers run. Here for the first time a new style of traveller is used, which works a small cart backwards and forwards so as to command the whole work, the engine being stationary. On account of the great width required for the construction of the new bridge, it was found necessary to have each of these two gautries of a span of 55 ft., which, with a gangway of 5 ft. between them, makes the total width of the wooden superstructure 115 ft. To cross the necessarily wide openings, a sort of girder, novel in application and ingenious in device, is used. This is not easy to describe without a drawing; but it is different from and cheaper than the old box-girder, and would have a tendency to buckle were it not that its centre of gravity is below the bearings on which it rests; its upper side is horizontal, and its lower is an inverted arch. There is another novelty in the *modus operandi* of carrying out this great and important contract. On the Surrey side, a new kind of dam is made of a single row of piles, which is rendered perfectly water-tight by caulking the interstices with oakum, precisely as ships are caulked. The usual method is to drive two rows of piles, some feet apart, and to fill in the space between them with mud or stiff clay. But by Mr. Bryant's plan the time, trouble, and outlay usually spent on the second row is saved.

The works are progressing rapidly, several hundreds of men being employed, and the bridge will probably be completed in two years.

There are to be four piers and two abutments under the new bridge, instead of the eight piers and two abutments which sustained its predecessor. Let us commence at the Surrey abutment, from which follows Nos. 1, 2, 3, and 4 piers in succession, No. 4 being the last on the Middlesex side, the bridge ending with the Northern abutment. At the Surrey abutment, where the foundation-stone of the bridge was laid by the Lord Mayor, on the 20th of last July, 15 or 16 feet below high water-mark, the work is now brought up to within a couple of feet of that mark. It is faced with granite, backed by brickwork and concrete. It may be as well here to state that the Cornish granite taken from the old bridge is being re-dressed and made available for the new, as far as it will go. The additional stone required will be of the same kind, and from Cornwall also.

Pier No. 1 of the new bridge will occupy the same site as the second pier of the old one. Here platforms, erected on piles, and made capable of supporting any weight of stone, iron, or workshops, have been constructed—they are technically denominated "stagings." Those now alluded to are meant to receive caissons; they are nearly complete, and some of the caissons have been fixed. At No. 2 pier most of the caissons are down; one is quite so, and is having concrete filled in. No. 3 is to have its "staging" shortly commenced, and No. 4 comes, like No. 1, on the site of one of the old bridge's piers.

At the Middlesex side the tidal dam is nearly finished; its object is to enable the workmen to excavate down to the proper level for the foundations. This space will be filled in with concrete at the bottom, on which will be built the masonry forming the abutment. The arches—the centre one of which is 185ft. span, the two on either side of that 175ft. each, and those next the land on the north and south sides 155ft. respectively—are to be formed of wrought-iron ribs.

All the old bridge has been removed except three piers, which are temporarily used for "staging." The timber taken out from the old foundation is as sound as when first put in.

The foundations of the new piers consist of four rectangulars and two cut-water caissons, which are to be sunk from 18 to 23 feet into the bed of the river, and filled in with concrete and brickwork. On this the pier will be carried up. They will be built of Cornish granite, surmounted by red polished granite columns, with bases and capitals of Portland stone, in the Venetian gothic style. The wrought iron arches are being made by Messrs. Lloyds, Foster, and Co., of Wednesbury, Staffordshire.

Mr. Cubitt, of Great George-street, Westminster, is engineer for the Corporation; and, as we have already said, Mr. Bryant for the contractors, Messrs. Thorne.

In December, 1864, the Committee of the Bridge-house Estates made an official inspection of the works of the new Blackfriars *Bridge, at the* conclusion of which the first stone of the river *piers was laid by* Mr. William Hawtrey, the chairman. The piers of the new bridge are being put in by means of wrought-iron caissons, six to each pier; four are rectangular, 36 ft. in length, by 18 ft. in width, set side by side; these receive the foundation of that portion of the pier which carries the roadway. Two triangular caissons, one at each end, will carry the cutwaters or pointed ends of the piers, which project beyond the width of the roadway. The caissons are 46 ft. in depth, and consist of 18 ft. of ironwork, riveted together, sunk into the bed of the river and permanently left there, the upper 28 ft. being merely used as a temporary dam, which will be removed as the work proceeds, in such a manner as to allow of the masonry of the pier being built continuously in one solid mass throughout. The caissons are sunk well into the solid bed of the London clay. The first 10 ft. is filled with concrete made with Portland cement, the next 8 ft. with brickwork. Upon this brickwork, 18 ft. above the real foundation, and 24 ft. below Trinity high-water mark, the stone was laid on the present occasion.

INSTITUTION OF CIVIL ENGINEERS.

The Council of the Institution of Civil Engineers have awarded the following Premiums for the past session:—1. A Telford medal and a Telford premium, in books, to Joseph William Bazalgette, M. Inst. C.E., for his paper "On the Metropolitan System of Drainage, and the Interception of the Sewage from the River Thames." 2. A Telford medal, and a Telford premium, in books, to Calcott Reilly, Assoc. Inst. C.E., for his paper "On Uniform Stress in Girder Work, illustrated by reference to two bridges recently built." 3. A Telford medal, and a Telford premium, in books, to Edward Hele Clark, for his "Description of the Great Grimsby (Royal) Docks, with a Detailed Account of the Enclosed Land, Entrance Locks, Dock Walls, &c." 4. A Telford medal, and a Telford premium, in books, to Captain Henry Whatley Tyler, R.E., Assoc. Inst. C.E., for his paper "On the Festiniog Railway for Passengers; as a 2-feet gauge, with sharp curves, and worked by Locomotive Engines." 5. A Telford premium, in books, to John England, M. Inst. C.E., for his paper on "Giffard's Injector." 6. A Telford premium, in books, to Thomas Hawthorn, for his "Account of the Docks and Warehouses at Marseilles." 7. A Telford premium, in books, to Edward Fletcher, for his paper "On the Maintenance of Railway Rolling Stock." 8. A Telford premium, in books, to Edward Johnston, M. Inst. C.E., for his paper on "The Chey-Air Bridge, Madras Railway." 9. A Telford premium, in books, to Godfrey Oates Mann, M. Inst. C.E., for his paper "On the Decay of Materials in Tropical Climates, and the methods employed for arresting and preventing it." 10. A Telford premium, in books, to William Jerry Walker Heath, Assoc. Inst., C.E., for his paper "On the Decay of Materials in Tropical Climates, and the methods employed for arresting and preventing it." 11. A Telford premium, in books, to Joseph Taylor, Assoc.

Inst., C.E., for his paper on "The River Tees, and the Works upon it connected with the Navigation." 12. The Manby premium, in books, to Henry Burdett Hederstedt, Assoc. Inst. C.E., for his "Account of the Drainage of Paris."

MACHINERY AT THE IRISH INTERNATIONAL EXHIBITION.

This Exhibition was opened on the 8th of May, by the Prince of Wales, with much *éclat*. The "in motion" Court presented the most attractive features, being for the most part connected with cotton, linen, and woollen manufactures, and generally of the most improved kind.

One of the great wants of this country in connexion with the extension of manufactures—namely, cheap fuel, was sought to be provided for by Mr. John Hackworth, of Darlington, who exhibited a high-pressure horizontal engine, with models of the sections, the peculiar property of which is to expand the steam on a principle of its own, and thus acquire greater power at a decreased consumption of fuel. Mr. James C. Kay, of Bury, Lancashire, also exhibited, in the next section, a horizontal condensing steam-engine, in which the same result is sought to be obtained. It works with patent safety-valves, and the result is greater durability and freedom from accidents, economy in fuel, and a reduction in the amount of labour required to keep the engines in working condition from the smaller liability to friction. These improvements are obtained by the patented valves, which are adapted to any construction of engine, whether beam, horizontal, or vertical, or with high or low pressure of steam. The woollen manufacture of Ireland was represented by Messrs. F. and R. Scott, of Islandbridge Mills, who exhibited a perfect set of improved carding machines at work, constructed by Mr. J. Tatham, of Rochdale. All the processes undergone by wool, from its raw state until it passes out of the weaver's hands, were here illustrated practically, and attracted much attention. There were several machines exhibited in connexion with the manufacture of the linen goods, the staple commodity of Ulster, by Robert Hay and Sons, of Chapelizod Mills; including a complete set of machines for the preparing and spinning of flax, in full work, the preparing machines being supplied by Messrs. Fairbairn, of Leeds, and Farmer and Broughton, of Salford; the spinning machines being manufactured by Boyd and Co., of Belfast. Mr. W. Friedlander, of Londonderry, and Messrs. Rowan and Sons, of Belfast, sent in rival scutching machines, made by Dobson and Barlow, of Bolton, and Messrs. Rowan.

A large space was allotted to the improved cotton machines exhibited and worked by Dobson and Barlow, of Bolton. Several newly-patented improvements were here shown, for the first time, to the public. By a new arrangement in the self-acting mule a far better quality of yarn is produced. This firm exhibited their "patent improved cotton gin," which turns out very considerably more work with much less labour than the ordinary gins. It is adapted for long or short stapled cotton, and constructed so as to suit particularly the fibre grown in India.

The other machines included a very miscellaneous collection. Mr. Sturgeon, of Leeds, exhibited a patent steam-hammer with a self-acting and self-adjusting valve motion, and embracing several improvements: the hammer itself weighs 1 cwt., but strikes a blow equal to 21 tons. Mr. William D. Grimshaw, of Mitcham, had among other articles an "improved atmospheric hammer," simple in its contrivance and cheap, and completely under the control of the worker as to speed and weight of blow. It is worked at a considerably less consumption of power than the ordinary steam-hammer. A model of a cask-cleaner equal to the cleansing of ten barrels was exhibited by Messrs. Davison and Schamel, of London, who also showed a patent thermoutèrion *or impeller* of heated air. Pim, Brothers and Co., of Dublin, had a silk *winding-machine* at work. The only manufacturer of linen checks in Ireland

Mr. S. S. Moss, of Balbriggan, had a power-loom at work; and a number of looms of a somewhat similar description, were worked by the Greenmount Spinning Company, having been manufactured by Dugdale and Sons, of Blackburn. A novel self-acting machine, constructed by Southwell and Heap, of Staleybridge, for securing the soles and paring and glazing the heels of boots and shoes, was worked by M'Dowell and Son, with rapidity and success, and was regarded with much interest. Sketchley's universal joiner, worked by Beardwood and Son, and the wood-working machines, shown by Noble and Collier, and Charles Powis and Co., of London, possess many commendable features. Letter-press and lithographic printing was represented by the Official Company of Dublin, and Hughes and Kimber, the latter firm working Huguet's patent French lithographic gripper. Smythe and Company, of Balbriggan, had two stocking-weaving machines at work, an old and an improved one. The new machine weaves two, while the old only produces one stocking at a time. They were manufactured by S. and J. Ward, of Nottingham. Edmundson and Co., of Dublin, exhibited an interesting lot of novel machinery, including "Lenoir's Gas Engine," with a new motive power, in which gas and a galvanic battery are the chief agents. They had also their portable apparatus for the manufacture of gas in isolated buildings; and Handcock's Butter Purifier, for restoring butter preserved with salt to its original freshness. Courtney and Stephens, of Dublin, exhibited a large and powerful punching machine, specimens of railway materials, and a large slide valve pump and engine, which work very successfully.

In the Machinery (at rest) Court were a large number of specimens of railway materials in various stages of manufacture, shown by a number of exhibitors. Fried Krupp, of Essen, Rhenish Prussia, had a very interesting collection of cast-steel rails, plates, and wheels, and two rifled cannon, one of which was of large calibre. The toughness of one of the rails had been tested by having it completely doubled over twice without snapping. The Rotherham Ironworks Company, Yorkshire, also sent railway wheels, tires, and axles; and improved permanent ways were exhibited by Mr. G. E. Dering, of Welwyn, Hertfordshire. The Dublin and Wicklow Railway Company exhibited a very fine locomotive manufactured by Messrs. Neilson and Co., of Glasgow.

William Muir and Co., of Glasgow, exhibited foot-lathes, slotting-machines, and an improved driller; and D. and J. Greig, several admirable machines in connexion with printing and bookbinding. Mr. W. H. Ward, of New York, exhibited several neat models of inventions in connexion with railways and steamboats that have recently been the subject of some discussion. They included a patent safety saloon and air-spring carriage, supplied with hand and self-acting brakes, ventilators, and alarm-bell arrangements, contrived on an ingenious plan. Ward's system of fog and flag signals at sea was illustrated, and appeared feasible. The same exhibitor showed a patent bullet-machine, "capable of delivering 60,000 bullets per hour of any serviceable pattern." Some of these inventions have already had substantial recognition of their merits, and all deserve consideration.

THE IRON-CLAD CORVETTE, "PALLAS."

This fine sea-going ship, of 2372 tons, six guns and 600-horse power, has been built at Woolwich Dockyard, from the design of Mr. E. J. Reed, Chief Constructor of the Navy. When the *Pallas* was proposed by Mr. Reed, the prevalent opinion in this country was that fast iron-clad ships must of necessity be of very large dimensions, the *Defence* class of frigate being the smallest previously designed for the Royal Navy; and, although she was of 3720 tons burden, her greatest speed was but eleven knots and a half. Although the *Pallas* is less than two-thirds of the *Defence's* tonnage, and although (owing to some alleged deficiencies in her screw-propeller) she was not yet at first considered fully successful in point of speed, she steamed at nearly thirteen knots, and was expected to exceed that rate of steaming on future trials with a new screw. The *Pallas* is 225ft. long by 50ft. broad, and is propelled by a single screw, 19ft. in diameter. Her hull is of wood, solid oak frames being fitted throughout behind the armour, to afford effectual support to the latter, which is 4½in. thick, and weighs 580 tons. With this weight of armour-plating the hull is protected from stem to stern up to the height of the main deck, and also over the whole extent of a central battery, carrying four 6½-ton rifled guns, firing heavy charges of powder and 200lb. shot. This battery is so contrived, and the side of the ship is so adapted to it, as to permit of these powerful guns being fired almost right a-head and right astern, notwithstanding that they are carried near the middle of the ship. This arrangement is said, also, to have the great advantage of allowing the deck above the guns to be completed into a spar deck at a great height above the water; thus giving the ship very superior sea-going qualities, and affording an opportunity of giving what is known as 'tween deck accommodation for officers and men to an extent unprecedented in small iron-clad ships.

The *Pallas*, notwithstanding her burden of armour-plating and the novel form of her battery, is consequently in every respect a sea-going ship adapted for ocean service in any part of the world. She carries provisions for three months, seventy tons of shot and powder, and coals for steaming ten days continuously at a high speed. She is full-rigged, having iron masts, and the improved anchors of Captain Rodger, R.N. Her engines are on the Woolf principle, manufactured by Messrs. Humphrys and Tennant, of Deptford-green, and are fitted with superheaters, surface-condensers, and all other modern improvements. As originally designed, the *Pallas* was to have had a light fore-and-aft rig and a battery-deck only; but it has since been deemed desirable to increase her sailing power; to complete her upper deck, as before described; and to sheathe her under-water armour-plating with teak, to prevent the sea water from destroying it; and, although each and all of these additions have tended, no doubt, to reduce the high speed proposed for her, she still equals, as a steamer, the very fastest wooden frigates and corvettes that carry no armour-plating at all. The bow of the *Pallas* projects 10ft. beneath the water, and is armed at the point with a formidable spur, or ram, for penetrating the bottom of an enemy or striking her rudder and screw, and thus destroying her powers of movement.—See the *Illustrated London News*, January 6, 1866, for a large and effective engraving of the *Pallas*, from a drawing by Mr. E. Weedon, whence the vignette to the present volume has been reduced.

ENGINEERING PRIZE.

M. Perdonnet, engineer-in-chief, president of the Society of Civil Engineers, Paris, has offered a prize medal of 2000 francs for the best treatise furnishing the results of new experiments, undertaken by the competitors, in an engineering point of view, on one or more questions comprised in the following programme:—To determine by a great number of experiments the resistance of vehicles and locomotives to traction on a railway, taking into account all the circumstances which can modify them,—such as the state of the rails, vehicles, and engines; the force and direction of the wind; the surfaces of the carriages and the length of the trains; the dimensions of the axles and the wheels; the method of attaching the carriages; the distribution of the load and construction of the engines; friction of mechanism, coupling of wheels, escape of steam and draught of chimney, gradients, curves, &c.; to determine separately the influence due to each of these above circumstances; to analyse the causes which, in curves, modify the resistance, whether for an isolated vehicle or a series of carriages, and to guide the reasoning by experience; to find by experiment a practical formula for calculating the load that a locomotive of given form and dimensions can draw, taking into consideration adherence to the rails and other important conditions; to study the circumstances which modify the production of steam per square mètre of heating surface, such as the position of the sides in relation to the fire-box, the thickness of the plates, the interspacement of the tubes, &c.; to determine the resistances opposed to the passage of the steam from the boiler to the valve-box, and from this into the cylinder; to determine the difference of the pressure of the steam in the boiler and in the cylinder in different conditions; to inquire into the effects of "priming" upon these differences of pressure; to examine the causes which influence the counter-pressure; to determine the influence of draught upon the dimensions of the exhaust pipe, and the pressure and velocity of the exit of steam and the dimensions of the chimney; to examine the resistance met with by the air in its passage from the fire-box to the chimney. These *mémoires* are to be written in the French language, and all the measures indicated are to correspond with the units of the metric system. The Society of Civil Engineers of Paris have adopted the above programme, which can be had on application to the secretary, No. 26, Rue Buffault, Paris.

STEEL LOCOMOTIVES.

The Maryport and Carlisle Company have for some time past employed Steel to a great extent in substitution of ordinary iron for the working parts of Locomotives; and, as we are informed, with the most satisfactory results. The traffic on the line is principally coal and mineral. It has been found that with the ordinary iron tyres on the engine-wheels, the distance run was not more than 90,000 miles—in many cases not more than 60,000 miles—and the wheels require to be taken from under the engine for every 20,000 or 30,000 miles run, for repairs and "turning up." In the case of the steel tyres, however, the wheels will run 100,000 miles before they require this "turning up" or repairing. The *Railway News* states that the result of a very careful examination of the effects of wear leads to the opinion that these wheels will run from 350,000 to 500,000 miles, or equal to some 12 or 15 years' work of a daily average of about 100 miles. The difference of cost as between the two metals is not great: in the one case it ranges from 40*l.* to 45*l.* per ton, while the steel is about 55*l.*; the cost of labour in placing the tyres on the wheels being nearly the same in each case. The Company have a number of boilers, axles, cranks, and excentrics, made of steel, in constant use on the line, and they have given the greatest satisfaction. These have not, however, been sufficiently long in operation to enable a comparison to be drawn between them and the ordinary iron portions of the locomotives; but there is reason to believe that the saving in point of wear will be equal to that effected by the substitution of steel for ordinary iron tyres. The ordinary excentrics are expensive to keep up, but those which are made of hardened steel do not require any looking after for ten years, not even to the slackening of a bolt, so far as regards repairs. The experience obtained on this, and we believe upon some other railways, points to a very important mode of saving in one of the largest items of cost in the working expenses of railways.

STEEL RAILS.

THE Pennsylvania Railroad was the first in America to try the experiment of Steel Rails. A lot of about 150 tons of cast-steel rails was procured near the close of the year 1863, but some delay being experienced in slotting them to receive the chairs and spikes, they were not laid down until the early part of the past summer, when they were placed on sidings in the yards at Altoona and Pittsburgh, where they would be subjected to considerable use. These rails appearing very brittle, it was not deemed expedient to place them in the main track where they would be passed over by trains at high rates of speed; none of them, however, have been broken in the track, and they exhibit little or no appearance of wear. Some other steel rails have recently been ordered, of a quality combining more toughness with a sufficient degree of hardness, and experiments will be continued to test the relative merits of the several descriptions of rail. Much confidence is felt that the result of the trials will demonstrate the superiority of steel rails for general use. The president of the Pennsylvania Road, in his annual report, speaks of the successful trial of steel rails, but states that their great cost at present precludes their general introduction.—*Mechanics' Magazine.*

MONT CENIS RAILWAY.

A VERY interesting Report, by Capt. Tyler, R.E., has been presented to the Board of Trade, on a proposed New Railway over Mont Cenis. In order to obtain great tractive power, a third rail is laid between the two outer rails on its side, and at an elevation of about seven inches above the other rails. This middle rail is grasped by horizontal wheels, worked at right angles to the usual vertical driving-wheels. By this auxiliary power trains, drawn by an engine weighing 16 tons 17 cwt., are enabled to ascend gradients of 1 in 12; and as the line can be carried parallel to the existing road, the estimated cost is 6720*l.* a mile, instead of 128,500*l.*, that of the line now in process of construction through Mont Cenis.

PNEUMATIC ROCK DRILL.

A PNEUMATIC Rock Drill, invented by M. Herman Haupt, has been used to drill a piece of Hoosac rock in Philadelphia. In all previous attempts to construct rock drills, the machines consisted of two parts—one stationary, the other movable; the movable part advancing as the drill penetrated, something after the principle of the movement of the carriage of a saw-mill. This is the principle on which the feed movement is effected in the drills used in the great tunnel of the Alps. In Haupt's drill, the arrangement is such that only the drill rod itself advances; all else remains stationary, and the movement, which is automatic, self-acting, and self-adjusting, is effected without screws, racks, or other equivalent devices; whether the rock is hard or soft, or the drill point sharp or dull, the machine accommodates itself to its work with unfailing accuracy. It strikes a very hard blow 500 times or more per minute; it rotates with mathematical accuracy, and it feeds at each stroke just in proportion to the ability to penetrate. The machine which accomplishes these results is extremely simple. It was designed for use in the Hoosac Tunnel, in Massachusetts; but that work having been taken out of the hands of General Haupt, and assumed as a State work, it is now proposed to use it in some other locality.

As compared with the Mont Cenis drills, the whole length of the machine is one-fourth; its weight and cost about in the same proportion; it has no fly-wheel, cog, or bevel gear about it; is not liable to get out of order; it is a steam-engine within itself, in a space of 2½ feet, and requires no other power to drive it.

In regard to rapidity of operation, it is said that the progress in the solid rock of the Hoosac Tunnel is not less than 2 to 3 in. per minute. The space occupied by the drills is so small that 20 holes can be drilled in the heading at the same time. The loading is proposed to be by cartridges, the blasting by magnetic electricity, the ventilation by vacuum, and the lighting by a very peculiar and novel process. If successful, the art of tunnelling will be revolutionised.—*Mechanics' Magazine.*

SAFETY ON RAILWAYS.

AT the Polytechnic Institution an Exhibition has been made of Models and Drawings of Inventions calculated to promote the Saving of Life in Railway travelling. Here we had a signal invented by Mr. Hipp, electrician, of Neufchatel, and patented as a communication from him by John Imray, engineer, London. The signal has been used on the Swiss railway, and found conducive to safety. It avoids some practical objections to distance signals of ordinary construction. M. Hipp's invention is an electric distance signal, consisting of a column surmounted by a disc, which is turned edgeways to the line for safety or flatways for danger. By means of this contrivance the station-master, by simple inspection of the instrument, sees how the signal stands. The cost of the apparatus is much less than that of the ordinary signal. Here, too, was a railway passenger's safety-signal, invented by E. Barber, Bernard, and Co. This is fixed in a division of a compartment in a railway carriage, the disc being illuminated by night by a bull's-eye lantern, visible to guard, driver, and porters at stations. Means are provided for procuring assistance from passengers in the next compartment by effecting an opening between the compartments, which is done by one pull of the handle, which at the same time exhibits the disc and rings the bell, both in the carriage and in the guard's break. The contrivance is very complete, and as simple as it is ingenious.

Next was Mr. Greenwood's improved means of preventing accidents upon railways. One feature his plan possesses, which distinguishes it from all other inventions. It provides the means for keeping the rails in gauge, and going over an object without running off the line. The invention consists in having a third pair of wheels in the centre of the carriage, the flanges running on the outside the rails, whilst the leading and following wheels have their flanges in the inside, as usual. Mr. Haggett also suggests improvements in locomotive engines and carriages for railways, the object of which is to increase the safety of railway trains travelling at high or moderate speeds, principally by providing a ready and effectual method of retarding their progress or stopping them within short distances, as may be required; preventing the carriages going off the rails, and providing communications between the engine-driver and guards, as well as between them and the passengers generally. The inventor contends that his patent breaks furnish the greatest power for stopping, and can be applied without injury to the wheels or requiring any alteration in the rails. Great benefit must be derived from the application of the patent. Next to these, Tyer's patent train-signalling telegraphs deserve serious attention, as depriving the signal-man of the power of altering his own instrument. Mr. Tyer's patent is in use on the South-Eastern Railway, and therefore can be tested.

SAFETY-BAR.

A SAFETY-BAR has been registered by Mr. Mappin, which is remarkable for its simplicity of arrangement, its great strength, and the effective barrier it will place in the way of the house or office breaker. The bar is made of solid iron about 3in. by 5-8ths, and presents no less than five points of resistance. One end passes into the door-post or jamb three inches, and by being drawn back 1½in. passes into the opposite groove. In the act of drawing the bar too strongly, fixed hooks in the back become fixed in well-contrived sockets inserted in the face of the door, or the window to be secured. An angular piece of iron hinged in the centre of the bar is then passed through an iron plate, which is secured by a lock, which engages itself in the angular iron-piece, and is managed with ease. The face of the bar is a plane surface, and will consequently supply the burglar with a remarkably difficult ground to work upon.—*Mechanics' Magazine.*

NEW RAILWAY SHACKLE.

MESSRS. FREEMAN AND GRUNDY, of Manchester, have invented a new Shackle or coupling apparatus for railway carriages, waggons, and other vehicles, with the view of superseding the coupling chains now in use. Every one who has travelled much on railways has seen the system of attaching engines and carriages now in use, which requires a man to go in between two carriages approaching each other in opposite directions, at considerable risk to his personal safety, to affix a link on one of the carriages at the proper moment to a hook on the other. The risk is well known. Great numbers of men are crushed and maimed, if not killed, every year by the present system, and it would no doubt be desirable to adopt an easier and safer mode of accomplishing the same purpose. The model of the apparatus by which Messrs. Freeman and Grundy seek to effect this object is very simple. Each carriage has a reversible screw-wedge and bell-mouthed cone, so that by the working of a lever over it either may be put in position, as wanted. Supposing two carriages approaching each other, one with the bell-mouthed cone in a horizontal position, and the other with the screw-wedge in a similar position, they are self-acting. The wedge goes within the bell-mouth, where there are four spring catches, which at once seize the screw and hold it, so that the coupling is effected in an instant, without the intervention of a railway servant to guide it in any way. To uncouple the carriages a porter at either side the line is within reach of short levers, which liberate the screw from the spring catches, and the uncoupling is effected in an instant.

THE PNEUMATIC DESPATCH.

ON November 7, was opened the first portion of the Pneumatic Tube which is to connect the General Post Office with the London and North Western Railway. The pneumatic despatch system, to a limited extent, has been in operation already. A short line was laid down experimentally at Battersea two or three years ago, and afterwards transferred to Seymour-street, where it has been and is now doing duty in the conveyance of mails between Euston-square station and the north-western district post-office in Eversholt-street. A short passenger line on the same principle has also been constructed at the Crystal Palace. The present, however, is the first practical application of the process on anything like a large scale. The distance from Euston-square to Holborn is exactly one mile and three-quarters; the second portion of the line, running off at right angles to the General Post Office, will be an additional mile in length, and of this further portion one-half has been laid.

Entering from No. 245, Holborn, the visitor passes along a corridor through a doorway, and emerges upon a spacious gallery, from which he looks down on a brick floor, supporting lines of rails, much as he might do from a railway platform down on to the line, but from a greater elevation. Underneath the corridor he sees some mechanical appliances suggestive partly of an engine-room, and partly of a pointsman's gallery outside a railway station; and below the level, again, on which the white-jacketed engineer in charge is standing, and supporting the platform on which both he and these mechanical appliances rest, are a couple of openings, looking like black polished modern chimneypieces with the grates withdrawn. These are the mouths of the pneumatic tubes, of which one communicates with the North-Western Railway; the other will soon be drawing in and delivering supplies from and to the postal headquarters in London. Shortly after the hour appointed for the above experiment, a sudden snap, and a sighing, rushing sound, like that which often heralds the beginning of a storm, announced that the machinery was set in motion. The snapping noise proved on examination to have proceeded from the closing of iron doors a little way within the shadow of what has been compared to a fireplace; and these doors met, not evenly, but at an angle like that of a broad arrow, the point projecting outward, so as to resist the atmospheric pressure. Some minutes passed before anything further was visible or audible; for, though with a moderate amount of pressure the pneumatic train is propelled at a speed of 25 miles an hour, from seven to eight minutes are required for the transit from Euston-square to Holborn. At last a telegraphic tinkling indicated that the greater portion of the journey had been accomplished. A second and third signal followed at no great intervals, and almost immediately upon the last of these the doors flew open, and in rolled solemnly four dwarfish iron waggons, weighing with their contents some 10 tons in the aggregate. The manner in which these doors open, as if by magic, to admit the string of carriages coming apparently from the bowels of the earth, is one of the most interesting features in the entire process. To render it intelligible, it must be premised that the air in the tube is alternately exhausted and condensed, according to the direction in which the train is going, and that the shaft communicating with the stationary engine which generates the blast, or causes the suction, enters the tube about 100 feet from its mouth. There is, therefore, a body—technically speaking, a "cushion"—of air 100 feet in length, behind the draught pipe, which renders material service in arresting the progress of the advancing train, and which would, in fact, bring it to a dead stop within the tube if the doors were suffered to remain closed. A spring lever, however, underlies the rails at a short distance up the tube, and this, when pressed by the weight of the train, withdraws the bolt that keeps the doors in their places, and suffers them to be blown open. Although they thus fly apart with a violence that is really alarming, they create no sound and sustain no injury themselves, owing to the fact that when fully open they are received into air-chambers. Air, therefore, in one and the same movement, is made to exhibit the force of a giant and the softness of a glove. The carriages in shape are like a capital D turned over on its straight side and mounted upon wheels; either end of the carriage has a raised hood or flange, shaped so as to correspond with the interior of the tube, the dimensions of which are 4 ft. in height by 4 ft. 6 in. in width. They were laden, or ballasted, with shingle filled into sacks, but their ordinary freight is expected to be in the first instance letter bags, then probably railway parcels, certain descriptions of market produce, and ultimately, it may be, general merchandise.

After the train had made some successful passages, some visitors expressed a desire to pass through the tube. They had to fit themselves in among the bags of shingle, taking care to keep their heads well below the edge of the carriage. The first sensation at starting, and still more so upon arriving, was certainly not agreeable. For about a quarter of a minute in each case there was a pressure upon the ears suggestive of diving-bell experience, a suction like that with which one is drawn under a wave, and a cold draught of wind upon the eyes, having almost the effect of falling water; but once fairly within the tube these sensations were got rid of, or left behind, and the motion had little more positive discomfort about it than would be attendant on riding on a "lorry" over the worst ballasted line in England. It was a curious sensation to be flying along through the earth, feet foremost, in utter darkness, for the best part of ten minutes, which in such a place, seemed half an hour, knowing that to right and left of you there were gas-pipes, water-pipes, drains, cellars, roots of trees, and all the intricate fibres of the London subsoil-way: that nearer again to you was an arch which you might touch at your peril, and that of all these you could see absolutely nothing. The air within the tube was by no means foul or disagreeable; here and there a strong flavour of rust was encountered, but this was explained by the fact that as the tube had to be laid in lengths through various soils, and encountered in the process a large share of unfavourable weather, the corrosion on the surface of the iron could not be expected wholly to disappear until cleared away by the friction of constantly passing and repassing trains. On the arrival of the excursionists at the upper, or Euston-square extremity of the line, they quitted their places for a few moments to inspect the smaller tube, which communicates with the Eversholt-street district post-office, and then returned by the way that they had come to Holborn.

No doubt remained on the mind of any person who made the double transit as to the facilities which the system, if a sufficient number of stations can be incorporated with it, is calculated to afford, not only to the postal service, but to the requirements of the general public. The scheme of the Company, who, it seems, possess under their Act powers to lay down pneumatic tubes at any points within the jurisdiction of the Metropolitan Board of Works, is to construct similar lines to the above between the ten district post-offices and the General Post Office; and between the different railway termini and goods depôts in London, connecting with these lines the six principal London markets and other important points. For these purposes it is calculated that some 35 miles of tubing, and a capital of 1,250,000*l.*, would be required, the cost per mile roughly estimated being from 30,000*l.* to 35,000*l.* The expenditure of the Company hitherto has been probably 150,000*l.*—*Abridged from the Times.*

THE ARMSTRONG 600-POUNDER AND THE HERCULES TARGET.

THE Hercules target has been again tested at Shoeburyness to show its power of resistance to the most powerful artillery yet known.* The same target had already been subjected to the fire of three Armstrong 300-pounders, or 12-ton guns, fired with 300 lb. rifled projectiles and charges of 45 lb., 55 lb., and 60 lb. of powder, when it proved quite impenetrable by any single shot. On the present occasion the 600-pounder Armstrong, or 22-ton gun, was brought against it at 700 yards' range, with rifled projectiles of from about 575 lb. to 585 lb. weight, and with charges of 100 lb. of powder—charges altogether unprecedented in any rifled gun. Except where two shots struck rather near together, the target was still victorious. Of course it is not proposed to coat an entire vessel with such a mass of iron and wood as constitutes the Hercules target. The lower half of the Hercules target is faced with 8 in. iron, the upper with 9 in. iron; behind both are 12 inches of horizontal timber divided by four horizontal plates, then a skin consisting of 2¾ in. plates, the whole being secured to the ribs, which are 10 in. deep, filled in between with vertical timber. Behind the ribs are two linings of horizontal timber 18 in. deep, and bolted, but confined by 7 in. iron ribs inside all.

There is, of course, another three-quarter iron skin within the innermost wood backing, making up the total thickness of the target to more than 4 ft.

It is seriously proposed to protect the water-line of a ship, to be called the *Hercules*, in this manner, leaving the remainder of her

* *See "Gunnery Experiments at Shoeburyness," Year-Book of Facts, 1865, pp. 20—25.*

sides as vulnerable as those of our ordinary ironclads, and the plan, if practicable, is undoubtedly of the greatest merit and importance.

Altogether seven rounds were fired as in the above, from the 600-pounder. The first of these was a steel rifled shot of 575 lb. weight, fired with a charge of 100 lb. This shot left the gun with a velocity of 1420 ft. per second, and struck the target at 700 yards' range with a velocity of 1280 ft.., burying itself completely, breaking the rib of the ship immediately in wake of the blow, and snapping off a considerable number of rivet-heads from the innermost skin. The second round was a repetition of the first, and, except that the shot deflected a little upwards, owing to its having struck where the target received the extra support due to the deck of the vessel, the result was nearly the same. After this a chilled iron Palliser shot of 580 lb. weight, fired with the same charge from the same gun, struck the target with 1330 ft. velocity, and close to the hole made by the preceding round. The effect produced by this shot was very great. The inner skin and ribs of the target were torn asunder and a great quantity of the pieces of the shot were forced through, as langrage, into the ship. A third Palliser shot of chilled iron struck the same 8-in. plate fairly, penetrated it completely, and lodged in the backing, cracking an inner rib. A blind steel shell followed, and struck the 9-in. plate, breaking it up to a serious extent, but with little penetration.

Except with the Palliser shot, the present form of which has always proved unfavourable for accuracy, the gun shot remarkably well on both occasions, when it was tested with the same enormous charges of 100 lb., for accuracy and initial and terminal velocities. The very high velocity given to the 580 lb. projectiles, varying from 1420 ft. to 1460 ft. per second, according to their greater or less windage, shows also that the gun and powder both did their full duty.—*From the Times.*

THE ERICSSON GUN.

A WROUGHT-IRON Gun, the invention of Mr. John Ericsson, is of novel construction, and valuable results are expected from it by its inventor. It is of 13-inch bore, and is composed of a barrel or cone of wrought iron, forged in the usual manner. This barrel is thick enough to give the necessary strength in the direction of the axis. To resist rupture in the opposite direction, it is surrounded by broad plate iron rings of the finest wrought iron, put on in a peculiar manner by hydrostatic pressure. These rings are of course without welds, and their fibrous character is preserved as they exist in the gun. According to the New York *Army and Navy Gazette*, this gun has undergone two official trials, during which the charges were gradually increased to 75 lbs. of fine powder, and the elevation to 35 deg. The result was a range exceeding 5½ miles at this elevation, with a solid spherical shot. Owing to the severe strain put upon the trunnion band by the recoil at this great elevation, it fractured. Several fissures also showed themselves in the bore, a circumstance which is quite common where the bore is made of wrought iron. In the Horsfall 13-inch solid-forged gun, for instance, fissures larger than these showed themselves after half-a-dozen rounds; but the subsequent career of that piece, with greatly increased charges, proved that they did not practically affect its strength, which is the prime condition. Still, this difficulty might be surmounted by inserting a steel lining within the gun to protect the wrought iron from the action of the powder gases; but what is better still, is to construct the barrel or core wholly of steel. We should then have the anomaly of a built-up gun without a single weld in it. It was understood that a gun on this plan would shortly be commenced. We hope the most sanguine expectations of Mr. Ericsson may be realized in the construction of a gun strong enough to project a spherical steel shot, with 100 lb. of powder. Mr. Ericsson is working in the right direction. Strength, endurance, calibre, are the essentials of the "coming" gun.—*Mechanics' Magazine.*

THE PARSONS GUN.

A TRIAL of the Parsons Gun has been made at Gavre, in France, by direction of the Emperor Napoleon, and it has shown extraordinary strength and endurance. The gun was originally an ordinary smooth-bore cast-iron 30-pounder, and it was converted into a 100-pounder rifled gun, by the insertion of a reinforced lining tube of homogeneous metal. The weight of the gun when altered was a little over three tons, about one-fourth of which was homogeneous metal. It sustained upwards of a thousand rounds without detriment, 500 of which were with a charge of 16½ lbs. of powder and a 100-lb. projectile. It is stated that this result has not been surpassed, if equalled, by any gun yet made, even though composed entirely of steel or wrought iron; and if we compare it with the performance of guns in this country of about the same weight and calibre, this statement appears to be justified.

For instance, in the Report of the Committee on Ordnance, we find a long list of 110-pounder Armstrong guns, made entirely of coiled wrought iron, and weighing over four tons, which have failed at various stages between 57 and 388 rounds, with charges of only 12 lbs. of powder and 110 lb. projectiles; and two Whitworth 80-pounders, also weighing four tons each, one of which failed at the eighty-first round with 12 lbs. of powder and a 70-lb. projectile, and the other at the thirteenth. It is perhaps hardly fair, however, to make a comparison with these early guns, as probably they had defects which have since been remedied, but this cannot be said of the Armstrong and Whitworth competitive guns, which no doubt embody all the improvements available up to the latest date. These guns weigh three and three-quarter tons, and are made entirely of steel and wrought iron; the first has a calibre of *6″·5, the same as* the Parsons gun, the Whitworth being of rather less calibre. Both these guns have shown a very creditable amount of endurance with charges of 10 lbs. of powder and 70-lb. projectiles, and with occasional charges of 12 lbs. and 14 lbs.; but this will bear no comparison to the charge of 16½ lbs. of powder and a 100-lb. projectile sustained continuously by the Parsons gun, especially when it is remembered that it is of less weight by three-fourths of a ton.

An estimate of the comparative cost is still more in favour of the Parsons gun. The cost of the wrought-iron and steel guns may be taken at 150*l.* per ton, the price of a three and three-quarter ton gun would therefore be about 560*l.*, whereas the price of the Parsons gun, which is composed three-fourths of cast iron, could not amount to more than 60*l.* or 70*l.* per ton, so that a three-ton gun would cost about 200*l.* This would do as much, and more, work than a gun made of steel and wrought iron on our present system costing 560*l.*, thus effecting a saving of 65 per cent. Parsons' system of strengthening the old cast-iron guns, by the insertion of a homogeneous metal tube, has received the sanction of our Government, and some of the waste guns will shortly be handed over to him for that purpose. The cost of the appropriation of the old guns on this principle will be very small, and the consequent saving to the country in being enabled to use up the enormous stock at present utterly useless will be immense.—*Mechanics' Magazine.*

PROTECTED GUNPOWDER.

Mr. Gale, electrician, of Plymouth, has proved, in experiments at Mount Edgecumbe, the facility with which the explosive qualities of any amount of Gunpowder can be rendered available at will. The whole of them were so thoroughly satisfactory that the members of the Committee expressed a unanimous opinion in favour of the invention. On the assembling of the Committee in their board-room, Mr. Saunders, for Mr. Gale, who is totally blind, entered into an explanation of the ingredients by which the powder is rendered inexplosive. He applied a slow match to a wooden bowl full of powder without effecting the slightest ignition. The match partly burnt in the loose gunpowder, but died out without causing even a spark. The powder was then passed through a sieve, and the explosive qualities were proved to be once more present. It was, in short, proved that if Mr. Gale's process is adopted there will be no greater danger in transporting an open barge full of gunpowder than a load of sand.

The Queen and the Court have witnessed experiments with Mr. Gale's protected gunpowder in the Orangery at Windsor Castle. The experiments were conducted by Mr. Gale and Mr. Saunders, and throughout the proceedings her Majesty manifested the greatest interest.

A bowl of the protected gunpowder having been produced, a portion of it was separated in order to show the facility with which the gunpowder would be restored. The bowl, with the remainder of the protected powder, was then held by Mr. Gale, while a slow match was allowed to burn down into the powder. This produced no effect beyond lighting a few grains. Vesuvians were then thrown in, and finally Lord Bury's test was applied, which consists of exploding a small quantity of neat gunpowder in the midst of the protected powder. The experiments were brought to a close by placing a bag of protected gunpowder upon a fire, when it was gradually consumed without any approach to an explosion.

The Queen, on leaving, said, "Mr. Gale, I thank you; I have been much pleased and interested in the experiments. It is a wonderful invention, and ought to be made very, very useful."

Instead of using an ordinary sieve in the experiments before her Majesty, a new model separator was used, by means of which a more perfect and instantaneous separation of the gunpowder is made. This machine enables the gunpowder to be separated just as fast as it may be required for use in filling shells or making fireworks, or any similar operation in which danger now arises from the accumulation of explosive powder.

Experiments have also been made at the Horse Guards, and at Westminster, by Mr. Gale, in order to satisfy the Duke of Cambridge and other authorities, military and civil, of the importance of his invention. These experiments were also quite successful.

Mr. Gale's results are obtained by very simple means, the whole secret being summed up in a little simple powdered glass. The cost is about 30s. per ton. The coating of the gunpowder by admixture with the glass-powder is a very rapid operation; the restoration of the two substances to their normal conditions by sifting is as quickly effected. There is only one condition requiring consideration, and that is an arrangement of sifting machinery capable of meeting the demands of an emergency. Another advantage accruing from the adoption of Mr. Gale's treatment is one that deserves special notice, and that is, the powder is preserved in a perfectly dry state, so as to be fit for use under any circumstance, or conditions of storage, directly the coating is removed.

A Correspondent of the *Times*, writes from the Royal Arsenal, Woolwich, that the above protective system was tried on a large scale, by M. Piobert, the well-known French writer on gunpowder, in 1835, and by M. Fadéieff, Professor of Chemistry at St. Petersburg, between 1840 and 1844. Some of the results of these researches will be found in Piobert's *Traité D' Artillerie, Théorique et Expérimentale*, pages 213 to 220, and in the *Comptes Rendus* of the Académie des Sciences, vol. x., p. 320, and vol. xxiii., p. 1148. The difference between Mr. Gale's system and that of MM. Piobert and Fadéieff is—the one used powdered glass, the others employed various powdered substances more or less suitable. The Englishman adds rather more of his glass, and so prevents his powder from burning at all; the Frenchman added *as much as he thought* necessary to diminish the rapidity of burning *to the point which* sufficed to deprive the action of the powder of its dangerously explosive character; and, instead of employing 3 to 1 or 4 to 1, like Mr. Gale, used only 1 to 2.

Mr. Gale's method has been objected to on the score of increase of bulk. Besides this, the shooting quality of the powder will of course depend upon the completeness with which the sifting process is performed; and here we have at once a serious element of uncertainty, the extent of which in these days of accurate shooting will be readily appreciated. Then, again, it is a question if the glass will not destroy in a great measure the glaze and surface of the powder, thus materially altering its character. The mixing and sifting processes will always be attended with more or less danger; and it is questionable to what extent the mixture would remain complete in transport, and in proportion as the powder becomes unmixed, so does it become more explosive, and our fancied security, by inducing us to dispense with precautions, might actually lead to the serious consequences which Mr. Gale seeks to avert.

Though ourselves impressed with the importance and utility to engineers of this simple and ingenious way of safely storing gunpowder (says the *Builder*), we have suggested that experiments are requisite to prove whether or not sufficient of the non-explosive powder, which, in fact, is simply powdered or ground glass, adheres to the grains of gunpowder, after sifting, to lessen, in any appreciable degree, its explosive strength. Another suggestion has also been made, whether in conveying gunpowder from place to place the one powder will not be partially separated by vibration from the other, so as to uncover the gunpowder to a great extent at one side while the powdered glass collects at the other. There is certainly a tendency in powders, even though homogeneous, to settle or partially arrange themselves, when shaken, according to the fineness of the particles. Mr. Gale, however, denies that even in transport there is any danger of this taking place, at least to a sufficient extent to restore the explosive power of the gunpowder. The same objection does not apply to storing, except where causes of vibration are at work, as from railways or carriage-ways, establishments where steam-engines are used, &c. And even if it should turn out that transport tends to deteriorate the non-explosive arrangement of the particles, the reversal of the barrels or packages, could that be practically accomplished, might, to a great extent, restore the arrangement. Before being stored, for example, they could be exposed to vibratory force, while in the reversed position, for a certain interval, so as to insure their safety when stored.

NEW BLASTING POWDER.

Messrs. Schäffer and Budenberg, of Buckau, Magdeburg, and Manchester, are endeavouring to introduce an Improved Blasting Powder, which seems to have the great advantages over *the best powders hitherto* used, in being some 50 or 60 per cent. more effective, weight for weight; and in leaving no smoke behind it, after explosion. The new powder consists chiefly of sulphur, charcoal, and nitrate of potash, like ordinary gunpowder; but these materials are employed in other proportions than in ordinary gunpowder, and certain new ingredients are added to them. The materials are combined in such proportions as to secure comparatively slow combustion, in order that all the combustible gases liberated by the explosion of the compound may be completely burnt; and so the utmost possible effect be obtained from them, and no smoke be left. The new powder has been in use for some time past in the mines at Framerles, in Belgium, under the direction of M. Gille, the Government mining engineer and a Government report of the results of the experiments with it has just been issued. This report compares the new powder more especially with the blasting powder manufactured by the Belgian Government at its factory at Welleren, and states that the new powder produces as much effect as twice its weight of the Government powder, that it explodes almost without noise, that it leaves scarcely any smoke, and that what little it does leave has no offensive odour, and is not nearly so noxious as the smoke of the Government powder and of ordinary gunpowder in general. When exploded in free air it does not produce any sparks, but burns with an intensely brilliant flame, and almost noiselessly, and leaves no carbonaceous residue, such little residue as there is consisting solely of white globules. When exploded in a bore hole it is said to "act in the manner of a lever, whereas the ordinary powder, exploding more suddenly, acts rather in the manner of a hammer, producing a shock more or less violent. The dislocation of the rock extends to a great depth, and there is no useless projection of *débris*. The noise of the blast is scarcely perceptible."—*Mechanics' Magazine.*

COMPRESSED AIR IN COAL-CUTTING.

MR. T. LEVICK has described to the British Association, his "Machinery for compressing Air, and the Applicability of such Compressed Air for working Coal-cutting and other Underground Machinery." The advantages which the paper detailed are:—1. The simplicity of construction, and small cost. 2. The small amount of power to overcome the friction of the moving parts. 3. It was not affected by the production of heat in the compressed air. 4. It acted as a regulator, adapting its speed to the consumption of air underground. 5. Being used at the mouth of coal-pits, the additional loss of power was not of so much consequence. 6. The small amount of space occupied. The paper explained that the air compressed by the engine at the mouth of the pit was conveyed to the machinery underground in 4 in. cast-iron pipes, carried along the main-headings, from which the compressed air was conveyed in 1¼ in. gas piping, connected with the machine in the pit by an india-rubber hose. The prominent feature of the machine is a pick, which digs the coal when the engine at the mouth of the pit is in motion.

This pick can be worked at any angle at which the coal may lie: it can be easily put to work at any part of the thickness of the coal, whether it might be desired to "hole" in the bottom or at the top of the measure, or at a parting in the middle, or any other portion of it, by simply shifting the pick to a greater or less distance upon the axis on which it is keyed. The machine moves forward as the work progresses, by means of a hand-wheel, which communicates motion by bevel-wheels to the wheels upon which the machine travels. In cases of bad roof, the use of the coal-cutting machines had been objected to on account of the distance required (between the face of the work and the supports to the roof) for the back work of the pick. Another objection was that the work had to be passed over twice or three times in order to gain the required depth of cut. These objections had been obviated by the machines introduced to notice, by which the stroke of the pick, when making its cut, was from the back of the cut towards the face, instead of passing across the road and striking into the face in the direction observed heretofore. By this means the supports to the roof could be brought close up to the road; the concussion of the blow was reduced; and about six inches of the coal had not to be cut, it being forced out as the pick approached the face. The quantity of compressed air consumed by each coal-cutter was determined from some indicator diagrams to be 327·6 cubic ft. per minute, at 30 lb. pressure. The machine was working at 98 strokes per minute, showing an expenditure of air equal to 3 horse-power. The machines at Blaina Ironworks, South Wales, were working in coal which the men refused to work, and which, though opened out, has not been touched for years, and hole at the rate of 8 yards per hour, to a depth of 3 ft. The machine, when worked with the outward cut and self-propelling motion, will exceed this quantity considerably.

Sir W. G. Armstrong thereupon remarked, with reference to Mr. Levick's coal-cutting machine, that although it might be a matter of regret with some persons that the application of machinery to coal-cutting and other similar purposes would operate to deprive labourers of their employment, it must be admitted that whatever tended to economize human labour in the dark and dangerous recesses of a coal-mine must be a benefit to the community; moreover, all experience had shown that although labour may be diverted in its channels by the introduction of machinery, the aggregate amount of employment suffered no diminution, but, on the contrary, seemed to increase.

ACCIDENTS IN COAL MINES.

From the Reports of the Inspectors of Mines in Great Britain for 1864, we gather:—

Notwithstanding much improvement, a large preventible loss of life yet occurs every year. The most serious danger is not from explosions of fire-damp; these are comparatively rare events, but hardly a day passes without some calamity *from the fall of ponderous masses* from overhead or from the *sides of the working-places and travelling* ways, crushing out life in a moment, or smashing and breaking bones, and leaving the miner for ever unfitted for the pursuit of his calling. About 400 lives are lost every year in Great Britain from these falls in coal mines—407 in 1863, 395 in 1864. The remedy lies in an abundant use of timber for props, as the natural support is taken away, and in the maintenance of a sufficient number of deputies to leave the working places but a very short time in the day without close and rigid examination. An inspector, Mr. Wynne, who reports 13 deaths from falls of roof, says that nearly all were preventible by proper application of timber. Mr. Evans reports:—"I am constantly pointing out places insufficiently timbered, and often find within reach a plentiful supply ready for use. Men will not give themselves the little trouble necessary to make all safe, even when their own lives depend upon it." To some extent this is due to the employment of inexperienced hands, in consequence of the demand for labour.

The loss of life by explosions of fire-damp in 1864 happily reached only 94. But Mr. Wynne declares that if every colliery had a good and efficient manager, explosions of fire-damp would be few and far between. Some managers have actually admitted that they have on many occasions assisted to brush out the gas from places where the men were going to work the same morning; and some have been appointed on account of the very equivocal qualification of having themselves been burnt. Mr. Brough, in recording four deaths at Pontypool, expresses his surprise that two of the men, being experienced persons, could have gone to work where they did, with the warning they had from seeing doors open that ought to have been shut; it almost amounts to insanity, he says, to go into such a place with naked flame. It would be a great step towards safety if overmen and deputies were always to obtain in a mining school some insight into physics and rudimentary chemistry. There are instances in these reports of men walking with naked lights into what is, in fact, an inflammable magazine, of a man going with a candle to a part where he has been expressly ordered not to go, of a man of remarkable attainments cautioning a workman not to go beyond a certain point, and afterwards himself walking into that body of gas and exploding it. Another class of accidents, those which take place in shafts, causes a very large number of deaths—no less than 184 last year, very many of them from imprudence and dangerous practices; it is sad to read of such a recklessness of danger and waste of valuable life. Still, there is improvement. The recent Act of Parliament requiring two shafts or outlets is popular with all who have to go underground, and is likely to prove of great service, not only as securing means of egress, but improving ventilation, and ultimately the physical condition of the miner. The Act is now in full operation.

DETECTION OF FIRE-DAMP.

An ingenious and simple instrument has been invented for this purpose by Mr. Ansell, of the Mint. Its action depends on that tendency which exists in gases and vapours to diffuse themselves through each other, notwithstanding the interposition of membranes, porous substances, &c., and which is called *endosmose* and *exosmose*. It consists of a small brass cylinder, one inch and a half long, and three-quarters of an inch internal diameter, and of a piston working freely in this. Under the piston, and within the cylinder, is a spring, that, when pressed by the sinking of the piston into the cylinder, moves a hand upon a dial on the outer case—which has a plate of thick porous earthenware at the back, and in appearance somewhat resembles an aneroid barometer. When this instrument is brought into an atmosphere containing coal gas, the latter passes through the porous plate with a velocity *dependent* on its amount; and the air within the case being expanded, the piston is forced into the cylinder to an extent which is indicated on the dial. Taken out of impure air, the effect will be reversed, and the index will move on the dial in the opposite direction, the exact amount of purity or contamination being indicated. It is clear that the instrument might easily be made to set a bell ringing, or give some other notice of danger from the presence of an explosive atmosphere. So far as trials of it have been made, it seems to work satisfactorily.

NEW ROTARY STEAM-ENGINE.

Mr. R. W. Thompson has described to the British Association a New Rotary Steam-engine, involving, it was said, a novel and ingenious application of mechanical principles for this purpose; and in which the difficulties arising out of the use of the steam-stop or abutment are got rid of by dispensing with the steam-stop entirely; and in which the inconvenience connected with keeping the packing steam-tight is obviated by giving the packing-straps the same curvature as the inside of the cylinder, causing them to bear equally and steadily against the steam, as in the packing of an ordinary piston. Mr. Thompson exhibited diagrams and wooden models of the engine. He said, from the experience he had in connexion with the new engine, he believed that for many purposes it would supersede the ordinary form of steam-engine, and in particular for gas exhausters. An engine on this principle was shown at work near the Section meeting-room, at Birmingham.

CORNISH STEAM-ENGINES.

An instance of the successful application of the single-acting Cornish engine to drainage purposes, is shown in the drainage of the Haarlem Lake, which covers an area of 45,230 acres, to an average depth of 14 ft. The cubic contents equal 800 millions of tons of water, which would be sufficient for the supply of London for seven years. This quantity has been pumped into the sea by three engines. When working for a trial, with a 10 ft. lift, and all the pumps in full action, 109 tons of water were raised per stroke.

One reason why Cornish engines are so costly is, that they are necessarily made strong enough for 1000 horse-power to give only about 250 horse-power. A cylinder 100 in. diameter and 40 lb. steam has the enormous strain of 140 tons on its piston at the commencement of the stroke. This gives a strain on the fulcrum or gudgeon of the beam of 280 tons, which at once accounts for the great strength and quantity of material used in its construction. With two double-acting cylinders connected to one crank-shaft, and having the same speed of piston, the strain on the piston is only one-fourth the above, or 35 tons. If the crank-engine piston travels quicker per minute, as it can with ease and safety, a further proportionate reduction in the strain ensues.—*Mechanics' Magazine.*

PRESSURE PISTON PACKING.

A NEW Pressure Piston Packing has been invented by Mr. A. Stevens, master mechanic on the Alameda and San Leandro Railroad. Steam is admitted into the body of the piston through small valves, and by its pressure and expansive force keeps the rings steam-tight against the cylinder without creating any undue friction. The valve on the steam side remains open until the pressure in the cylinder, either by expansion or exhaustion, falls below that in the piston, when it closes; and the steam by its expansive force retains the rings against the cylinder to the end of the stroke, when the action is again repeated. Among the advantages claimed are—1. Absence of friction of the rings on cylinder proved by the tool marks remaining on the cylinder after six months' constant running. 2. The retention of the steam inside the piston by means of the two valves, thereby preventing waste. 3. The steam being of the same pressure inside of the piston as it is outside, the piston may overrun the counterbore without damage, and thereby prevent a ridge being formed in the ends. 4. The body of the piston fitting the inside rings keeps the piston always in the centre of the cylinder. 5. The increased ring surface, which wears much longer than narrow ones. It is not only the saving in steam and fuel which lends importance to this invention. The economy in the cost of machinery for a given amount of power must be equally great, as also the benefit to be derived from the conceutration of power into small space and weight.—*Mechanics' Magazine.*

COMBUSTION PUMP.

AN improvement has been made by Mr. Thomas J. Linton, of Providence, on that class of Pumps or water elevators in which, by the combustion of a hydro-carbon liquid, a vacuum is produced, whereby the water or other liquid is caused to rise through the suction pipe and to discharge at the desired point. The invention consists in the use of steam combined with the hydro-carbon liquid in the interior of the reservoir or chamber, in which the vacuum is to be produced in such a manner that, by the condensation of the steam, the intensity of the vacuum is considerably increased and the raising or elevating of the water is materially facilitated. The water from which the steam is to be formed is placed in a shallow pan over a similar pan containing the hydro-carbon liquids, in such a manner that the heat evolved by the combustion of the hydro-carbon liquid volatilizes the water, and a sufficient quantity of steam is obtained to produce the desired result. The hydro-carbon liquid is measured by means of a bell-shaped or other vessel or spout attached to the supply tube; and it is ignited by introducing into the spout, after the pan in the interior of the reservoir has been filled, a small quantity of hydro-carbon liquid, and lighting the same, so that it runs into the reservoirs while burning, *and ignites that portion* of the liquid in the pan. The gaseous products of combustion are allowed to escape through the reservoir pipe, which is provided with a hinged drop-valve fitting into a cavity filled with liquid in such a manner that, so soon as the gases have escaped, the valve can be dropped and an air-tight joint is obtained, whereby the operation of the apparatus is not disturbed. —*Mechanics' Magazine.*

STAY-BOLT CUTTER.

THE numerous Stay-bolts in the fire-box sheets of steam-boilers are usually cut off, after their ends are screwed to their proper place, by a cold chisel and hammer. This method of cutting them off is slow and expensive work, and the rest of the bolt is usually injured by reason of the jambing of the thread, so as to require trimming before it can be again inserted in the sheet. Besides this, that portion of the bolt which enters the sheets and the sheets themselves are subjected to injurious strains by the old method, owing to the successive and violent blows of the workman in cutting off the bolt; the bolts are thereby often loosened in their holes, and the holes altered in their outline, whereby it becomes necessary, in riveting them upon the sheets, to subject the bolts to an excessive amount of hammering, which is injurious to them. Mr. Joseph Renshaw, of Michigan, has invented a machine which provides against these injurious tendencies and the disadvantages of the present method of doing this sort of work by means of a tool composed of an annular stock, whose base is to rest upon or over the fire-box sheet, and whose sides are slotted to receive a cutting tool having its head pivoted to the side of the stock. The tool is held to the work by a clasp sleeve.—*Mechanics' Magazine.*

THE STRENGTH OF MATERIAL IN RELATION TO THE CONSTRUCTION OF IRON SHIPS.

MR. W. FAIRBAIRN has read to the British Association a paper on this subject, the joint production of himself and Mr. Tate. The quality of iron estimated by work expended in the ultimate elongation of a bar one foot long and one square in. in section was first considered. This work with dynamic effect gave a comparative measure of the powers of resistance of different kinds of material to a strain of the nature of impact. The value of this modulus or co-efficient of dynamic resistance, determined by Mr. Fairbairn's experiments for different plates or bars of iron, shows that the resistance of thick plates to mixture is about $2\frac{1}{2}$ times that of thin plates; that the resistance of thick steel plates is about $\frac{1}{10}$ greater than that of the low iron plates A; and that the resistance of these latter plates is one-half greater than that of the rolled plates D. Similarly the work expended in the deflection of a bar supported at its extremities by a force applied at its centre may be taken as the modulus of dynamic resistance strain, different *kinds of material to a force of* impact tending to produce transverse. The next section of the paper gave the maximum transverse strain produced on a ship when the load is unequally distributed. The point of maximum strain is not always at the centre of the ship, as many practical men assume. The third section of the paper gave the value of the moment of inertia for different elementary sections of material. Section four gave certain simple general analytical expressions for the moment of inertia of complex sections of girders, such as that of an iron ship. The distribution of the material, so that the beam may have the greatest strength, was then investigated, and the formula applied to the section of one of our most approved iron ships showed that the upper portion of the ship should be about one-half stronger than it was in order to have a proper distribution of the material. Section five treated on the penetration of iron armour-plates by flat-faced tempered steel shot.

APPLYING MOTIVE POWER TO SHIPS.

This invention consists in the application of a combination of steam and air as a Motive Power to Ships and vessels of all descriptions. It has been patented by MM. Jean Baptiste Andreux and Eugène Coulon, both of 82, Boulevart Sebastopol, Paris. The improvements in the combination of steam and air are as follow:—A boiler of suitable size and shape is used, inside which is coiled a serpentine copper tube or pipe, through which steam is conducted to a second tube or pipe hereafter described; the steam in passing through the first tube is superheated by means of boiling water, steam, jets of gas, or other similar means. For the purpose of increasing the force the superheated steam is made to escape from this first tube by a small jet into a second tube whose mouth is slightly funnel-shaped, and whose diameter is larger than that of the first tube; it is in passing from the first to the second tube that atmospheric air is introduced, the superheated steam drawing it into the second tube as it enters the funnel-shaped mouth; the other end of the second tube opens at the stern of the vessel. Other tubes may also lead from this second pipe to the sides of the vessel, the escape being so arranged that the steam strikes in a backward direction so as to aid in propelling the ship.—*Mechanics' Magazine.*

SAVING VESSELS FROM SINKING.

Mr. J. Smith has patented certain improvements in Saving Ships or other vessels from Sinking. This invention has reference more particularly to ships or other vessels having two decks, the lower deck about the water line having divisions according to the size of the ship or vessel. There is a hatchway—or there may be more than one—to each division, which hatchway or hatchways is or are constructed differently to those heretofore used. The outer framing of the hatchway is made broader than hitherto, and also lower, and is rendered air-tight and water-tight. Between the framing of the hatchway and the hatchway itself or the lid, the patentee places a layer of vulcanised india-rubber or equivalent material, and presses the lid on the framing by screws or similar contrivances. This lid is screwed down or otherwise secured and rendered air-tight and water-tight. He employs one, two, or more pumps for forcing air, the number of pumps varying according to the size of the ship or other vessel, with requisite piping to conduct air to different parts of the ship or vessel. He also employs indicators and safety valves of ordinary arrangement. He makes the windows or other outlets of the ship or vessel air-tight and water-tight, and underlays the framing thereof with vulcanised india-rubber or equivalent material, so as to render the same air-tight and water-tight. Although ships and vessels having two decks and divisions are best adapted for this invention, the invention is also applicable to ships or other vessels of other construction. — *Mechanics' Magazine.*

COMPOSITION FOR PRESERVING SHIPS' BOTTOMS.

Dr. Henry de Briou, of Welbeck-street, Cavendish-square, has patented an invention which consists in coating the metals, iron, copper, zinc, the ships' sides and bottoms, and all surfaces or objects to be protected, with an improved composition formed of vulcanised india-rubber 750 parts, and mineral pitch 250 parts. The india-rubber cut into small pieces is thrown into a copper cauldron, placed upon a slow fire and heated until it is melted; all the time it must be stirred up, then the mineral pitch is added and melted; the mixture must be stirred up for some time until the two substances are thoroughly mixed together, and left boiling for two or three hours; then the fire is put out. Before it cools down, the composition is poured into barrels, copper, iron, or other vessels, and kept ready for use. To apply it, the requisite quantity, put into a copper vessel, is placed upon a slow fire, melted again, and spread over the surfaces to be protected by means of a vegetable brush; and then to spread it smoothly and uniformly upon the surfaces, a lighted torch of reeds, such as used in melting tar, is held close to it, which makes it run and gives it a smooth surface.—*Mechanics' Magazine.*

THE CIGAR SHIP.

This novel vessel is of wrought iron, and is being built as the private yacht of Mr. Wyman, an American gentleman, who has designed everything connected with the ship. The execution was at first entrusted to Mr. Hepworth, and he expended upon it the most perfect workmanship of which wrought iron is capable. The hull is immensely long, perfectly round, resembling the shape of a cigar, being, however, finely pointed at both ends instead of, as in a cigar, only one. She appears to be little more than a gigantic iron main-yard for some vessel of the *Great Eastern* class, having a rather wide diameter in the middle and tapered at each end to a point almost as fine as that of a needle. As regards her external appearance, then, we need only add that the rivets that fasten her are counter-sunk, so that she presents outwardly a perfectly smooth surface, while the workmanship of her joints is so perfect that even the touch fails to detect the slightest irregularity in her evenness. Her engines are three-cylinder, to be driven at high pressure, turning one steel shaft (made by Mr. Krupp), which revolves through the whole length of the vessel, projecting from the fine points at each end, where it carries a screw. These screws are four feet greater in diameter than the greatest diameter of the vessel—namely, 22 ft., and each is to have eight blades, because the two points being only, say, a foot or so below the water, four of the blades of each screw will be out as it revolves, while there will be always four of each immersed to do the work of propulsion. Under each screw is a rudder, and by steering with both the vessel can be turned as on a pivot. As the extreme points would be too fine to admit the passage of the screw shaft and its bearings also, this difficulty is obviated by making about 16 feet of each end revolve with the shaft, and thereby form part of it, so that with the increased diameter of the point at the end of the 16 feet towards the midships there is room gained for both shafts and bearings.

Her boilers, like all the other parts of the vessel, are on a new plan. Four of them are on the locomotive principle, with vertical tubes. A blast fan is to give them draught, and they are to work at 150-lb. pressure. This is a great power, but as the boilers are built far stronger than even locomotive boilers, it is asserted that they could be worked up to 1000 lb., or even 1100 lb. per square inch with safety. There are 136 ft. of fire-bar surface, and it is expected that, with the aid of the blast-fan, each of these 136 ft. can be made to burn 50 lb. of coal per hour. If the furnaces can accomplish this, then, according to the rule which gives one nominal horse-power for every 2½ lb. of coals consumed per hour, Mr. Wyman's yacht will be working at nearly 2500 horse-power. In our best mail steamships, on their fastest trips, it is found difficult to burn 30 lb. of coal per foot of fire-bar surface per hour. If Mr. Wyman's, then, burn 50 lb., he will be working up to nearly 2500 horse-power, or at the rate of eight indicated horse-power to every ton burden of his vessel. In very fast ocean-going steamers the ratio of horse-power to tonnage is only about 2½ tons to one nominal horse-power. The advantage which the Cigar Ship possesses in this respect, together with those which her slender form, smooth surface, and very small midship section (only 100 feet) will give, should enable her to go at an extraordinary speed. The extreme length of the vessel over all is 256 ft., and her greatest width and depth is, of course, amidships, where the circle is 16 ft. diameter. Thus, then, her length is no less than 16 times that of her greatest width, ordinary vessels being thought very narrow if their width is only one-seventh of their length. The Cigar Ship is built throughout of the finest boat-plates, in some parts of steel, in some of Low Moor iron. To the water-line these plates are five-eighths of an inch thick; above the water-line they are only five-sixteenths. Her displacement will be about 500 tons, which gives her a little over 300 tons' burden, according to builders' measurement. She is built without any longitudinal stringers, but throughout her entire length she is divided by no less than 16 water-tight compartments, and in the engine and boiler rooms is further strengthened by inner rings of angle iron seven inches deep, which are riveted to the side and placed as close as at intervals of only three feet apart.

Underneath the vessel's bottom, in place of a keel, is a broad band of the best Low Moor iron an inch thick by three feet wide, and meant to protect her in case of her taking the ground. Inside is an iron floor, which also runs from end to end, covered with wood, and forming, in fact, the lower passenger deck of the yacht. This floor amidships is only about six feet from the bottom of the cylinder, so that overhead there is a roomy cabin enough, much resembling in shape a small railway tunnel. The upper and only external deck is 130 ft. long by 10½ ft. broad, and is formed by building for that length what we may call a square flat-topped wooden cover on the top of the cylinder. This cover, or deck, is 4 ft. 10 in. high altogether, of which the lower 2 ft. is of iron, the other 2 ft. 10 in. of common light wooden bulwarks. She has two short funnels, two light telescopic iron masts; and these, and her little deck, and a small part of the upper curve of the cylinder are all that will be seen out of the water.—*Abridged from the Times.*

NEW STEAM-RAM.

The *Toulonnais* gives a complete description of the *Taureau*, a Steam Ram built on a new system, and, in June, launched at Toulon. The *Taureau* presents a formidable appearance, due more to its form than to its size. The impression produced is that of an impregnable fortress. It is neither pretty nor light, and its beauty consists in its formidable appearance. The construction was commenced in 1863, and it was Admiral Bouet-Willaumez, at that time Maritime Prefect of Toulon, who, by permission of the Minister of Marine, prepared the plan of an iron-plated steam ram for the defence of the seaports. Its utility was incontestable, and it became more so after the attacks on Charleston and Fort Fisher. The *Taureau* draws so little water that she may be concealed close to the shore while waiting for an enemy to enter the harbour, or she may take a position in shallow water where it will be impossible to follow her. Her prow terminates in a point, and this point is armed with a kind of massive bronze cone which serves as her spur. It is with this spur that this heavy ram, driven at a speed of 12 to 14 knots an hour by machinery of 500 horse-power, can strike and split a ship.

The *Taureau* is, moreover, supplied with two screws, which enable her to turn in a very small space, and with the greatest facility. She can consequently in a moment present her front to an enemy, whatever her position. Let it be supposed that an iron-plated frigate has forced the entrance to the port of Toulon, and is attacked by the ram. The latter can turn in a small space at a speed of 12 knots an hour, while the frigate, moving at that speed, must describe a circle of 600 yards in diameter. Under these disadvantageous circumstances it will be difficult for the frigate to avoid the shock of the ram. The latter can further avail herself of one large gun which she carries. Her facility of evolution will enable her to place herself in any position. She may, for example, attack the frigate by approaching her stern, and thus avoid her broadside. This large gun, the only one the *Taureau* carries, weighs 20 tons. This ram is intended not only to do battle in the harbour and defend its entrance, but likewise to pursue a ship when she has been driven out of it. Her powerful artillery will enable her to attack an enemy on her arrival, and pursue her in her flight at such a distance that it will be impossible for a frigate to return her fire. In a word, the new ram, with her formidable spur and her heavy gun, is a very terrible instrument of war, and no less efficient for defence. The *Taureau* has but one deck, which is plated with iron from one end to the other. The sides of the hull are likewise plated with iron the full length, from 3 feet under the water-line to the deck. The deck and the sides form, as it were, an iron box, safe from any shot that may be fired at it. It is in this iron box that the machinery is placed, and the entire crew during an action, except those in the tower. The deck of the *Taureau* is covered over its entire length with a cylindrical ball-proof dome. The surface of the dome is so inclined that it is impossible to walk on it: it will consequently be impossible to capture it by boarding.—*Abridged from the Daily News.*

THE BELLEROPHON.

In a lecture delivered on "The Properties of Iron, considered as a Material for the Construction of Ships of War," at the School of Naval Architecture, South Kensington, Mr. Fairbairn has made the following observations on the ironclad frigate *Bellerophon*:— "I am bold enough to assert," said Mr. Fairbairn, "that the cellular form is not only the strongest but the cheapest mode of construction that can, in the present state of our knowledge, be adopted for every description of vessel that exceeds 1000 tons burden; and I am gratified to find that the present Constructor of the Navy, convinced of its advantages, has successfully adopted the principle in the construction of the *Bellerophon*, which, in my opinion, is one of the finest and strongest vessels for her tonnage in Her Majesty's service. As this vessel appears to combine economy in the distribution of the material with greatly increased strength, I have considered it instructive to exhibit her section at midships, without going into detail. Along the bottom there are nine longitudinal keelsons—four on each side of a central one. These beams or keelsons vary from 4 ft. 8 in. to 3 ft. 4 in. in depth, and extend the whole length of the ship, or to the point of intersection at the bows and stern. At every four feet the transverse frames or ribs are secured by rivets, and extend from the upper deck all round the sides and bottom, forming the whole, when plated inside and out, into a series of open cells, 6 ft. wide by nearly 4 ft. deep. At every 20 ft. the cells are closed by plates, riveted watertight between the outer skin and the inner skin; thus rendering the ship much more secure in case of accident to the bottom, and perfectly independent of the open spaces between the principal watertight bulkheads. From the lower edge of the armour plates, and from some distance below, intermediate frames are introduced between the principal ribs for the support of the backing of the said plates; and these, again, being securely fastened to the sides, render the construction as a whole a solid and compact mass, admirably adapted to the resistance of projectiles at high velocities. The upper deck, it will be observed, is covered with sheet-iron plates, superimposed and riveted to the deck beams under the planking.

"I have been the more particular in this description as I consider the *Bellerophon* a model ship. From this outline of her construction it will be interesting to consider how such a vessel will behave when pitching in a heavy sea, or, under more trying circumstances, if stranded on a lee shore. In the first of these cases we have perfect security, to say nothing of her speed, form, and other conditions as a sea-going vessel; and in the latter case we assuredly have the means of escape, and the chance of the vessel holding together, with her double bottom and the enormous strength imported into her by the cellular system of construction. On these points, in regard to strain, a very few remarks will be necessary to show the reciprocating motion of the vessel, and the resistances that are called into action when exposed to a hurricane in a tempestuous sea. In the previous statement I have chiefly treated of the material and its distribution; let us now consider the ship, such as the *Bellerophon*, and taking her sectional dimensions with an area of 1200 inches in the bottom, and assuming that she is duly proportioned on the upper deck, we have, according to formula, 8640 tons as the breaking weight in the middle, or 17,280 tons equally distributed, which is more than double the weight of the ship, or its displacement on a draught of water of 24 ft. Hence follows the immense strength and great tenacity of this important vessel. In this investigation I have assumed that the *Bellerophon* is a class of vessel admirably adapted for the purposes of war. She will carry guns of large calibre, and of sufficient power to penetrate armour plates; and she will also, from her compact form and size, have the advantage over larger vessels of manœuvring with greater celerity either in attack or defence."

The *Bellerophon* is described in the *Year-Book of Facts*, 1865, p. 42.

SUBMARINE DIVING.

ENDEAVOURS were made in November, at Brest, to float the English vessel *Columbian*, sunk in January last; the details are highly interesting as furnishing details concerning the difficulties encountered in deep diving operations. The diver was M. Casimir Deschamps, an experienced man, formerly *éclaireur* in the Crimean army, Member of the Committee of the Association of Inventors under the presidency of Baron Taylor. Clad in the impermeable dress, and covered with the casque, he descended at 3 h. 30 m., at the same time that the submarine lamp was lowered down the ladder. At 30 mètres (98·4 ft.) the lamp was no longer visible, and the men who held it felt its weight suddenly increased. At 3 h. 40 m. the diver reached the depth of 60 mètres (196·8 ft.), when one of the air-supply pipes burst at the joining with the pump. Order was given to continue pumping, while the man was at once hauled up, the pump working while the engineer held the pipe to the pump with his hands bound round with a handkerchief. At 3 h. 44 m. the feed-pipe of the other pump burst also, and the lamp was then carefully drawn up; but it was found completely crushed in by the pressure, which amounted to 6 atmospheres, or 85 lb. per square inch. The cylindrical body of the lamp was unscrewed and unsoldered, the flat glass had disappeared, and the lens was driven into the interior, where it hung by one screw. The diver came up safe and sound.

Fresh pipes having been put to the pumps, the courageous diver, paying no attention whatever to the accident that had happened, eagerly descended a second time.

At 4 h. 44 m. he commenced the second descent, under the pressure of two atmospheres: at 4 h. 46m., at 25 mètres (82 ft.) depth, the pressure was 3 atm.; 4 h. 49 m., at 40 mètres (131 ft. 3 in.), pressure 4¾ atm. (here the diver called for *more air*); 4 h. 50 m. 30 s. at 55 mètres (180 ft. 5 in.), 6 atm.; 4 h. 54 m. 30s., at 60 mètres, 6 atm.; at 4 h. 58 m. 50 s., depth 60 mètres, same pressure; at 5 h. 2 min., the diver gave the signal to be hauled up, which was obeyed very carefully, the pumps working. No air-bubbles were seen to rise on the starboard side. The captain, stationed on the bridge, perceived the diver floating on the surface, and at once sent a boat to his rescue, the pumps working with two atmospheres pressure. The man was lifted on deck in a very exhausted state; having fainted twice, he was ultimately brought round by being rubbed over the body with camphorated spirits of wine, ether, &c. He then slept, and at seven o'clock took some food. It was found that the diving apparatus (an impermeable one) had been broken in the interior, so that the water penetrated into the legs of the contrivance. The state in which the diver rose clearly proved that neither the man nor the apparatus could support with impunity a pressure of six atmospheres, or 85 lb. to the square inch.—*Builder*.

THE RESPIRATEUR.

THIS new apparatus is invented by M. Galibert, the use of which enables a lengthened stay to be made beneath the surface of the water, or in atmosphere deleterious to human life. M. Galibert constructs his apparatus in two forms; the first for use where the operator enters a non-respirable medium not far distant from the external air, and the second where the external air is at a considerable distance. The first is composed of three parts—viz., first, a piece of boxwood, horn, or ivory of the form and dimensions of the human mouth when open: secondly, two caoutchouc pipes of a proper length and fitted to the boxwood, horn, or ivory; and, thirdly, a nose pincher for preventing respiration through the nose. The apparatus is used as follows:—The pincher being applied to the nose, the mouth-piece is placed in the mouth, where it is held by the teeth. The lips by surrounding the mouth-piece, prevent communication between the chest and the air in which the operator is at work, so that he can only breathe the air brought by the tubes, the other ends of which are in the open air. The tongue acts the part of a valve, opening and closing alternately, the holes communicating with the tubes for inhaling and exhaling air. This alternate movement of the tongue is exceedingly easy, and is performed almost instinctively after a few minutes' practice. On placing the mouth-piece between his teeth, the operator closes the right hole with his tongue; he then draws air into his lungs by the left tube; he next moves the tongue without pressing it, over the left hole, and then expires or breathes out vitiated air by the right tube. There are thus no mechanical parts in this apparatus; the lungs fulfil the functions of a suction and a force-pump, and the tongue acts as a double valve. But it is not only on the chest that gases exert a deleterious action; smoke and gases affect the eyes, and the inventor provides special glasses, or even surrounds the head with a hood. Where the apparatus is to be used at some distance from the external air, M. Galibert proposes that the operator should carry an air reservoir on his back to which the tubes before-mentioned lead.—*Mechanics' Magazine.*

RESISTANCE OF WATER TO FLOATING AND IMMERSED BODIES.

THE Committee of the British Association appointed to make experiments for the purpose of ascertaining the difference between the Resistance of Water to Floating and Immersed Bodies have had several meetings during last winter and spring, and agreed to a programme of experiments. Two models of shipshape, 4 ft. long, and painted, were made and employed in the experiments: each of them consisted of two equal and similar halves, joined together at the middle water-line. One model was made in two parts, joined at the circular midship section, so that by turning the after-body through a right angle about a longitudinal axis, the water-lines could be converted into buttock lines, and *vice versâ.* The experiments were made according to the method formerly put in practice by Mr. Scott Russell, in which the uniformity of the propelling force was maintained by means of a regulating weight hanging from a pulley, under which the hauling cord passes, the model being guided in a straight course by means of a stretched wire. The experiments were made principally at speeds not exceeding the natural length of the wave corresponding to the length of the models—viz., about two knots per hour, and some at higher speeds. The experiments were made with the models both totally immersed and only half immersed. The execution of the experiments was superintended by Mr. Scott Russell, as being the only member of the Committee resident in or near London. The actual performance of the experiments was entrusted by Mr. Russell to Mr. J. Quant, who performed the duty with great skill and assiduity. A lake in Blackheath Park was kindly granted for the experiments by Dr. Joseph Kidd. Twenty-eight experiments were made on the first model, with the following results :—1. The resistance, when immersed so as to be just covered with water, and no more, was more than double its resistance when half immersed, at the same speed. 2. When the after-body of the model was turned so as to convert the water-line into buttock-line, its resistance was increased, and that whether the model was half immersed or just covered. The Report deferred the detailing of the description of the experiments until they should be completed.

HYDRAULIC POWER.

At the goods station of the Midland Railway, Agar Town, the trucks are brought up to the landing-stage by hydraulic machinery; loaded or unloaded when required by hydraulic cranes; and they are shifted from one set of rails to another by means of traverses worked by hydraulic power. Press a lever, and in an instant the loaded truck glides noiselessly away; another lever is pressed, and forthwith a huge bale of goods, or a heavy forging, is seen dangling in the air, and is swung round, and deposited in the truck or waggon, as tenderly as a mother would place her sleeping child in its cradle. The *Railway News* says :—"The machinery by which all this power is made so readily available consists of the water-engines of Sir William Armstrong, situated some hundred yards distant from the place. Our readers are familiar with the principle upon which this power is obtained and applied. The effect of a pressure of water from natural sources is got by what are termed 'accumulators,' which, in this instance, consist of a large reservoir formed of iron plates, and filled with 70 tons of gravel and sand, its pressure being about equal to that of a head of water 1500 ft. This force is raised by the hydraulic power, and is ever ready and available for acting on a column of water, and the pressure may be regulated as required over every part of the system. A small steam-engine is employed for pumping the water into the cylinder of the hydraulic press. This hydraulic pressure is obtained at a very small cost. Some engines of this description which are employed at the Newport Docks, in Monmouthshire, delivered, last year, 219,000 tons of coal, at a cost of about one farthing per ton for pressure, and about one halfpenny for wages, stores, and repairs; the cost of loading by hand having previously been from 5d. to 7d. per ton."

A PUMP WITHOUT A PISTON.

In a very simple form of pump, recently invented in America, friction is got rid of, as there is neither piston nor packing; and the wear and tear is, therefore, reduced to an inconsiderable amount. The vacuum is obtained by means of diaphragms fixed in chambers, and connected with rods, to which a reciprocating motion is imparted by racks and pinions moved by the handle. The apparatus may, however, be of a much simpler form, since racks and pinions may be dispensed with, a single diaphragm chamber may be used, &c. When the diaphragm is raised, water rushes up under it to fill up the vacuum; when it is depressed, the water is forced into the air-vessel, if there is one, or in any other required direction.—*Mechanics' Magazine.*

NEW APPLICATION OF WATER PRESSURE.

At a meeting of the Paris Academy of Sciences, a communication from M. L. D. Girard has been read, on the application of Water-Pressure to the bearings of the fly-wheel of a rolling machine, weighing 35,000 kilogrammes (about 34½ tons). The principle consists in admitting water having a pressure corresponding to the weight of the axle and wheel, &c., under those parts of the axle which are supported by the bearings. It was found that, when the bearing surfaces of the axle were merely greased, the co-efficient of friction was 10 per cent.; but that, when water was admitted under the axle, and the rising of the latter permitted the escape of the fluid across the whole of the bearing surfaces, the co-efficient became 0·001, and in ordinary circumstances did not rise above 0·003. The water had a pressure of ten atmospheres, derived from air condensed in the reservoir containing it. At starting the axle bearings are merely greased, and only a certain velocity can then be attained; but, the instant the water is turned on, the velocity becomes greatly accelerated. This contrivance appears specially adapted to the support of great weights moving with high velocities. The French Minister of Marine has caused it to be applied to the bearings of the screw-propeller of a steam-tug.—*Scientific Review.*

AIR-HAMMERS.

Mr. Grimshaw's high-speed compressed Air-Hammer is now employed at Birmingham for various stamping and forging purposes: at Glasgow for coppersmith's work, and at Sheffield for steelwork. The machine consists of a force-pump supplying compressed air to a reservoir, and a working cylinder and piston similar to those of a steam-hammer; having arrangements for varying the action of the hammer as required, and increasing the rapidity of the blows, which may attain a maximum of 800 strokes per minute. The largest hammer yet put to work has a cylinder 8½ in. in diameter and a stroke of 28 in., and the pressure may be adjusted to any amount from 5 lb. to 40 lb. per square in. Several steam-hammers of from 4 cwt. to 10 cwt. are working at Sheffield, with which 500 or 600 blows per minute can be struck if required.

Mr. G. Burt has described to the British Association a Pneumatic Hammer, with a model. It was not pretended that the hammer at all approached the power of a steam-hammer of the same total weight, or that it would take the place of the steam-hammer for general smith's work. The advantages claimed for it were that it was very simple, especially in its single-acting form, as shown by the model; that there were no valves in constant motion and wear; that the momentum of the driving parts connected with the crank-shaft was very small, on account of their small extent of motion (a throw of 1 in. only being given to the 10 in. piston); that the wear on these parts was consequently very slight; also owing to the elastic nature of the medium between the driving and driven pistons; that there was an absence of all dropping of condensed steam, such as would invariably be caused by the use of a steam-hammer, and which would be fatal to a surface under the operation of being planished.

STEAM PILE-DRIVER.

Mr. W. Sissons has read to the British Association a description of the Patent Steam Pile-Driver, manufactured by the firm of which he is a member. By the machine the ram falls twelve times in a minute, with a 5 ft. lift. The size of the bottom frame is only 7 ft. 6 in. square: it occupies a smaller space than an ordinary hand-machine, and can be used in any situation, on land or afloat, where the other can. It supplies a deficiency long felt—viz., something more powerful and expeditious than hand-machines, and something less ponderous and costly than those steam-machines hitherto brought out. During the past six years fifty-four of them have been made; seven are in use on the Thames Embankment, and Mr. Brassey has five in operation in Galicia.

PERPETUAL MOTION CLOCK.

One of the wonders of the New Zealand Exhibition of Works of Art and Industry, opened at Dunedin early in February last, was a Perpetual-Motion Clock, in which there is no deception. The workmanship and the secret of the invention both belong to a Mr. Beverley, a watchmaker long resident in Dunedin. The clock has nothing recondite about its appearance; extreme simplicity indeed is its characteristic. An oblong case, the upper half of which is glazed and the lower boxed in, stands on end, and supports the works within it; and there is no apparent opening. A dial of the ordinary kind, a singular-looking but not novel "torsion" pendulum, three little weights, balancing one another on what seems an endless chain passing over two wheels, and a single upright attached by way of support and passing down into the boxed part of the case below,—these are all the parts visible. The inventor does not make a mystery of the principle; he has had a clock openly going in his house for the last fifteen months without being touched, and there seems no reason why it should not continue to go as long as the material may wear. The alternations in temperature of the atmosphere are applied to create motion, which is applied to work always in the same direction, winding-up the weight, whose gravitation keeps the clock going. The principle of Mr. Beverley's clock is, of course, the principle of the thermometer, the invention of which, by Debbel, the Dutch astrologer, was regarded by that singular genius as "one of perpetual motion." So, at least, it is asserted in Poggendorff's *Annalen*.

A NEW CLOCK.

At the meeting of the Society of Natural Sciences of Versailles, M. Jeannon has presented a clock, which requires to be wound but once a year; and it appears that he could construct it to go for a much longer period. He does not change the mechanism; the pendulum is merely replaced by a horizontal lever, which is made to oscillate by the torsion of an elastic metallic wire suspended vertically. In the clock he presented to the Society, the lever makes one oscillation in six seconds; by varying the dimensions of the lever and of the elastic wire, the length of the oscillation is changed. The simplicity of the contrivance is said to exceed anything hitherto known.—*Scientific Review.*

ON CHAIN-PROVING.

Sir W. G. Armstrong has read to the British Association a paper consisting of a description of the principles involved in the apparatus for testing cables, recently established at Birkenhead by the Mersey Harbour Trustees, the construction of which was entrusted to the engineering firm of which Sir William is a member. The hydraulic press, he said, had been for many years the appliance universally employed for exerting the testing strain, and nothing could be better fitted for the purpose; but the method for determining the amount of the strain had been extremely imperfect. Most commonly, the strain had been estimated by the indications of a mitre valve pressed down by a lever and weight. This mode of indication, Sir William said, was highly delusive; and he pointed out the advantage of substituting a packed, loaded plunger for the loaded valve. The packing, he said, should consist of cup leather, and the friction should vary directly as the pressure. When a chain broke in the test, it was desirable to show not only that it failed to bear the full test strain, but also what was the amount of strain exerted at the moment of fracture. Various indicators on the principle of those commonly used for steam-pressure had been used in the Birkenhead machine for this purpose, with unsatisfactory results. The pendulum indicator had since been brought into general use. In this indicator the pressure upon the indicating plunger was exhibited by the travel of a pendulum through a graduated arc. The movement was communicated from the plunger to the pendulum through the medium of a compound lever. When a chain broke, the pendulum fell back until stopped by a ratchet, but left a marker at the exact point on the scale attained by the pendulum. Having spoken of the effect of friction on the results indicated, the paper proceeded to say that in the arrangement of a public chain-testing establishment, it was desirable that the apparatus for the various operations should be placed in such succession as would allow the chains to move from process to process without any retrogression. The paper then proceeded to a description of the Birkenhead establishment, in which the machines are adapted to cable lengths of fifteen fathoms,—the Board of Trade having recently fixed upon that length as the limit of length of chain to be tested at one time. Sir William approved of this restriction as to length; and, having pointed out the objections to testing chains in greater lengths, he gave his opinion in favour of the action of the Board of Trade.

A NEW COTTON GIN.

MR. E. A. COWPER has read to the British Association a paper descriptive of "A New Cotton Gin for separating the Fibre from the Seed." The writer said that though undoubtedly the fibre could be taken off the seed by the finger and thumb in the best possible manner, and no doubt was so taken off in olden times, the process was so slow that a man could do no more than one pound weight of cotton per day. After describing the machines previously in use, the new machine was detailed. This gin is composed of a roller having strips of leather on its surface at intervals, and strips of pointed surface between them; the roller revolves continuously, and there is a blunt steel blade which is caused to approach the roller, and recede from it, at intervals, by means of eccentrics which also move it up and down both in the direction of the surface of the roller, and in the opposite direction; in addition to this roller and blade, there is a vibrating beater to push off the seeds, this last action being very similar to the motion of the beater in a M'Carthy gin. The eccentrics are on a small crank-shaft that moves the beater, and which has a pinion on it driven by a wheel on the roller shaft This gin differs from all others in its complete intermittent action, and it also acts on an entirely new principle, viz., that of nipping fast hold of the cotton fibre close up to the seed (just as it might be taken fast hold of by a person's finger and thumb) whilst the seed is separated.

The steel blade recedes from the roller when fibre is entering, and then nips upon it and holds it fast close up to the seed, whilst the beater pushes off the seed. In consequence of the fibre being thus locked fast in the jaws, it has been called the "Lock Jaw Gin," one side of its jaws being formed of the strips of common leather on the roller, whilst the jaw on the other side is formed of the blunt steel blade caused to approach the leather surfaces when nipping, by means of eccentrics. This machine (manufactured by Messrs. Parr, Curtis, and Madeley, of Phœnix Works, Chapel-street, Manchester) does its work so effectually and quickly that it gets through several times as much work as a common "M'Carthy Gin" can, and many times as much as an "Indian Churka," and at the same time gives a decidedly increased length of staple from a given sample of cotton. This new principle of action in separating cotton fibre from seed promises to cause as great a change and improvement in ginning cotton as Heilmann and Lister's invention did in the combing of wool. The new machine, it is anticipated, will tend to great improvement in the growing and packing of cotton, as the machines are adapted for use on the cotton fields.

IMPROVED SPINNING MACHINERY.

MR. JOSEPH SMITH, of Bradford, has made certain Improvements in Machinery or Apparatus for Spinning and Winding Wool or other fibrous materials on to spools and tubes; the objects being to prevent the unravelling of the worsted or other material, and to obtain a better drag or tension upon the yarn or thread while being wound upon the spools or tubes in what are called cap-frames. The invention consists in screwing or otherwise attaching to the outside of the ordinary cap a ring of metal, or other material, by preference conical. The yarn, on its way from the delivery rollers to the spool or tube, travels round the bottom of this ring; and by raising or lowering the ring on the cap, the inventor regulates the tension or drag upon the yarn, and, if necessary, as for coarse threads, prevents friction upon the edge of the cap. For fine threads he sometimes reverses the position of the ring—that is, he places the small end downwards to reduce the extent of surface exposed to the yarn. The ring also prevents the yarn rubbing against the side of the cap, and becoming wound thereon, whereby breaking of the yarn is avoided; or the yarn may be prevented winding on the cap by a wire fixed round the cap. Instead of the movable conical ring he sometimes casts or fixes a circular rib or projection on the cap. The invention also consists in contracting the entrance or mouth of the cap about 3-16ths of an inch, by fixing a ring or projection in the mouth or otherwise, to prevent the thread revolving against the inside of the cap. Sometimes this ring or projection, and the outer ring, are made in one piece—that is, the inner ring or projection is made with a broad *flange below the cap to* take the place of the outer ring, the inner ring or projection in this case being screw-threaded externally, in order that it may be screwed up and down a female thread in the cap, to regulate the drag.—*Mechanics' Magazine.*

STITCHING MACHINE.

MR. J. M. CLEMENTS has described to the British Association a Machine for Stitching Button-holes. The paper stated that the almost universal adaptation of the sewing-machine to manufacturing as well as domestic purposes, had given rise to a demand for a machine for working button-holes, most of the large manufacturing clothiers in England, and the shirt-makers of Belfast, and other towns of Ireland, having for several years expressed their desire for, and a great want of such a machine. Having noticed the various attempts made to produce a botton-hole stitching-machine, the paper described that introduced to notice by the writer, and proceeded to point out that it could be applied, not only to fine work, but also to heavy work, such as sail-making, railway sheets, or carpet-making. The machine would work sixty or seventy holes per hour, both sides alike, and with a knot-stitch. The arrangements cannot be described intelligibly without inspection of the machine.

BANK-NOTE PRINTING MACHINERY.

MR. THOMAS GRUBB has described to the Institution of Mechanical Engineers the Bank-note Printing Machinery of the Bank of Ireland, the process of which is as follows:—

In the manufacture of bank-notes, while the printing has usually been accomplished from engraved plates as affording a better protection against fraudulent imitation, the slowness and consequent increased expense of this manner of printing as compared with ordinary type on surfaced work have led, in some instances, to the advancement of the finer protective process. Any attempts, however, to abridge the labour and time of the operation, by making the engraved plates by means of machinery, appear to have failed entirely previous to the construction of the machine which was the subject of the paper. The process of printing from an engraved plate might be considered as divided into three separate portions—namely, first, the making of the plate; second, the wiping of the plate; and third, the taking of the impression, including the laying and removing of the paper. All these were usually performed by hand, except the actual taking of the impression by the press, and each of the three operations occupied about the same time in performance, in consequence of which all the operations were arranged to be proceeded with simultaneously. The machine consists of a horizontal polygonal prism of 20 sides, on ten of which are held the engraved plates from which the notes are to be printed. These ten engraved plates are held in position in dovetails formed by ten plain plates screwed on the ten intermediate sides of the polygon. The plates and polygon are maintained at the proper temperature for working by steam admitted inside the hollow polygon through the back bearing. In the ordinary rate of working, each impression occupied ten seconds, and the polygon is held stationary during eight seconds of the time, and during the remaining two seconds it is turned round through one-tenth of a revolution, so as to bring the next engraved plate to the top. *During the eight* seconds in which the polygon is stationary the undermost *plate is inked by the* machine that the uppermost plate has been printed from, and that plate has the wiping of its surface completed. The machine requires two attendants, one to lay the paper and remove it after being impressed, while the other gives the final wiping by hand to the surface of each plate as it comes into the proper position. The greater portion of the superfluous ink is wiped off the machine, thereby lessening the final labour of the working by hand. This is done by means of a roller covered with cotton cloth.

Mr. Grubb also described several contrivances producing the respective actions of the machine, the principal of which are the apparatus for locking and turning the polygon, and for the motions of the printing roller and inking apparatus.

SOLID-BRICK MACHINES.

THAT brick machinery has not yet been brought to perfection seems evident from the great variety of inventions, each intended to supersede all others. First we had the moist-clay machines, requiring softening before manufacture and drying after it. Then we have had the dry-clay machines, requiring previous drying of the clay, but obviating the subsequent drying. The Solid-brick Machinery appears to be an improvement on both of these. In this machine (Oates's patent) the clay is used of such a degree of dryness as to allow of its being mixed up and macerated and compressed into bricks by a single continuous action, the clay being formed into a continuous column and compressed into the moulds by the action of a revolving vertical screw. The clay requires generally no previous preparation beyond that given by the ordinary crushing-rollers, and is sometimes ready for putting into the machine direct from the pit; in other cases, where containing a mixture of stones, it is first passed through a pair of crushing-rollers.—*Mechanics' Magazine.*

PUDDLING BY MACHINERY.

AT the annual meeting of the Institution of Mechanical Engineers, in Birmingham, a paper has been read upon "Machine Puddling," by Mr. Menelaus. The author had in the room a bloom of iron in the condition in which it left the furnace, and which weighed 5 cwt. As it lay upon the floor it looked like a huge iron egg, and near to it were specimens of the same iron in a finished state. There were also diagrams, not only of the furnace in question, but also of the various descriptions of furnaces which contemplated the stirrings of the molten iron in the ordinary puddling furnace with a "rabble," or puddler's tool, moved by machinery, so as to imitate manual labour. Mr. Menelaus said that he had thoroughly satisfied himself of the practical value of the invention; and the Dowlais Company were then engaged in laying down works, in which eight of those rotating furnaces could be kept in operation in the production of an unexceptionable quality of finished iron. The quality of the bloom and of the iron in the finished state, which had been rolled from other blooms made in the furnace, was pronounced excellent. Every such furnace as that now used at the Dowlais Works can easily produce 60 tons of iron a week. It is said that by the use of the rotary furnace the expense of production will be diminished, as compared with the cost of iron made by hand labour, at the same time that the quality is improved.

CAST IRON AND STEEL.

At a meeting of the Paris Academy of Sciences, M. Jullien has contributed "New Facts on Cast Irons and Steels." He adopts Karsten's views of the constitution of cast iron, steel, and alloys, but modifies them by asserting that metals do not combine with one another, but one metal dissolves in another. His object was to demonstrate—1st, that metals do not combine with each other; 2nd, that iron does not combine with either carbon, silicium, or nitrogen; and 3rd, that a mixture of hydrate of lime and dry hydrated sulphate of soda presents all the characters of a solution, but none of those of combination. M. Jullien then gives his ideas on the constitution of irons and steels. Liquid cast iron, he says, is a solution of liquid carbon in liquid iron. Soft steel is a solution of amorphous carbon in either amorphous or crystallized iron. Grey pig obtained by casting in hot moulds or sand, is a mixture of graphite and steel, the components, iron and carbon, being both in the amorphous state.—*Mechanics' Magazine.*

The Royal Academy of Sciences of Brussels has awarded its Gold Medal to M. Caron, for an Essay embodying the results of his extended and laborious researches with respect to the constitution of steel; and that profound chemist, M. Stas, has expressed his "entire concurrence" in M. Caron's conclusion that "iron, in passing into the condition of steel, does not take up any nitrogen in addition to that which it originally contained."

BESSEMER'S CAST STEEL.

Mr. Bessemer has read a paper to the British Association "On the Manufacture of Cast Steel, its Pureness, and Employment as a Substitute for Wrought Iron." The author detailed the history of the invention and its various processes. There are now 17 extensive Bessemer steelworks in Great Britain. There are at present, erected and in course of erection, in England no less that 60 converting vessels, each capable of producing from 3 to 10 tons at a single charge. When in regular operation, these vessels are capable of producing fully 6000 tons of steel weekly, or equal to 15 times the entire production of cast steel in Great Britain before the introduction of the Bessemer process. The *average selling price* of this steel is at least 20*l.* per ton below *the average price* at which cast steel was sold at the period mentioned. With the present means of production, therefore, a saving of no less than 6,240,000*l.* per annum may be effected in Great Britain alone.

The operation of casting a cubic block of steel, of the weight of 100 tons, has been successfully accomplished at the new works of Messrs. Bessemer and Sons, at East Greenwich. At Bolton, in Lancashire, a block of steel weighing 250 tons was cast, by the aid of Messrs. Ireland and Son's patent upper-twyer cupola furnace. The cupola furnace lent by Messrs. Ireland and Son for reducing the Bessemer steel to a liquid condition melts at the rate of 13 tons in an hour, and is charged with 3 cwt. of coke to 50 cwt. of metal. It seems that there are about 500 of these furnaces in operation in many parts of the world. The large mass which has been cast at Greenwich will take about six weeks to cool. The liquid metal was poured into the sunken mould—a large square hole, like a tan-pit—in quantities of about 4 tons every twenty minutes, and the entire operation was accomplished between light and dark. This, and another block weighing 57 tons, are to serve as anvils for steel hammers in the new works of Messrs. Bessemer.

IRON MANUFACTURE.

MR. R. T. CRAWSHAY, of the Cyfarthfa Ironworks, Merthyr Tydvil, in conjunction with Mr. C. J. Lewis, has patented what is expected to prove a most valuable method of producing Puddled Bar, or No. 1 Iron, direct from the pig, without recourse to the "finery" process. It consists simply in the introduction into the boiling furnace, at a certain stage, of sulphate of iron and oxide of lead. The oxide of lead greatly increases the fluidity of the slag, and the sulphate of iron acts as a powerful oxidising agent, being decomposed, at the high temperature of the furnace, into sulphurous acid, oxide of iron, and free oxygen. The first of these bodies escapes as gas, the second is reduced by the carbon or carbonic oxide present, and the third combines with the sulphur and phosphorus associated with the iron, and so causes their elimination as sulphurous and phosphorous acids. It is said that a much larger yield is obtained by the new process than by the much more expensive old one, and that the new process enables iron of the very finest quality to be produced from very inferior pigs indeed.

CRYSTALLIZATION OF IRON.

IN a paper addressed to the French Academy of Sciences, M. de Villeneuve-Flayose says, "under the influence of reiterated trepidation the iron of rails constantly gone over by rapid trains assumes a crystalline form; the axles of the wheels do the same, and the places towards which the least coherent particles converge during *this continual vibration become* the points where fracture occurs.

The repeated explosion of gunpowder in the chamber of a piece of ordnance modifies the cohesion of its metallic particles, and at length causes the fracture of the mass." According to M. Kuhlmann, a tenacious fibrous quality of sheet iron, out of which a steam-boiler was made, in a short time became crystalline and brittle by the constant trepidation caused by the evolution of steam.

THIN SHEET IRON.

THE American specimen (which we noticed in the *Year Book of Facts*, 1865) has naturally led to attempts in this country to ascertain the thinness to which British iron can be rolled; and Messrs. Murrall and Stothert, the metal brokers, of Cardiff, are said to have produced some sheets which, it is claimed, surpass the American specimens, both in quality and thinness. The plates are less than the 1000th part of an inch in thickness, and a plate 8 in. by 5½ in. weighs 2 dwts. 14½ grs. only, without the slightest flaw, either at the edges or elsewhere. They are manufactured by Messrs. T. W. Booker and Co., of the Melingriffith Works, near Cardiff, from their celebrated R. G. "tagger" or "button iron," and are one-tenth thinner and lighter than the American plates to which such great consideration has been given. "The thinnest sheet of iron yet rolled in the world" (1000th part of an inch) has elicited numerous competitors in this country. We mentioned that iron had been rolled at Cardiff considerably thinner, and since then, some iron still thinner has been rolled by Messrs. James, of Bilston. A sheet has been rolled from common iron, in the ordinary sheet mills, by Messrs. Robert Williams and Co., of Swan Village, West Bromwich, which is only 1015th part of an inch thick, is very tough, and has a good even surface. Another specimen consists of two sheets, measuring 8 in. by 5½ in., weighing respectively 49 and 49½ grs., and being the 1400th part of an inch in thickness! These marvellous examples of iron rolling were produced by Messrs. Nevill, Everitt, and Co., of the Marshfield Iron Works, Llanelly.—*Builder*.

NEW SAFES.

Mr. J. CHUBB has invented a method of Securing Safe-doors from the application of the professional burglar's wedge. The frame, in place of being made flush as hitherto, projects beyond the door, so that the door will be recessed; and further to protect the door and the keyhole or holes through the door of a strong room or iron safe, a hardened steel bar is applied externally to the door, and from side to side thereof; the bar being fitted within a groove across the door. This bar is of a curved convex form externally, and flat on the side where it comes next the door. At each side of the framing of the door a projecting socket is formed, into which the bar slides after the door has been shut and fastened or locked. In order better to insure that no thin steel wedges shall be introduced, the side of the groove across the door in which the bar is fitted are under cut.

A FEAT IN CASTING.

At a meeting of the Polytechnic Association of the American Institute, Mr. Norman Wiard has described a novel method adopted by him for Casting an Iron Tunnel. When the preparations for casting his great gun were nearly completed, a need was discovered for a broad flat tunnel, some 10 ft. in diameter. Not having conveniences at hand for making it of boiler plate, it was necessary to cast it, and as there was not time to make a pattern he determined to cast it flat, and attempt to shrink it into dishing form as it cooled. He swept an open mould and filled it with molten iron. The centre was first cooled, and as the edges began to harden, levers were placed under opposite sides, and weights were hung upon their ends, tending to pry up the edges while the centre was held down. Thus, the rim was started up a very little, and then as it cooled and shrunk around the previously hardened centre, it arose 10 inches, giving this depth of dish to the tunnel.

GALVANIZED WATER-TANKS.

M. Roux has laid before the Paris Academy of Sciences a memoir on the means adopted for the Preservation of Water on board the Ships of the Imperial navy. The great use of zinc in the galvanisation of tanks and vases has led to numerous interesting chemical researches which have determined the existence of the carbonate and oxide of that metal in the water in quantities quite sufficient to cause injury by the formation of various salts through a combination of zinc with the lactic, acetic, and other acids present in the stomach, furnished by the gastric juice or during the process of digestion. As it was proved that the sulphate, nitrate, acetate, and chloride are all very energetic in their actions (caustic, astringent, emetic, and otherwise), prudence demanded that the use of water containing them should be proscribed; and, in consequence, the employment of galvanised iron as a material for water-tanks was prohibited in the Imperial navy. Recent researches have led M. Roux to recommend that the exterior of the iron tanks should be galvanised with zinc, but that the interior should be tinned, by which the preservation of the vessel and the purity of the water would both be ensured.

PLATINUM MIRRORS.

A process has been patented in France by M. Dode, a chemist, for the manufacture of Platinum Mirrors, which are greatly admired, and which present this advantage, that the reflecting metal is deposited on the outer surface of the glass, and thus any defect in the latter is concealed. The process is very expeditious. A single baking, it is said, will furnish 200 metres of glass ready for commerce. It would take fifteen days to coat the same extent with mercury by the ordinary plan. A reduction of from 40 to 100 per cent. in cost of looking-glass is expected to result from the adoption of this process; for any glass, even the common bottle metal, will serve to be coated. The process is conducted as follows:— "Chloride of platinum is dissolved in water, and a certain quantity of oil of lavender is added to the solution. The platinum immediately leaves the aqueous solution and passes to the oil, which holds it in suspension in a finely-divided state. To the oil so charged litharge and borate of lead are added, and a thin coat of this mixture is painted over the surface of the glass, which is then carried to a proper furnace. At a red heat the litharge and borate of lead are fused and cause the adhesion of the platinum to the softened glass."—*Mechanics' Magazine.*

EMERY.

Dr. Charles T. Jackson, the State Geologist of Massachusetts, has reported the discovery of what he terms an inexhaustible bed of the best Emery in the world, at Chester, Hampden county, in the middle of Massachusetts, and refers to the English saying, "That a good mine of emery is worth more to a manufacturing people than many mines of gold." He states that he discovered the emery while examining a hard rock excavated by the miners, who supposed it to be iron ore. He soon found it would scratch quartz and topaz readily, and that it possessed all the properties of emery. Chemical analysis gave—alumina, 45·50; protoxide of iron, 45; silica and titanic acid, 11·50. Regarding the oxide of iron, which he dissolved out by acids, as accidental, and that which cannot be so removed as an essential constituent, Dr. Jackson thinks that emery must be ranked as a distinct species, and not as a mere granular form of corundum or sapphire.

UTILISING THE HEAT OF THE EARTH.

Sir John Herschel, in a communication to the Literary and Philosophical Society, refers to a paper read by Mr. Greaves, "On the Internal Heat of the Earth as a Motive Power," in which the high temperature of the carboniferous strata at the depth of 4000 ft. (120 deg. Fah.) is spoken of as likely to oppose an insuperable obstacle to the extraction of coal from that depth. "On reading this it occurred to me (says Sir John) that by employing condensed air, conveyed through conducting pipes, as a mode of working machinery at that depth—provided the air immediately on its condensation, and before its introduction into the pit, were drained of the heat developed in the act of condensation by leading it, in pipes exposing a large external surface, through a sufficiently large supply of cold water (or in winter time of snow)—the workings below might be sufficiently reduced in temperature by the re-expansion of the air on its escape, when given out below in the act of working the machinery, to admit of workmen remaining there in comfort; at the same time that ventilation would be supplied. Water at 120 deg. Fah., or even much higher, would, I fear, afford but an inefficient moving power unless some means could be devised (without the expense of more power than the gain expected) of concentrating the heat of a large quantity of warm water into a smaller. This might perhaps be done through the intervention of air alternately rarefied and condensed."

Mr. Binney, F.R.S., F.G S., said that at the present time little is known as to the difficulties we should experience in working coal mines at a depth of 4000 ft. from the surface. The exact increase of temperature in deep mines is not by any means well ascertained. All we can say is that no great difficulties have been found in working at a depth of 2100 ft. It must always be borne in mind that the deeper a mine is the greater will be the natural ventilation, that is, the current caused by the air of the mine, at say a temperature of 80 deg. Fah., ascending the upcast shaft, while the air at the surface, of 40 deg., descends by the downcast shaft. No doubt a mine might be cooled by the expansion of compressed air, but it could not, so far as at present known, be done economically. In most deep mines a considerable cooling of the air takes place by the expansion of the compressed gas (light carburetted hydrogen) as it escapes from the coal, where it has been long imprisoned under great pressure; and this has not always been allowed for by observers of temperature in such places. In newly-opened mines this pent-up gas forces off large pieces from the face of the coal, and it sometimes makes a noise like water rushing over a weir. In sinking a deep shaft at Wigan some years since, the compressed gas in the coal forced up about four yards of strong bind and made its way through it into the shaft. The rising of the roof of the coal as the shaft approaches it is well known to sinkers in deep and newly-opened coal fields.

MECHANICAL EFFECTS OF HEATED AIR.

M. Babinet has communicated to the Paris Academy of Sciences an account of experiments by M. Mouchot, Professor of Mathematics at Alençon, on the Mechanical Effects producible by Confined Air heated by the rays of the Sun. In these experiments M. Mouchot employed a cylindrical vessel of thin silver, blackened on the outside, and enclosed within two cylinders of glass, placed one inside the other. The office of the glass cylinders, of course, was to prevent the heat which might pass through them to the blackened silver cylinder being radiated back again,—glass, while affording a free passage to the direct rays of the sun, being practically opaque to radiant heat. The silver cylinder was half filled with water, and an airtight cover was then fitted on it; a tube, fitted with a stopcock, passing vertically through this cover to very nearly the bottom of the vessel. Thus arranged, the apparatus was placed in the sun, whereupon the air in the upper part of the vessel speedily became heated sufficiently to cause it to exert so much pressure on the water under it, that the latter, on the stopcock in the tube passing through the cover of the vessel being opened, escaped in a jet more than ten mètres high. This very remarkable result led M. Mouchot to construct an apparatus on the same plan which yielded a continuous jet of water as long as the sun was shining on it. M. Babinet is of opinion that machines on this principle might be found useful for raising water on the great scale in tropical countries.—*Mechanics' Magazine.*

HEAT GENERATED BY MECHANICAL POWER.

SOME of the French scientific journals are seriously discussing a proposal for employing Mechanical Power to Generate Heat, for certain practical purposes—thus reversing the usual order of things. The author of one proposal is M. Pelon, who calls his machine a "Thermo-Générateur." He makes a wooden truncated cone, covered with hemp, revolve inside a hollow copper cone, the hemp-covered wooden cone being made to press forcibly against the interior surface of the hollow copper cone. The iron axis of the wooden cone is made hollow, in order that it may be filled with a lubricating liquid; and there are a number of channels made through the substance of the wooden cone by means of which this lubricating liquid can pass from the interior of the hollow axis to the surface of the cone. The whole is enclosed in a metal vessel, of cylindrical or other shape, in which is placed the substance to which it may be desired to communicate the heat generated by the friction between the surface of the wooden cone and the inner surface of the copper one. The model which the inventor exhibits is applied to keeping chocolate hot, but it is for heating air, under certain circumstances, that he considers that his machine will be most useful. When applied to this purpose, the space between the exterior surface of the copper cone and the interior surface of the vessel in which the whole is enclosed, is so divided as to cause the air to pass spirally, many times, round the copper cone; and the air emerges at a temperature dependent upon the size of the "générateur," the speed at which the wooden cone revolves, and the rate at which the air passes through. M. Pelon thinks that, in the case of factories worked by water power, his apparatus would be found more economical than any kind of fuel as a means of warming the workshops, and supplying drying-rooms and the like with currents of hot air; and he urges that it is also well adapted for warming railway-carriages in cold weather. He would have a "générateur" of moderate size placed outside each carriage, and connected with one of the axles of the carriage in such wise that the rotation of this axle should cause that also of the wooden cone of the "générateur," and would so arrange that air heated by the "générateur" could be admitted into the carriage at the will of the passengers. *Cosmos* states that the feasibility of this plan has been fully attested by experiment, and that it has been found that *the cost of warming* by this method a train of forty carriages *is simply that of* the exertion by the engine of an extra two-horse-power.—*Mechanics' Magazine.*

NEWTON'S HEATING AND EVAPORATING APPARATUS.

MR. A. V. NEWTON, of Chancery-lane, has patented a novel arrangement of apparatus which when applied to the generating of steam ensures an efficient circulation of the water, prevents the incrustation of the heating surfaces, and allows of the superheating of the steam before leaving the apparatus. The heating surfaces employed are rows of tubes contained within furnace walls, and pendent from horizontal metal channels or chambers, which are supported by the walls. The apparatus is divided into three compartments by transverse walls. In the first compartment, which is the steam generating compartment, a furnace grate is fitted immediately below the pendent pipes to receive the fire for heating the fluid to be evaporated. At the upper part of the division wall is an opening to allow of the flame and gases of combustion entering the second compartment in which the feed water is heated; and at the lower part of the second divisional wall is an opening through which the gases of combustion pass to the third compartment where the superheating of the steam is effected.—*Mechanics' Magazine.*

NEW SYSTEM OF SMELTING.

A NEW and successful System of Smelting has recently been tried at Messrs. Woodward's, Queen's Foundry, Ancoats. A cupola was exhibited, to produce the blast in which, on the old method, a 4 ft. fan, requiring eight horses' power, was employed. By the new method, invented by Messrs. Woodward, that fan and all its usual accompaniments of shafting, strapping, oil, and wear and tear have been dispensed with. The new cupola is 2 ft. 4 in. diameter, and of the usual height. At its upper portion, immediately above the part where the charge is put into the cupola, a steam pipe, 1¼ in. bore, is inserted into a wrought-iron chimney, about equal in length to the depth of the cupola below. The action of the jet of steam thence projected is to create a partial vacuum below it, and, as a consequence, a strong draught of air through the mass below.—*Mechanics' Magazine.*

MISCHIEVOUS EFFECTS OF STOVES.

AN account has been presented to the Paris Academy of Sciences by M. Carret of a new epidemic which has made its appearance in Savoy, and which has been ascribed to the production of carbonic acid by the cast-iron stoves that have recently come into use there. It prevails only in winter, and is more fatal and more widely spread in proportion as the latter is severe and premature. In its choice of localities, it differs from most other epidemics, preferring mountainous districts; and it does not spare localities usually considered salubrious. Persons following sedentary occupations are the first attacked by it; those whose labours employ them out of doors enjoy an immunity from it.

That it is due to the use of Stoves, appears to admit of but little doubt; although it is not easy to understand why these, which are in many countries—North America, for example—in such general use, without producing any injurious effects, should be found so injurious in Savoy. Perhaps the mischief is prevented by evaporation from the vessel of water which is almost always placed on the stove. It appears certain, however, that the malady is prevalent in any locality in proportion as stoves are used there, and it is not to be found, in any case, where stoves have not been introduced.

This subject is considered of great importance in France, where stoves are so common. M. Regnault, however, took the opportunity of directing the attention of the Academy to certain points connected with the subject. He remarked that the unhealthfulness of cast-iron stoves has been ascribed to that compound of carbon and iron having, when heated to redness, formed carbonic oxide; but he had ascertained that in such cases it is carbonic acid that is produced, and in a quantity which is utterly insignificant, since cast iron contains only 3 or 4 per cent. of carbon; and he found stoves which had been in use many years to have lost only a minute portion of that element. He asserted, therefore, that the cause of the unhealthfulness of stoves must be looked for elsewhere; and he attributes it to the want of proper ventilation, which is especially necessary when they become heated to redness, and thus decompose, though incompletely, the dust derived from organic matters, animal exhalations, miasmata, &c., that come in contact with them, producing volatile products which, if they remain in the apartment, are injurious to health. M. Chevreul agreed in opinion with M. Regnault.—*Scientific Review.*

THE COPPER SMOKE QUESTION.

For many years past the subject of utilizing or neutralizing the effects of the obnoxious Copper Smoke has received much attention from practical chemists and the smelters engaged in the trade. In the neighbourhood of Swansea, where there are large copper works, the effect of the smoke is such that vegetation is completely destroyed for miles around, and the result is that the copper smelters have to pay enormous sums of money as compensation for the land that is thus rendered valueless. Various remedies have been attempted to neutralize the poisonous effects of the smoke, such as high stacks, conductors, condensers, &c., but only a limited degree of success has been attained. It is well known that the smoke possesses some valuable properties, which, if separated from the other ingredients, could be utilized and made profitable, and nearly all the inventions proposed have had these objects in view, but hitherto, as already stated, the attempts made have ended in failure. Messrs. Vivian and Sons, the extensive copper smelters, have determined to adopt the patent of a German chemist, and Mr. H. H. Vivian, M.P., the senior partner, has stated publicly that he believes, after a careful investigation, that the invention will prove completely successful, and that it will enable the firm to make 1000 tons per week of sulphuric acid from the copper smoke, which is now not only of no value, but a source of great loss, owing to its injurious effects on the surrounding vegetation.

TORBITE, A NEW PREPARATION OF PEAT.

MR. D. R. CLARK has described to the British Association the system pursued at Horwich, near Bolton, for the manufacture of Torbite and Charcoal from Peat. The obstacles hitherto to treating peat for the manufacture of fuel were shown to consist chiefly in the difficulty of separating, at a moderate cost, the excessive proportion of water held in suspension by peat in its natural condition, in consequence of the uncertainty of the climate and the great amount of hand-labour employed, and in the impossibility of efficiently condensing and solidifying peat by mechanical compression, which has been the agency relied on for that object. The author then explained that, according to the Horwich system of treatment, compression by mechanical force in any manner is studiously avoided; and that, on the contrary, advantage has been taken of the natural property of peat, suitably prepared, of contracting as it parts with its moisture, and becoming perfectly solid and cohesive. To separate the water, the peat travels upon endless bands, within a close chamber, exposed to currents of heated air, by which the moisture is effectually extracted; the blocks of peat being turned up on all sides in succession, so as to be equally and regularly dried, and emerging dry, hard, and dense. To the peat substance thus prepared the name of "torbite" has been given; and it was stated that it could be delivered at a cost of from 10s. to 12s. per ton. In the subsequent stage, the conversion of the torbite into charcoal, it was pointed out that the fatty and other matters disengaged during the charring process were valuable commercial products, the sale of which alone would nearly cover the cost of the whole process. Some experiments were described, proving the suitability of torbite and its preparations for purposes of generating steam and smelting iron ore, and in the other stages of the manufacture of iron. It was contended, therefore, that the problem of the probable utilization of peat had at last been solved. It was stated, in conclusion, that the bogs of Great Britain and Ireland cover an area exceeding 5,000,000 of acres, the average depth of which might be taken at 20 ft.; and that the benefits of the utilization of peat on the large scale, particularly for Ireland, could scarcely be over-estimated from an industrial point of view.

VENTILATION.

THE vexed question of Ventilation, which has for some time past occupied the attention of the French Government, has been lately brought before the Academy of Sciences by General Morin, with a plan for introducing fresh air into the upper part of public buildings without raising the temperature by heating apparatus, which is a method unsuitable for summer, when a great heat is required to raise the interior temperature above the exterior. The General described experiments, some of which had been conducted at the Conservatoire des Arts et Métiers with the following processes:—1. The air was cooled by being made to pass through water in a finely divided state. 2. The air was made to come into contact with the walls of metallic reservoirs filled with cold water. 3. The providing numerous proportional orifices for the natural admission and ejection of air by means of cast-iron chimneys. 4. As soon as the new water-supply system for Paris is in action the General proposes the adoption of a method for producing a species of artificial rain for cooling the roofs of public buildings in the summer season. For further details, and some remarks by the eminent chemist, Dumas, we must refer to the *Comptes Rendus*, vol. 61, No. 5.

BRITISH LIGHTS AND LIGHTHOUSES.

The Lights on land, or Lighthouses which are at the highest elevation, with the distances they command in clear weather, are given in the following Table, compiled from the general return published by the Admiralty:—

	Year when erected.	Height of Lantern above high water.	Distances at which the lights are seen.
Lizard	1751	224	20
Needles	1786	469	27
Beachy Head	1828	285	22
South Foreland	1793	372	25
Cromer	1719	274	22
Flamborough Head	1806	214	19
Inchkeith	1804	220	18
Isle of May	1816	240	21
Dunnet Head	1831	346	23
Sumburgh Head	1821	300	22
Cape Wrath	1828	400	25
Barra Head	1833	680	32
Kintyre	1787	297	22
Mull of Galloway	1830	325	23
Calf of Man	1818	375	22
St. Bee's Head	1718	333	23
Lundy Island	1820	540	30
Cape Clear	1817	455	27
Clare Island	1806	349	27
Skellig's Rock	1826	372	25

GAS-LIGHTING.

Dr. Letheby, the gas analyst for the City of London, in his quarterly report to the Commissioners of Sewers on the illuminating power and chemical quality of the Gas supplied during three months, from which it appeared that 656 examinations have been made during the quarter, and the results are that the mean illuminating power of the Great Central Gas has been equal to that of 14·23 standard sperm candles; that of the Chartered, 14·33 candles, and that of the City Company, 14·19 candles. The range of power had been from 12·52 candles to 16·98, so that the illuminating power had not on any occasion been below the standard of the Act of Parliament. With respect to the chemical quality of the gas, he reported that the gas supplied by the City and Great Central Companies had always been free from ammonia, but that the gas of the Chartered Company had been always highly charged with it; and as regards the proportion of sulphur in the gas the weekly averages of the City and Chartered Companies had rarely shown an excess of this impurity, but the gas of the Great Central Company had always been overcharged with it; while, for example, the quarterly average of the City gas had been but 18·7 grains, and that of the Chartered 19·58 grains, the proportion in the Great Central Gas had been nearly 26 grains. The maximum amount in the City gas had been 25 grains, in the Chartered 26·3 grains, and in the Great Central 32·1 grains. Lastly, he reported that the gas of all the Companies had always been perfectly free from sulphuretted hydrogen, and that the average pressure of the gas had been equal to that of rather more than an inch of water.

The Rev. Mr. Bowditch's apparatus for improving Gaslight is attracting attention, and it has been tried with satisfactory results by experimentalists in different parts of the country. Briefly, the apparatus may be described as a tight metallic vessel, containing oil, or naphthalin, or whatever hydrocarbon may be used. The gas enters by one opening, passes across the surface of the liquid, takes up its vapour, and escapes by another opening to feed the burner. As the flame is placed below the vessel or holder, the contents are vaporised; hence the passing gas finds material already prepared for enriching the light. The amount of improvement is remarkable; for, with the addition of about thirty grains only of naphthalin vapour to one foot of gas, the light is increased seven or eight times. With oil, the result is lower, not exceeding from four to five times; but even this is an important gain. Mr. Bowditch has made numerous experiments at his residence at Wakefield, and among the practical conclusions which he has worked out, the following may be selected as highly satisfactory—namely, that with his apparatus, one gallon of oil worth 2s. will produce with 1000 ft. of coal-gas such as is used in London more light than would be given by 4000 ft. of gas; the cost being in the one case 6s. 6d., in the other 18s.

Down to the present time, most of the railway companies, so far as they have adopted the use of Gas at all in their carriages, have preferred the gas-bag system, of which Mr. Newall's is one variety. India-rubber bags are made like the bellows of accordions and concertinas, which close gradually by their own weight, and expel the gas by closing. When filled to inflation, the bags can be placed in any part of the *train of carriages*, or in a compartment of the break-van—the latter being the place most approved. When in the break-van, service-pipes run along the roofs of the carriages, with india-rubber tubing and union joints from carriage to carriage. Bracket-burners, attached to the service-pipes, descend through the roof. Of course, the bags can only contain a limited supply of gas, and require to be replenished at intervals. To effect this, the gas is admitted to a large receiver, supplied with inlet and outlet pipes and stop-valves. The gas is forced out of the receiver by the pressure of thirty feet head of water, and passed through hose into the bags, which are placed in a convenient position to be filled; a stop-valve being quickly turned when the bag is full. This system is more adapted for short than for long journeys, seeing that the bags become collectively very bulky. An ordinary railway-carriage burner consumes three cubic feet of gas per hour. Hence a long train—say a mail-train from London to Edinburgh with gas-lights in all the compartments of all the carriages—would require a formidable amount of bag-room to supply the light.

Mr. Dalziel, in a paper read before the London Institute of Foremen Engineers, has pointed out the reasons which had led him to adopt a plan in which gas-bags are dispensed with. The bag-system he deprecates, (1) because the bags necessary for a long journey would occupy too much space; (2) because the gas is likely to injure them; (3) because the water in the receiver affects the illuminating power of the gas; and (4) because air, if it finds admission in a certain ratio to gas, renders the gas explosive. He thinks there ought to be a vessel provided in the train that would carry a large amount of gas in a small space, in a highly compressed state. Some years ago, gas was supplied to London shops and houses by the "High-pressure Portable Gas Company," by whom the gas was sent in carts in strong iron vessels. The plan failed, not for want of due compression, but because the emission at the burners was fitful and unequal. Mr. Dalziel's plan is intended to remove this inequality; and carriages have been supplied by him to the South Eastern Railway, to test its validity. There is a high-pressure iron vessel, about 8 ft. long, containing gas at 135 lb. pressure on the square in.; and this will supply two burners for 16 hours. The vessel is laid along the bottom of the carriage, and is filled with gas by a force-pump worked by steam; there is an outlet pipe to a regulator, which supplies the burners equably and steadily. Wherever the system is adopted, every carriage is to have its gas-holder or vessel. The advantages which Mr. Dalziel claims for his apparatus are, that he can carry ten times as much gas in a given space as by the india-rubber bag system; that the apparatus is stronger; and that no air can get in to mix with and vitiate the gas.—*Abridged from Chambers's Journal.*

LIGHTING UNDER WATER.

THE following note on the application of the electric light *(Geissler's tubes)* for Lighting under Water is from the pen of

M. Paul Gervais. Of late years the Electric Light has been used for illumination under water:—

In the Channel and in the Mediterranean attempts were made by means of water-tight receivers of glass, in which works a regulator for bringing in contact carbons made incandescent by a battery, the elements of which are on board a vessel on which the trials are made. The part serving as lantern is sunk under water. In some cases these attempts have been successful, and the light thus produced has been utilised either for submarine works or in fishing, which this method seemed to render more productive by attracting the fish. Yet the use of such apparatus is costly, and the manipulation difficult; moreover the light is in many cases too bright, and, besides, the entire arrangement is liable to numerous accidents, such as, for instance, the spilling of the liquid owing to the motions of the vessel.

There are, moreover, circumstances in which a less brilliant light is sufficient and even preferable. It would, therefore, be useful to construct an apparatus capable of working under water, and such that its total immersion would not stop its working. I thought that these results might be arrived at by means of Geissler's tubes, placing them in connection with an exhausted receiver containing the elements of a battery and a coil for producing the electrical current by which these tubes are made luminous; and M. Ruhmkorff has constructed for me the following apparatus:—Our receiver is a sort of bronze box mounted on four small feet, and the cover of which is made to fit hermetically by means of screws and of a vulcanised india-rubber washer. A ring on the cover serves to suspend the entire apparatus. The exhausted box contains two bichromate-of-potash elements closed in their turn by plates. The poles of the current furnished by the element can at pleasure be connected with the coil, and the induced current, by means of insulated wires, passes through the bottom of the apparatus to a Geissler's tube. This tube, of an appropriate form and filled with carbonic acid, is enclosed in a thick glass cylinder provided with copper armatures, and into which water cannot penetrate. This is the illuminating part of the apparatus.

With this instrument a soft but distinct light is obtained, resembling that which military engineers and miners now use. In some respects it resembles that which phosphorescent animals emit, though it is more intense. It can be seen at a considerable distance, even when the apparatus is worked under water at a depth of several metres. It cannot be doubted that it will attract fish as does the phosphorescence of certain species, and it might also be used to illuminate closed spaces situate below the surface of the water, or for making floating signals. Captain Derouix has seen this apparatus work in the port of Cette last September. In this experiment the apparatus was immersed for nine hours, and it illuminated during six hours under these conditions. The duration of its phosphorescence may be greater. A second trial at Port Vendres also succeeded.—*Comptes Rendus; Mechanics' Magazine.*

METROPOLITAN DRAINAGE.

We quote the following from Mr. Bazalgette's Report of this great work:—"As much as possible of the sewage was to be removed by gravitation; and for this purpose there are three lines of sewers at each side of the river, termed respectively *high*, *middle*, and *low* level. The two former discharge by gravitation, but pumping is required for the third; and for this purpose double-acting rotative beam-engines, with plunger and ram-pumps, have been adopted. The three lines north of the Thames unite at Abbey Mills, on the east of London, where the contents of the low level sewer are pumped into the upper level. The three south of the Thames unite at Deptford Creek, where, in the same way, the contents of the low-level sewer are pumped into the upper. At the Abbey Mills station—the largest in the works—engines, collectively, of 1140 horse-power are used. They are guaranteed to raise 80,000,000 lbs. 1 ft. high, with 1 cwt. of Welsh coal, and are to lift 15,000 cubic ft. 36 ft. high per minute. For this purpose 9700 tons of coal per annum will be required; but all of this is not to be considered as an additional outlay consequent on the new drainage system, since it had previously cost 30,000*l*. per annum to remove deposits from the stagnant sewers. Besides, drainage by pumping was equivalent to raising a low and unhealthy district a height of 20 ft., to the great improvement of the public health. At the Deptford pumping station, engines, collectively, of 500 horse-power are used. They are to raise 10,000 cubic ft. of sewage 18 ft. high per minute. Engines of equal horse power are used at the Crossness reservoir. The total pumping power is 2380 nominal horse-power, with an estimated consumption of 20,000 tons of coal per annum."

The details and difficulties of the works are fully described; and it may be here remarked that the northern outfall sewer exhibited, perhaps, the most striking peculiarity. It is raised above the surrounding neighbourhood, on an embankment, which is sufficiently strong to carry a road or railway on the top, should such be required; and its construction presented special difficulties, as the district was already intersected with railways and other public works. The total cost of the main drainage undertaking would be about 4,100,000*l*.

NEW ARTESIAN WELL, AT PARIS.

The interesting work of the boring of the Artesian Well at the Place Hébert (eighteenth arrondissement) continues actively, in spite of the enormous difficulties met with at almost every step. The first 72 ft. of the shaft are lined with masonry; then succeeds wrought-iron "tubbing," in sections 6 ft. 7 in. in diameter, and 3 ft. 3⅝ in. high, forced in by screw pressure. When this lining had been carried down through thirty-six beds of different strata, a zone of sand was reached, mingled with such a quantity of water that it was almost in a fluid state. This dangerous sand might have been traversed by driving the tubbing with extreme precaution, had it not been for another obstacle which presented itself. It was found that the under-currents of water had actually driven the tube out of the perpendicular. To obviate this was impossible, so that nothing remained to be done but to remedy the defect radically by taking up the tubes altogether, and continuing the masonry lining, which afforded a better guarantee of stability. The cylinders having been removed with enormous difficulty, it was plain that the masonry could not be continued on the ordinary conditions, and that a new method must be devised. This was done as follows: After several yards had been excavated below the existing masonry, and the sides properly shored up, a strong cradle of timber, exactly fitting the circumference of the well, was lowered and held suspended by stout chains to beams over the orifice of the well. This being done, the masonry was rapidly carried up from the cradle or platform as far as the existing lining, the chains being sealed up in the work.

One section being thus terminated, another space was cleared away; another circular platform was let down, by other chains, and the masonry laid upon it. By this ingenious method, the *calcaire grossier* was at last reached, and a firm footing gained, though not without its share of complicated difficulties. One of the upper platforms of the tier was found to have been crushed by the enormous weight upon it, and it was necessary to replace it by a new one; but, in piercing the masonry all around for this purpose, it was found, with surprise, that a large hollow or bell-shaped cavern was behind the masonry. Fortunately this sort of vault was strong enough to prevent the top-soil from falling in, and to fill up the cavity no less than 700 fascines had to be stowed away. Other obstacles have arisen since the *calcaire grossier* has been reached; the water springs up in such abundance that the two pumps at work are not sufficient, and as there is not room for a third, the sinking of the well by manual labour must be abandoned, and recourse had to the trepan. This boring implement weighs no less than 5 tons, and is composed of six branches, each armed with a steel chisel. At the orifice of the well a space has been cleared 13 ft. square, and 20 ft. deep; this is the sort of chamber in which the various operations of boring will be conducted. It is not expected that the works will be free from unforeseen obstacles till the chalk is reached at an estimated depth of 472 ft., only one-fourth, or 118 ft., being at present gained.—*Builder*.

DRAINAGE OF PARIS.

MR. H. B. HEDERSTEDT states, that up to 1832, remarkable for the ravages of the cholera, there were in Paris only about 25 miles of Drains. The matter was then taken up strenuously, new works were added from time to time, until, in 1863, there were 217 miles. The mode adopted in cleansing the Paris drains is very fully entered into. One contrivance for the purpose deserves a special description. It consists of a boat furnished with a scraper at the bow, which nearly filled the lower portion of the drain. This scraper forms a dam, and the water rising behind it affords a motive power, which pushes the boat forward, carrying the mud along with it. With one exception, no night-soil passes into the drains: it is collected in cesspools, and removed as required. Various unnecessary items of expense were also alluded to, and it was mentioned that about 60 per cent. of the material employed in the drainage works is mortar, or rather, a kind of concrete; but it is very durable, on account of good hydraulic lime being used with it. Latterly, a mixture of stuff dredged from the Seine, mixed with hydraulic lime, or Roman cement, has been adopted.

AMERICAN ICE TRADE.

It is estimated that the associated Ice Companies of New York and Brooklyn began last summer with 600,000 tons of ice in hand. It is supplied chiefly from small lakes near the Hudson, or from the river itself beyond the reach of tide, as at Athens, opposite Hudson, and other places. The largest quantity furnished by any one of these sources is from Rockland Lake, in Orange County—about 120,000 tons annually. With the growth of the business upon the coast it has also spread into the interior, where, especially near the large towns, the gathering of ice has become an important business. The methods of gathering the ice are few and simple, and comparatively inexpensive. When the ice is nine or ten inches thick, or, if for exportation, 20 inches thick, the snow, if any, is scraped off by a wooden cleaner, drawn like a dirt shovel by one horse. A second scraper, armed with a steel blade, planes off the porous upper layer to the depth of three or four inches. The ice is then marked off into squares by a sort of plough drawn by a horse, which cuts a groove some three inches deep. A machine with parallel rows of teeth, some 20 inches apart, is next drawn along the lines already made, one row running in the groove as a guide. This is repeated on the cross lines until the whole area is cut into small squares. A row of blocks is then sawn out by hand, and, being taken out or floated under the others, room is afforded for splitting off the adjoining squares, which is done by an ice-spade dropped into the grooves. The blocks are then floated to the houses through canals cut in the ice, or are hooked up on to sleds and dragged to the place of deposit. They are raised by steam to the top of the warehouses, and thence let down by an inclined plane to the desired point of storage. These houses are from 100 to 200 ft. long and proportionately broad, and calculated admirably for preserving the ice, some of them holding as much as 20,000 tons. One at Athens holds 60,000 tons, two at Rockland hold 40,000 tons each, while all along the shore of the Hudson may be seen these long, low, black houses, stored with ice, windowless, cheerless, and gloomy. The entire cost of cutting and storing averages about 30 cents per ton; but, after the ice is stored, waste naturally follows, and is estimated to amount to one-third, bringing the cost therefore up to 45 cents per ton. Adding the towage and freightage, which average $1 25c. a ton, the entire cost of a ton of pure good solid ice is less than $2. But we are asked to pay $20 for it unless we take 100 lb. a day.—*New York Times.*

NEW ICE-MACHINE.

A machine for the production of Ice on a large scale has been tried at Paris with great success. Its peculiar feature is that, unlike all the machines whose action depends on the circulation of *ether or* ammonia, it requires no pump whatever. Its effect is produced by means of heat, and the circulation of the vapour of amylic ether (oxide of amyle). The latter is obtained, as usual, by the action of sulphuric acid on amylic alcohol, or that derived from potatoes; and it is liquefied by transmission, at a pressure of from five to seven atmospheres, into a reservoir. When a cock is opened, it passes from this reservoir into spiral ducts surrounding the quadrangular reservoirs, which are filled with the water that is to be congealed, and are immersed in a solution of salt that will not freeze. After the ether has been vaporised in the spirals, it passes into vessels containing sulphuric acid, by which it is dissolved. One vessel contains a concentrated solution, which is ready to yield up its ether under the action of heat afforded by the circulation of super-heated steam; a second vessel is ready to absorb ether vapour; the third is in a state of rest, and ready to give up its ether. A machine of this kind, calculated to produce about a quarter of a ton of ice per hour, has been constructed for the concentration of sea-water, for the purpose of extracting its soda, potash, and other salts.—*Scientific Review.*

BOARDS, PIPES, ETC., MANUFACTURED OF PAPER.

COLONEL SZERELMEY is best known in this country as being the most successful among the many competitors for the treatment of the stone decay in the new Houses of Parliament. But he has made it the study of his life, during many years of foreign travel and research, to attain a knowledge of what the zopissa of the ancient Greeks was composed. This is one of the ingredients in most of his compositions. But our main business just now is with the products from his paper pulp, treated and manufactured in a way peculiarly his own. They were shown at the Exhibition of 1862; but, like many other things, they did not then attract the attention they now apparently deserve. He professes to make zopissa paper boards stronger and cheaper by 50 per cent. than oak, indestructible, and perfectly waterproof. They can be made of any length and thickness, and may be cut to any shape, like wood, with a common saw. They will resist a pressure of 250 lbs. to the square inch, or more if required. They are said to be suitable for shipbuilding, the construction of portable houses, roofing, flooring, coach-panels, boxes, piano and packing cases, &c.

The paper pipes, for water, gas, liquid manure, &c., are produced from the same substances as the boards, and have the same properties. They can be made of any length, diameter, and thickness required; and can be constructed to bear almost any pressure to the square inch. They are said to be 50 per cent. cheaper than iron pipes; they are not affected by gas or water; not being porous, no leakage can take place from them; and the material being a non-conductor of heat or electricity they possess many advantages over all other pipes, besides keeping the passing water cool in summer aad unfrozen in winter. Rocket tubes, cartridge cases, large guns, and even houses are to be manufactured of this paper. *Its power of resisting* shot is said to be ten to one greater than that of oak. It can be easily moulded to any form desired. It is capable of being used in mass, without waste, like fusible metal. It is entirely free from moisture; and while any ordinary paper would corrode iron, this can be made to adhere to and form a covering impervious to water over it. It is said that it must eventually be generally used as a covering for boilers, steam tubes, funnels, &c. The raw material, we are informed, is much cheaper than any now in use, and its manufacture simple.

But what strikes us most at the present time—just after a second failure to establish telegraphic communication with America—is the confident assertion of Colonel Szerelmey's friends, well known in several circles, that by the use of this zopissa paper alone, of all the materials at present known, can a perfect electric cable be formed. A rope of less than an inch in diameter, with an ordinary copper wire projecting at each end through its centre, was formed neither of hemp, india-rubber, gutta-percha, cork shavings, nor any ordinarily recommended covering—but simply of zopissa paper. It is almost impossible that it can break; it will not stretch, and thus throw the strain on the copper wire, although it is perfectly flexible. Lastly, it has been reported by some of the most skilled electricians of the day as being perfect in insulation and other respects.—*Times.*

PAPER MOULDS.

THE *Mechanics' Magazine*, in noticing the use of Paper as a material for Sugar Moulds, observes that the moulds used in sugar refineries are sometimes made of clay, sometimes of zinc, or of plated copper, occasionally of glass; but, at least in France, most frequently of sheet-iron, either painted or enamelled. The great disadvantage of such moulds is that the paint or enamel upon them invariably cracks after a time; whereupon, if the defect be not instantly remedied, the portion of the metal which the crack lays bare rapidly oxidizes, causing the mould to deposit upon the sugar spots of rust, which very greatly deteriorate its value. This disadvantage on the part of the moulds in common use led MM. Dufournet et Cie., of Clichy, about seven years ago, to turn their attention to papier-maché as a material for sugar moulds, and it is stated by M. Clémandot, in a paper on "The Industrial Applications of Stiffened Pasteboard," which he lately read before the Society of Civil Engineers of France, that nearly a hundred thousand of their paper moulds have now been in use for nearly six years, without any one of them having required repair. The first cost of the paper moulds is somewhat greater than that of iron moulds; but iron moulds cost an average of a franc and a half each per annum for repairs—so that, to set against the excess of first cost on the part of the hundred thousand paper moulds, is the saving of the nine hundred thousand francs which six years' repairs of the same number of iron moulds would have cost. The paper moulds are still in excellent condition; so that the saving already realized does not represent by any means the full amount of the economy to be effected by their use.

ARTIFICIAL IVORY.

We learn from *Les Mondes* that an Artificial Ivory is made in France by M. Dupré from a simple paste of papier maché and gelatine. Billiard-balls formed of this material, though barely the third of the price of those made from real ivory, are yet so durable and elastic that they can be thrown from the top of a house on to the pavement or violently struck with a hammer without injury. With this same paste, to which the name of Parisian marble is given, among many other things, the finest and most complicated mouldings for ceilings can be made, or capitals of columns can be constructed in any colour, so as to resemble the most valuable marbles.

NEW SYSTEM OF TANNING.

The *Nouvelliste*, of Rouen, states that a new system of Tanning Leather has been invented by M. Picard, which is said to be 50 per cent. less expensive and less tedious than the old mode. The inventor has substituted a mechanical process for the use of bark, and he undertakes to tan a hide in twelve hours, which will last as long as one prepared on the old system. He uses turpentine, which dissolves fat substances, and is a most powerful preservative. This turpentine, he observes, may be procured from the small fir-trees, and the full-grown may be reserved for the Imperial navy. He expects that when the use of turpentine shall become general among tanners an impulse will be given to the plantation of waste lands such as may be found in abundance in the Sologne. He further observes that the process of stripping oak-trees of their bark causes a great loss by retarding the growth of those valuable trees, while the feet of the workmen and the carts employed to carry away the bark cause great injury to the young timber.

LINOLEUM MANUFACTURE.

The manufacture of this new and interesting compound, which threatens to rival the india-rubber trade in the multiplicity and utility of its applications, is based on the invention of Mr. Frederick Walton, whose patents are now worked by the Linoleum Manufacturing Company, at Staines; and 45, Cannon Street West. The word linoleum is derived from *linus* linseed, and *oleum* oil, from which the new substance is produced for the manufacture of ships' blocks, surgical instrument handles, picture-frames, mouldings, veneers to imitate marble, ivory, ebony, and other woods. Combined with emery it forms a grinding wheel, having extraordinary cutting or abrasive power. Very *dissimilar are some of the* uses to which the new substance can be applied. Carriage-aprons, cart-sheeting, sail-covers, reticules, tarpauling, printers' blankets, gas-pipes, telegraph supports, washable felt carpets, table-covers, paints for carriages or for printing floor-cloth, or enamels, of any colour, for enamelling papier maché or metals.

The manufacture has, however, hitherto been chiefly confined to the development of the floor-cloth trade, for which the new material has proved itself well adapted. Linoleum floor-cloth is produced by combining the linoleum with ground or powdered cork, which is rolled on to a stout canvas, the back of the canvas being afterwards waterproofed with a cement or varnish made from the solidified or oxidised oil before referred to. The combined fabric so manufactured is then printed by means of blocks in every variety of pattern, in the ordinary way. The floor-cloth thus produced is pliable, and comparatively noiseless to walk upon. It washes well, preserves its colour, and can be rolled up like any ordinary carpet. Besides being very durable—the component parts being almost indestructible except by fire—it will not decompose by heat or exposure to the sun or air, as is the case with india-rubber. It is, therefore, better adapted than that substance for hot climates.—*Abridged from the Mechanics' Magazine.*

"MAGNETIC PAINTS."

A NEW species of Paint Powders, under this perhaps more *attractive* than chemically correct title, is now in the market. It does not seem to be intended for fine work, but is deemed suitable for iron and wooden bridges and girders, gasometers, railings and fencings, boilers, and such like; and it is said to be composed of iron. The colours are mainly black (as the magnetic oxide of iron is), browns and greens, slate and lead colours, purple, red, and blue. Whatever may be thought of their alleged "magnetic" properties, these paints seem, from testimonials in their favour, to be very economical colours. Thus, in a report, signed "James Edward Ransome," and addressed to Messrs. Ransome and Sims, of Ipswich, we find it is said:—"We took ½ lb. of mixture of white lead and lamp black, and thinned this down with ¼ pint of oil. We took ½ lb. of (Pulford's) magnetic slate-colour, and thinned this down with ⅛ pint of oil. The two colours thus made were of the same consistency and fit for use, and they both covered the same quantity of work. As the magnetic paint is about half the price, in the first instance, and takes only half the oil, in the second, to thin it down, and will then cover as much surface, its cost is just one-half." As to the effect of weather on the paint, the Report does not testify.—*Builder.*

IMPROVED MANUFACTURE OF VARNISH.

SOME attention has been given to the use of acetone in the *manufacture of* Varnish, by M. Wiederhold, according to whom acetone rendered anhydrous by rectification over chloride of calcium readily dissolves cold copal which has been previously heated to the point of fusion. Only 2·8 of acetone are required for 1 of copal, and a copal varnish is thus obtained which dries almost instantaneously, leaving a hard, brilliant, and durable coating. A more concentrated and almost syrupy solution is obtained, without separating any copal, by expelling part of the acetone by distillation. Evaporated to dryness, the remaining copal is more soluble in acetone than when in its original state. The solubility of gum lac in acetone varies according to the species of the gum; 1 part of artificially bleached gum lac required only 1·5 of acetone to form a thick solution like syrup; another, a coloured specimen of gum lac, was almost insoluble; and a third required 3·5 times its weight of acetone to dissolve it. Acetone dissolves with especial facility and in considerable quantities mastic and sandarach; dammar, yellow amber, and india-rubber are, on the contrary, almost insoluble. The solution of acetone and mastic produces a very beautiful and brilliant varnish. M. Wiederhold is of opinion that acetone might be employed for the restoration of oil paintings deteriorated by the alteration of the varnish, which often becomes opaque from the effect of a molecular modification, and which, from a vitreous and transparent state, becomes crystalline or pulverulent. By carefully applying acetone, the opaque varnish may be momentarily dissolved, and will then redispose itself, but in a vitreous state.—*Mechanics' Magazine.*

NEW INKS.

Mr. Baildon has patented certain improvements in the manufacture of Inks or Writing Fluids to be used with special kinds of paper. This invention consists in the use of an ink or writing fluid composed of an acid and colouring matter that can be combined therewith: also of a paper, the colour in which may be discharged and changed by such acid, and the texture of the paper also changed and weakened by the action thereof in those parts that are written upon. By this means the texture of the paper in the parts affected by the acid will be so changed as to prevent the possibility of alteration or erasure, and the ink or writing fluid by penetrating through the paper, will be seen on both sides thereof. The ink or writing fluid above referred to is or may be composed of diluted sulphuric acid, made according to the British pharmacopœia, and indigo paste as a colouring matter, in the proportions of a quarter of an ounce of indigo paste to three-quarters of an ounce of diluted sulphuric acid. But the patentee prefers adding to the indigo paste a small proportion of magenta crystals, or other aniline colouring matter. And the paper intended to be used is blue-tinted paper, or paper tinted or coloured with any colouring matter which will be acted upon by the acid so as to discharge and change the colour at the back of the paper, and weaken the texture of the paper. The paper preferred is tinted or coloured with ultramarine (which may be of a deeper tint than usual); but paper coloured green, or otherwise coloured, may also be used.

NEW DYES.

A GERMAN chemist is said to have produced most splendid Purple and Scarlet Dyes, almost surpassing in beauty the finest of the aniline dyes, from "theine," the alkaloid to which tea and coffee owe the refreshing and stimulating properties which have brought them into such general request all over the world. As the kinds of Chinese tea which are richest in theine do not contain much more than two per cent. of that substance, the new dyes, however valuable in themselves, could scarcely come into extensive use if Chinese tea were the only available source of the alkaloid from which they are derived; but, fortunately, there are other sources of that body. Not to speak of the kola-nut of West Africa, which has just been discovered to contain theine, the leaves of the Paulina Sorbilis contain nearly five per cent. of that alkaloid, and those of the Ilex Paraguaensis are also very rich in it. The Paulina Sorbilis is a Brazilian tree, belonging to the same family of plants as the English horse-chestnut. The locality in which it chiefly flourishes is the great vâlley of the Amazon. Its fruit, when ripe, is dried and pounded to powder, and the powder is made into a thick paste with water. This paste is moulded into cakes, which are baked by the heat of the sun, and then constitute the famous "Guarana bread." A spoonful of the powder obtained by scraping one of these cakes, added to a pint of boiling water, makes a very refreshing beverage, which is largely used throughout the Brazils. Still more largely used, however, both in the Brazils and in other parts of South America, is an infusion of the leaves, &c., of the Ilex Paraguaensis, or "Paraguay tea-plant,"—a plant belonging to the same order as our English holly. In the forests of the Brazils and Paraguay this plant grows wild in enormous abundance. The natives gather its leaves, buds, and young branches, dry them, and reduce them to a coarse powder, which powder they then use much as we use Chinese or Indian tea. This powder does not contain so large a percentage of theine as is contained in the Guarana-bread, but it contains nearly as large a proportion as the best Chinese tea; and as it is calculated that fully *two millions of pounds* of the leaves of the tree from whose leaves and twigs the powder is made fall to the earth and rot every year, in the forests of Paraguay alone, if theine-dyes should prove to possess, intrinsically, any real advantages, it need scarcely be difficult to produce them cheaply enough.—*Mechanics' Magazine.*

BUTTER-MAKING.

IT is well known that Cream may be converted into Butter by *simply being buried* in the ground, but it is not generally known that this mode is in common use in Normandy and some other parts of France. The process is as follows:—The cream is placed in a linen bag, of moderate thickness, which is carefully secured and placed in a hole in the ground, about a foot and a-half deep; it is then covered up and left for twenty-four or twenty-five hours. When taken out the cream is very hard, and only requires beating for a short time with a wooden mallet; after which half a glass of water is thrown upon it, which causes the buttermilk to separate from the butter. If the quantity of cream to be converted into butter is large, it is left more than twenty-five hours in the ground. In winter, when the ground is frozen, the operation is performed in a cellar, the bag being well covered up with sand. Some persons place the bag containing the cream within a second bag, in order to prevent the chance of any taint from the earth. This system saves labour, and is stated to produce a larger amount of butter than churning, and of excellent quality, and is, moreover, said never to fail.—*Journal Society of Arts.*

PRESERVING GRAIN.

M. LOUVEL's method of Preserving corn, flour, and biscuit, by securely enclosing them in large iron cylinders and then exhausting the air, has been tried with success. The weevil, the most difficult of all the corn parasites to subdue, has been completely destroyed in the rarefied air, and during six months none have been developed. The apparatus, therefore, may be rendered available for the prolonged conservation of grain under most unfavourable circumstances. A good account of the process was given last year by a Commission of eminent men, among whom were Marshal Vaillant, MM. Boussingault, Senard, and Tisserand.

NEW METHOD OF PRESERVING MEAT.

DR. MORGAN, one of the Professors of the Royal College of Surgeons in Ireland, has published a totally New Method of Preserving Meat, which, if found to answer as well as there is reason to expect, will leave the nutritious matter altogether undiminished. It is distinguished from all other processes of a similar kind, by the fact that it applies the preservative medium before, instead of after, the animal is cut up. When meat is salted after having been divided, more or less of its important elements are gradually abstracted and transferred to the brine; and the salting may even be carried so far that almost no nutritious matter will remain.

In Dr. Morgan's process, the beast is suddenly killed by a blow on the head; it is then turned on its back, the pericardium is opened, incisions are made in each ventricle of the heart, and a pipe having a stop-cock on its outer end is passed through the incision in the left ventricle and fastened into the aorta. The outer end of this tube is then connected with a caoutchouc tube 20 ft. long, which leads up to a tank containing brine mixed with a little saltpetre. This mixture being allowed to flow down through the tube, passes into the left ventricle of the animal, and thence through all the vessels, including the very smallest, until it escapes by the right ventricle. Five gallons are sufficient in this way to clear out all the vessels. About one gallon to the hundredweight of meat of another liquid, intended to retain the nutritive qualities, and consisting chiefly of brine, nitre, sugar, spice, and phosphoric acid, is now placed in the tank. This rushes through every portion of the animal, and is retained within it by the closing of the aperture in the right ventricle. The animal is next cut up into pieces, *dry*-salted, and, if it is desired, dried.

The process is very simple, and occupies but little time. In an experiment made by Dr. Morgan in the lecture-room, a bucket of brine, which had been raised to the height of 12 ft., and was connected by a tube with the left ventricle of the animal, issued in three or four minutes from the right ventricle, having driven the blood before it.—*Scientific Review.*

GLASS-BLOWING.

Glass-blowing, in its simpler adaptations, is very easy of acquirement, and capable of affording much recreation at a small expense. Even cold glass may be worked with a facility known to few. It may be drilled in holes very easily, the only implement needed being a common watchmaker's drill-stock. A steel drill, of good quality, well hardened, will do the business perfectly; and, even if the edge of the tool should give way before the hole is pierced through, a little emery-powder and oil will remove every difficulty; or, with the help of these, the hole may be bored with a copper drill. Not only so—glass may even be turned in a lathe. Any amateur turner who has operated on either of the metals may chuck a piece of glass in his lathe, and turn it with the same tools and in the same way as he would a piece of steel, only taking care to keep the chips from his eyes.

MANUFACTURE OF PERFUMES.

Amongst the popular lectures which have been delivered to the Horticultural Society, Mr. Septimus Piesse has given one on "Perfumes and the Methods of Obtaining the Odours." The lecturer pointed out that, contrary to general belief, nearly all the perfumes derived from flowers are not made by distillation, but by the processes of *enfleurage*, or inflowering, and by maceration or infusion. The odours of flowers do not, as a general rule, exist in them as a store or in a gland, but they are developed as an exhalation. While the flower breathes, it yields fragrance; but kill the flower, and fragrance ceases. It has not been ascertained when the discovery was made of condensing, as it were, the breath *of the flower during* life; what we know now is, that if a living flower *be placed near to* butter, grease, animal fat, or oil, these bodies absorb the odour given off by the blossom, and in turn themselves become fragrant. If we spread fresh unsalted butter upon the inside of two dessert-plates, and then fill one of the plates with gathered fragrant blossoms of clematis, covering them over with the second greased plate, we shall find that after 24 hours the grease has become fragrant. The blossoms, though separated from the parent stem, do not die for some time, but live and exhale odour, which is absorbed by the fat. To remove the odour from the fat, the fat must be scraped off the plates and put into alcohol; the odour then leaves the grease and enters into the spirit, which thus becomes "scent," and the grease again becomes odourless.

The flower farmers of the Var follow precisely this method on a very large scale, making but a little practical variation, with the following flowers:—rose, orange, acacia, violet, jasmine, tuberose, and jonquil.

The commercial importance of this branch of perfumes may be indicated by the quantity of flowers annually grown in the district of Cannes. Flower harvest: orange blossoms, 1,475,000 lbs.; roses, 530,000 lbs.; jasmine, 100,000 lbs.; violets, 75,000 lbs.; acacia, 45,000 lbs.; geranium, 30,000 lbs.; tuberose, 24,000 lbs.; jonquil, 5,000 lbs. The quantity produced at Nice has not been ascertained; with violets and orange there are more, but with cassie less than here stated.

The market season for orange-flowers at Nice lasts for more than a month, as an average, and during that time there are sold about 15 to 18 tons of flowers daily! and a ton of flowers will yield more than a kilogramme of otto (say forty ounces), worth 20*l.* sterling; and the residuary water, highly saturated with odour, is worth another 10*l.* note.

A surface of land, equalling an acre of planting, yields 180 to 200 lbs. weight of flowers, valued as an average at two francs the pound. Violets may always be looked upon as an extra crop, growing as they do under the orange and lemon trees. The kind grown is the double Parma. About 25 tons weight of violet-blossoms are produced annually at Nice.

In France, the commerce in perfumes has risen to the annual value of 3,000,000*l.* sterling.

LAYING THE ATLANTIC TELEGRAPH CABLE.

In the *Year-Book of Facts*, 1865, we reported Mr. Fairbairn's paper on the "Mechanical Properties of the Atlantic Telegraph Cable" (p. 111), and Captain Selwyn's communication (p. 160) upon the same inquiry. Among the proceedings of the British Association, the attempt to lay the cable, made last summer, was much discussed. The following is a summary of the great work, as it lay in the *Great Eastern*, prepared for the expedition:—

"The present Atlantic cable is just 2300 nautical miles, or in rough numbers, about 2600 miles long. The central conductor is *composed of 7 fine copper* wires, twisted into one complete strand, which is insulated with Chatterton's patent compound. Outside this come four distinct layers of gutta percha, each also insulated with the same material that encloses the conductor. Outside the gutta percha again are wound 11 stout iron wires, each of which, before being twisted on, is itself carefully wound round with strands of hemp, soaked with tar. Thus, then, there are no less than 25,000 miles of copper wire in the conductor, about 35,000 miles of iron wire in the outside covering, and upwards of 400,000 miles of strands of hemp, more than enough in all to go 24 times round the world. The cable has been made on an average at the rate of 17 miles per day complete, and in some days its outside covering of hemp and iron has been overlaid at the rate of 173 miles, though not a fathom or a foot has been manufactured without every part being kept under constant test for 'conductivity' and insulation, and to this hour it is as regularly tested as it was a year ago, when the first mile was twisted. In strength the cable is equal to bearing a strain of 7¾ tons, while its specific gravity is so low that it can with safety be depended on to support 11 miles of its length in water. It has been made mile by mile, joined up in long lengths of 700 and 800 miles, and shipped on board the *Great Eastern* into three enormous tanks. The first of these wrought-iron structures, which look like little gasometers, is in the forward part of the ship, and is 51 ft. in diameter; that in the midships over the boilers, 58 ft. 6 in., and that in the afterpart 58 ft. The first will hold a coil of 630 miles of cable, the second one of 840, and the third one of 830. All three tanks are kept filled with water, and when each is stowed with cable as well, the ends of the wire will be joined up and a constant system of signals kept through every part from the moment the expedition starts till the whole cable is laid. The tanks themselves, with water and their contents of cable, weigh in all upwards of 5000 tons. Great care has therefore been used in shoring them up from beneath the main deck and down by a succession of powerful supports to the very keelson. Some idea of the massiveness with which this part of the work has been effected may be derived from the fact that in the construction of these cross-beams, struts, and braces, no less than 400 loads of timber have been consumed. Every part of the tanks themselves also is braced with wrought iron tie-rods to the sides of the ship. In fact, unless the vessel meets with such a heavy sea as would break her back, there seems to be no possibility of danger arising from the stowage of the cable. The mere cable, however, is but an item in the mass of heavy weights the *Great Eastern* will have to carry on this occasion. Her draught of water will be rather over than under 30 ft., and, all told, her weights, when starting from Valentia, will come near the stupendous mass of 18,000 tons."

The following are the leading details of the expedition:—

"The *Great Eastern* sailed from Valentia on the 23rd of July, *and for 10 days* she proceeded on her way with scarcely an interruption. *Two faults* were discovered in the cable, due in each case to the perforation of the gutta percha by a piece of iron wire; but these faults were so soon detected and so easily cured, that they only served to heighten the prospect of ultimate success. The first fault occurred in soundings of 1000 yards, and 10 miles of cable were hauled in before it was detected. The second happened in 4100 yards soundings, and it was reached after about 2 miles and a half of cable had been hauled in. On the 2nd of August a third fault was discovered, which the electrical tests placed about 6 miles astern, and which was apparently due to the same cause which had produced the other two. The ship had then advanced five-eighths of her way, being 1063 miles from Valentia, having paid out 1212 miles of cable, and she was in 3900 yards soundings. It was resolved to haul in the cable as on the former occasions, and for that purpose it was passed from the stern, where it had been paid out, to the bow. About 2 miles had been hauled in when the cable itself, which had been injured by chafing on the stern of the ship, parted 10 yards inboard of the bow wheel; the end, as a matter of course, went straightway overboard, and those earth currents which were signalled at Valentia began working. The spirit of the men on board was not damped by this untoward accident, and they immediately began a labour than which nothing can be imagined more wearisome. A grapnel was lowered, 2 miles and a half of rope were paid out, and the *Great Eastern* drifted to and fro over the line of the cable in the hope of hooking it up. How many times it passed and re-passed drawing up nothing we are not yet told; but on the 3rd the cable was hooked. The rope was hauled in, and nearly one-half of it got back, when a connecting swivel gave way, and the half which had not been drawn up went to the bed of the Atlantic to join the electric cable, which latter, it was calculated, had been lifted 1200 yards, or nearly one-third of the distance from the bottom. Eight precious days of summer were lost mainly in futile attempts. For three days, indeed, fogs and contrary winds prevented anything being done save marking the spot by a buoy with a flag and ball, but on the 7th the cable was again hooked and again lost, through the breaking of a swivel, after it had been raised 1000 yards. A third attempt failed to hook the cable at all, on account of the grapnel chain having fouled the flukes of the grapnel; but on a fourth being made, the grapnel cable again broke, after the electric cable had been raised 600 yards from the bottom. The stock of rope on board was by this time exhausted, and any further attempt to haul in the cable with the imperfect machinery provided was abandoned.

"Two or three petty accidents, due to causes which were plainly preventable, put an end to an expedition which, from first to last, appears to have been conducted by those concerned in it with the utmost skill, discretion, and courage. Two or three little pieces of wire sticking in the gutta percha, an ill-made swivel of imperfect strength, a rope unfitted to bear the strain of hauling the cable up from the depths in which it had been laid—these are the *comparatively trivial* circumstances which compelled the Great

Eastern to return without having done her work. There was no defect in her seaworthiness, no question of electrical or mechanical science presented itself which was not capable of immediate and satisfactory solution; the ultimate failure was due simply and solely to the imperfect strength of a grapnel and the inadequacy of the machinery provided for hauling in the cable after it was once paid out."—*Abridged from the Times.*

The Atlantic Cable has given rise to scientific controversy in this country. Herr Siemens, a partner of the telegraph manufacturing firm of Siemens and Halske in Berlin, in an article inserted in *Dingler's Polytechnisches Journal*, contends that gutta percha is an elastic, but not a porous substance, and that the water cannot possibly have found its way to the wire while the cable remained undamaged. To this argument Dr. Moor objects in the *Cologne Gazette*, stating that gas will escape from a gutta percha bag; and inferring from this fact that, though gutta percha may ordinarily be impermeable to water, it is not so when subjected to a pressure equal to 400 atmospheres. He recommends that a cable of some 30,000 ft. should be sunk to a great depth, being partly suspended in the water and partly disposed on the bottom of the sea; and that the ship employed for this purpose should try to keep over the same place as long as possible, maintaining its connexion with the cable, and making telegraphic experiments of every kind; that the results of these experiments, and the condition of the cable when wound up at length, will supply many useful hints as to the difficulties to be encountered and the defects to be remedied. Dr. Moor is, however, not very sanguine as to the ultimate success of the enterprise, and rather inclines to think that no efficient cable will be thrown across the Atlantic, while we have failed to discover a substance which is light, elastic, non-conducting, and waterproof, under a pressure of 400 atmospheres.

FAILURE OF DEEP-SEA CABLES.

Mr. W. Fairbairn has read to the British Association a paper "On some of the Causes of the Failure of Deep-Sea Cables, and Experimental Researches on the Permanency of the Insulators." The author said the recent disasters and loss of the greater portion of the Atlantic Cable is one of those casualties which may be considered national, and may be looked upon as a misfortune much to be regretted, as it delays the completion of one of the most arduous enterprises that has taken place in marine telegraphy. It is, however, suggestive of improvements, and of the removal of impediments which seem to have beset the last attempt to submerge what was considered the best and most effective construction for a durable and certain communication between this country and America.

The lost cable, or that part of it which now rests as a lifeless thread at the bottom of the Atlantic, was unanimously selected by the scientific committee to whom was entrusted a long series of laborious experiments to determine the strength and other mechanical, chemical, and electrical properties of the material of which it was composed; and it may be interesting for the Section to know how these experiments were conducted, and to what extent they were calculated to form a safe and durable cable. For these details, the author referred his audience to his paper published in the *Transactions* of last year, in which would be found the mechanical properties of this and other cables, submitted to various experimental tests. In this Report, the results deduced from these experiments are given, and we have now to inquire how far they were conducive to carry out the objects of the company in establishing a safe and effective communication between Valentia and Newfoundland. It will be noticed that the late failure of the insulation, submergence, &c., is not an uncommon occurrence. On the contrary, it has been estimated that out of about 14,000 miles of cable that have been so laid, nearly three-fourths of that length have been failures, and that at the present time not more than from 4500 to 5000 miles are in successful operation.

These repeated failures and loss of property are much to be deplored, but they have been, like the last great failure, fruitful as the means of accumulating a vast amount of experience, and have suggested remedies for the almost inevitable difficulties that have to be surmounted. There are, however, two things in marine telegraphy which require special attention—viz., the manufacture of the cable, and its submergence in deep water. In the first, we may venture to assume that the condueting wires, insulation, and strength of the cable are satisfactory, and that we have nothing more to do than to lay it quietly in the bed of the ocean. The recent defects of the Atlantic Cable, and the imperfect insulation of others, are, however, important lessons, which prove the necessity of vigilant inspection of every yard of cable as it is manufactured in the first instance, and its careful preservation until it is safely deposited at the bottom of the ocean, in the second. All these conditions were supposed to have been carefully attended to in the manufacture of the Atlantic Cable. When it was run from the machines into the water tanks at the manufactory; from these again into the steamer conveying it to Sheerness; and ultimately into those of the *Great Eastern* ship, where it was carefully coiled for final immersion—every possible care was taken. But, notwithstanding the precautions exercised by the manufacturing company, small pieces of wire, on three different occasions, were found sticking in the cable, in contact with the conducting wires, and destructive to the insulation. Now, these very trifling circumstances were the whole and the sole cause of the loss of the cable; and it may be necessary, as we proceed, to advert to the subsequent trials of underlaying, dredging, fishing, and hauling which ensued, and which finally terminated in the loss of nearly two-thirds of the cable.

In the author's paper of 1864, a full account of the experiments and results which led to the manufacture of the present cable was given; and he closed with the remark, that he "had not entered upon the process of immersion, either in tanks or the sea; and the questions of coiling, shipping, submersion, &c., were left for future inquiry." The author had hoped that this inquiry would not have been necessary, excepting only to prove that the machines and every other appliance on board the *Great Eastern* had effectually performed their respective duties, and that we had only to record them as contributory to one of the most successful enterprises that had been achieved in modern times. In these, our most sanguine hopes, we have been disappointed, and we have simply to inquire what extra precautions should be taken to prevent a similar occurrence in laying the next cable, which the author has every hope will be done, with perfect success and without interruption, at the bottom of the Atlantic.

Having spoken approvingly of the paying-out machinery on board the *Great Eastern*, he proceeded to discuss the difficulties in paying-out a cable of great weight and strength arising from kinks proceeding from the twist which it receives in coiling. Smaller and lighter cables might be put on reels and so paid out without fear of kinks, but for heavy cables the coil is the only suitable plan. On the subject of the manufacture and of splicing, the paper went on to say greater care must be taken. If the short pieces of wire which penetrated the gutta percha had not been there, the cable would at the present moment have been in full activity, and in regular communication with the American States; and it is much to be regretted that this cable, so strong and so powerful in its resistance to strain, so well executed, and so full of promise, should have failed from such small and preventible causes.

With regard to the *Great Eastern* ship, never was a Company more fortunate in having such a vessel for such a purpose. She proved herself everything that could be wished for. Her easy, steady motion was just what was required for paying out the cable, and its relief from any undue strain by the pitching of the vessel renders the big ship exclusively calculated for the submergence of submarine cables in deep water. She is the very thing that is wanted for such a purpose; and the author firmly believes, if she was properly fitted and prepared for such a service, with some additional stringers to strengthen the upper decks and sides, she would find full employment as a submerger of cables in every sea which divides the four quarters of the globe.

As to the recovery of the lost cable, the paper goes on to say that such a process was at all times a precarious operation, and especially so in the case of the Atlantic Cable. If that cable were raised at all, it must be at an exceedingly low speed, and with one end loose; he should despair of raising it from a depth of 2100 fathoms by hooking it in the bight or middle, where the resistance would be doubled in raising two sides instead of one. The slack, *too,* would be insufficient to enable this to be done, and a drag of *five miles on each* side would have to take place, before it could be brought to the surface. Any attempt to raise the cable in this way would be fruitless, unless some means were adopted for cutting the cable on the American side, and hauling in with a second grapnel which would hold fast until the cable was cut. He had, however, great doubts of the success of this plan; and the only feasible plan which suggested itself to him was to commence *de novo*, not to lay a new cable, but to place the *Great Eastern* under the cable at Valentia, and pluck it up at a rate proportionate to the depth of water from which it had to be abstracted. The paper concluded by referring to an elaborate series of tables giving the results of the experiments undertaken in reference to the materials to be used in the construction and insulation of the cable, to which the author had directed attention in his paper of last year, and in conformity with which the cable had been actually constructed

Mr. Siemens read a paper "On the Sheathing of Deep-sea Cables," calling attention to the forces which act upon a cable while descending to the bottom, and to certain conditions which have to be fulfilled in order to ensure its durability when laid. The paper proceeded to show that a sheathing composed of two layers of strong hemp under a certain tension bound tightly round by a flexible armour of copper or zinc sheathing is free from the objections made to the spiral, or rather heliacal, sheathing; that such a cable actually forms the connecting link between France and Algeria, and has given evidence of permanent success.

It is not denied that the construction of Submarine Telegraphs, with our present imperfect knowledge of the uneven bottom of the sea and of the disturbing effect of tides and currents upon a slender line traversing its obscure recesses, beyond the reach of our skill to repair any damage or to recover the fragile cord, is an enterprise of great risk. This has been most forcibly exhibited by Mr. Francis Gisborne, in the very instructive table of statistics which he has published, showing at a glance the history of all the sub-marine telegraph cables yet laid down; those which are now at work being, with the exceptions of the Persian Gulf line and of that from Malta to Alexandria, comparatively short lines, which were laid at a moderate depth, and were stouter and stronger than many which have failed or have become unfit for use. Mr. Gisborne remarks that no deep-sea telegraph of any great length has yet lasted more than two years; except, perhaps, the line from Spezzia to Corsica, which, being 110 miles long, at a depth of 100 fathoms to 325 fathoms, was of the strongest and heaviest construction, and remained in good working order for ten years. The Persian Gulf cable, of which we have spoken, is 1500 miles long, and the depth at which it lies from 30 to 60 fathoms. It appears that, although cables have been raised to the surface, for repairs, from a depth of 200 fathoms or more, it may generally be considered impracticable to repair them in deep water: from 20 to 100 fathoms is a moderate and convenient depth for cables weighing two tons or more per statute mile. Such cables have, in this situation, been found *permanently* successful and efficient. The stability of our telegraphic communications with the Eastern world, soon to be extended to China, will therefore be tolerably secure. From Rangoon, in the Burmese provinces of our Indian empire, to the great commercial port of Singapore, a cable will be laid, at no great distance from the coast of the Malayan Peninsula, in a depth not exceeding 50 fathoms; and the same depth prevails from Singapore northwards, along the eastern coast of Asia, to Hong-Kong and Shanghai. But with regard to the Australian branch, we do not yet possess sufficient information to speak confidently of an early realization of the project, as displayed by the dotted lines in our Map. The Lords of the Admiralty, having been requested to employ one of the surveying vessels of the British Navy in taking soundings between the east end of Java, the isle of Timor, and Port Essington on the coast of New Holland, declined to render this public service, because the directors of the Anglo-Australian and China Telegraph Company were not quite prepared to pay the cost, amounting to 24,000*l*. It has, however, since been intimated that the Dutch Government, as the possessor of Java and Timor, will be disposed to act more liberally in this matter than the British Government, with all its rich Australian provinces. The land telegraphs of Australia already constructed, passing round from Adelaide to Melbourne, Sydney, Brisbane, and Port Denison, are now at work; and the Governor of Queensland, Sir George Bowen, has invited those of New South Wales and Victoria to join him in encouraging the scheme for a complete telegraphic communication with Europe.

INDIA-RUBBER INSULATOR.

MR. WILLIAM HOOPER has read to the British Association a paper "On the Applicability of India-rubber as an Insulator for Telegraphic Conductors." The usual mode is to manufacture the caoutchouc and cut into tapes, which are served around the wires consolidated by heat or by the use of solvents, both of which are injurious in their tendency to oxidation. The results obtained with five specimens of indiarubber-covered wire supplied, for experimental purposes, to the Government of India, and sent out to Kurrachee in 1863, were adduced by the author, and showed that four out of the five were defective after submersion in the Indian Ocean, one only, supplied by himself, remaining perfect. In insulation this specimen was the highest yet attained, and the perfection of the joints was fully proved. The central position of the conductor was unaltered by any elevation of temperature, and its insulation remained good up to 150 deg. Fahr., and even higher temperatures. The mechanical properties of the core devised by the author were also shown to surpass all other materials yet produced.

TELEGRAPH TO INDIA.

SIR C. TILSON BRIGHT, M.P., has read to the Institution of *Civil Engineers* a paper "On the Telegraph to India, and its

Extension to Australia and China." The author having referred to the causes which led to the failure of previous attempts to establish telegraphic communication with India by the Red Sea, described the steps taken by Government to carry out, through Mesopotamia, and by the Persian Gulf to Kurrachee, the line, which extends as far as Rangoon, and connects England with all the chief places in India. The cable used in the undertaking was described: it was 1234 nautical miles in length, and weighed 5028 tons. The Persian Gulf line was laid by the author: sailing vessels, towed by steamers, being employed. The laying of the portion of the line between Bagdad and the head of the gulf was delayed by some of the route in the Valley of the Euphrates being in revolt against the Turks. The part of the line worked by the Indian Government is very satisfactory; it is otherwise with the portion between Constantinople and Belgrade.

The core was composed of 225 lbs. of copper and 275 lbs. of gutta percha per nautical mile, the gutta percha being applied in four separate coatings; over this was laid a bedding of hemp, covered by twelve galvanised iron wires, the whole being coated with two layers of a compound of bitumen and silica, applied in a plastic state, in combination with two alternate servings of hemp laid in opposite directions. In the construction of the conductor four segmental pieces of copper within a copper tube were used, by which the mechanical advantages of a strand were preserved, while the electrical efficiency was added to, in consequence of the cylindrical form of the exterior. The difference between the conducting powers of gutta percha and India-rubber was determined by a series of elaborate experiments, during the construction and laying of this cable.

The author also described the difficulties encountered in the construction of the Persian telegraph between Teheran, Ispahan, Shiraz, and Bushire. He considered, likewise, the various plans proposed, with regard to the extension of telegraphic communication to China and Australia; and concluded that, although a part of the line might be taken by land, the object would be best attained by submarine cables. The line might pass from Rangoon to Singapore, thence to Batavia, where it would join the Dutch land lines. Passing from the south-eastern extremity of Java to Timor, it would next proceed to the Australian coast, and join the Australian lines. A line could be carried from Singapore to China, touching at Saigon; or the Peninsula might be crossed at Morgin, and the sea line be carried thence to the Gulf of Siam.

DISTRICT PRIVATE TELEGRAPHS.

Mr. N. J. Holmes has read to the British Association a paper, in which, having given an outline of the history and uses of the Telegraph, and its great importance as a vehicle of communications in towns, he pointed out that the popular use of the Telegraph depended upon the adoption of a more easy system of signs than was used by the ordinary telegraph companies. This desideratum was secured by Professor Wheatstone's invention of the alphabetical telegraph in 1858. The communicator or transmittor, by which the operator with his finger spells out words, letter by letter, consisted of a box, fitted with a dial, round the face of which the letters of the alphabet were arranged. Opposite to each letter was a button, or finger-key. In the interior of the box was a magnetic arrangement, the generation of the currents being consequent upon the revolution of an armature, kept in continuous motion, when passed through its arrangements. A Company was formed four years ago for the promotion of this form of the telegraph, the use of which, in newspaper offices, was yearly increasing. Several papers had an independent system of their own between the Reporters' Gallery in the House of Commons and their offices. The *Daily Telegraph*, in addition to this, has wires to the residences of its managers. Its use was increasing among commercial houses generally. Though the Company had been incorporated little more than four years, its system already extended throughout the United Kingdom, at all points where commerce and manufacturing industry existed. Upwards of 2000 miles of private wires had been erected by the Company, employing upwards of 863 sets of instruments. The principle upon which the wires and instruments are supplied is that of rental. Comparatively few lines supplied were purchased by the parties using them, and when purchased, were those chiefly over private properties. The paper set forth a mass of information as to the details by which the system was worked, and the advantages arising from it. The paper was illustrated by working models.

PARKESINE AND ITS PROPERTIES.

A PAPER has been read to the British Association, by Mr. Owen Roland, on Parkesine, which derives its name from its inventor, Mr. Alexander Parkes, of Birmingham, whose popular invention of the vulcanisation of india-rubber was spoken of in very favourable terms by Mr. Thomas Handcock. Parkesine is serviceable for a great variety of purposes, and possesses properties akin to gutta percha and India-rubber. It can be manufactured with the utmost facility into any shape and of any colour. Gun cotton is used in its manufacture as a basis, but a number and variety of other materials are also introduced; they consist mainly of solvents, oils, cotton waste, &c. Articles manufactured from Parkesine were exhibited, and attracted considerable attention. Cotton not readily explosive is the most desirable thing that can be used for manufacturing iodide; chloride of zinc being also used to prevent rapid combustion. The solvent was invented by Mr. Parkes, and is applicable chiefly for India-rubber solution, gutta percha, and a number of gums. It is by mixing these substances in their legitimate proportions that the several varieties of Parkesine are manufactured. Mr. Roland had also observed that Parkesine was valuable as an insulating material for the purposes of telegraphy. He considered it more valuable for such a purpose than India-rubber, gutta percha, or any other combination hitherto brought into operation for a similar purpose. The material is enormously strong, being capable of supporting a mile of its own weight, while it possesses the great qualification of being joined in case of fracture with a strength equal to the original substance. It is not affected even by acids; and sea-water, in which it has been immersed for a period of four years, has not in the least deteriorated its qualities. In dry heat as high as 212 degs. it remains electrically unimpaired, and not softened at even a higher temperature.

THE DUJARDIN TYPE-PRINTING TELEGRAPH.

This improved Type-printing instrument has for some time been experimentally worked by the Electric and International Telegraph Company, with favourable results, according to the *Mechanics' Magazine.* The type-wheel, says our authority, is of the ordinary form, with the type disposed around its periphery. Motion is communicated to it by means of a weight acting upon a train of wheels, and this motion is governed and made to take place, "step by step," by means of an escapement attached to what may be termed a pendulum vibrating between the poles of two electro-magnets. The type-wheel, in its motion from one letter to another, is thus independent of the electric power, and this motion would even take place by the effect of the weight, if the currents, rapidly alternating in the two electro-magnets, were interrupted. The weight and the escapement, in fact, of themselves give to the type-wheel a motion which is synchronous with that of the apparatus at the sending station, also set in motion by means of a weight, for the transmission of alternately positive and negative currents, the synchronism being merely controlled by the action of the latter. The transmitting apparatus is furnished with keys similar to those of a piano, and corresponding to the letters of the alphabet. When one of the keys is depressed, a current somewhat longer in duration than those which regulate the step-by-step movement of the type-wheel is transmitted at the exact moment of time when the latter reaches the proper position for the impression, upon a band of paper, of the corresponding letter. In the new inking apparatus the resistance offered by friction to the motion of the type-wheel is said to be greatly reduced. It is composed of a pad of velvet, the pile of which only is in contact with the type.

GRAPHOTYPE.

A paper has been read to the Society of Arts, by Mr. H. Fitz-Cook, "On a new Method of Producing, from Drawings, Blocks for Surface Printing, without the aid of the Engraver," to which the name of "*Graphotype*" has been given. The new process is the *invention of Mr. De Witt* Clinton Hitchcock, one of the foremost draftsmen and engravers of New York, and was suggested by a little incident which Mr. Fitz-Cook thus related :—"In the summer of 1860, Mr. Hitchcock, in the course of making a drawing on box-wood, found it necessary to alter a portion of his design by erasing it and re-whitening the exposed surface of the wood. The material used for this purpose was the enamelled surface of an ordinary visiting-card, softened by water and a brush—a method known to most draftsmen on wood. The card employed happened to be one printed from a copper-plate, and after the removal of all the enamelling, as described, the artist discovered that the printed letters were undisturbed, and standing up in bold relief." His first attempt to carry out the idea which this circumstance instantly suggested to him was made upon a slab of chalk, sawn from an ordinary lump, and on one surface made as smooth as possible by scraping. He drew upon the smoothed surface of this piece of chalk with ink and a quill pen, using as ink silicate of potash, or "water-glass," coloured with indigo, and when the lines of the drawing were dry he brushed away, by means of a tooth-brush (but not using water, as when removing the enamel from a card), all the portions of the chalk surface upon which there were no lines. "The lines of the drawing," we are told, "being literally composed of stone, withstood the assault of the tooth-brush, but the intervening particles of exposed chalk succumbed, and vanished in a cloud of snowy dust, leaving the impregnable lines standing in relief, inviting a proof of their strength by printing on paper. This could not be done until the whole mass of chalk was changed into stone, by saturating it with the liquid glass, but in half an hour the chalk block was inked and printed in the ordinary way by burnishing."

Ultimately, as the result of a great number of experiments, Mr. Hitchcock elaborated a process which seems likely to supersede wood-engraving, if not for all, at least for many purposes, being much cheaper than wood-engraving, and having moreover the great advantage of infallibly reproducing the artist's every touch, however delicate, with the most perfect accuracy. In its present shape the process is conducted as follows:—An artificial chalk block or plate is first produced by grinding the best French chalk to fine powder, mixing this powder with water to a thin cream and separating the portion which precipitates first, repeating this operation several times, in order to ensure the complete separation of any hard or coarse particles, drying the very finely-divided chalk thus obtained and sifting it through wire-cloth having 10,000 holes to the square inch, on to the surface of a perfectly smooth plate of zinc, placing a plate of highly-polished steel on the top of the even layer of chalk-flour thus obtained, and then submitting it to powerful hydraulic pressure. On removing the pressure and lifting off the steel plate, the chalk is found to be firmly attached to the zinc plate, and to present a perfectly smooth upper surface, which only *requires to be "sized," in order that the ink to be used in drawing on it may not "spread,"* to be ready for the artist. The latter proceeds as in the ordinary method of drawing on wood, first making a red chalk tracing on the block or plate, and then, with sable hair pencils of various sizes, drawing his design line for line, exactly as he wishes it to appear when printed. The ink used is a mixture of glue and lamp-black, and dries instantly, so that one series of lines, of whatever thickness, may be immediately crossed by others. The drawing being completed, the portions of the chalk surface intervening between the lines of the drawing are disintegrated and removed, to the depth of an eighth of an inch or so, by means of brushes, some of them of fitch hair and others of silk velvet, and the chalk block is then hardened by being soaked in a solution of an alkaline silicate. A mould is then taken from the chalk block, and a type-metal cast produced from this mould, by the ordinary processes of stereotyping, and it is this type-metal cast, and not the original block, that is used to print from. "The process is so delicate," says Mr. Fitz-Cook, "that the impression of the thumb wetted with the graphotype ink, skeleton leaves, feathers, and other objects to which nature-printing has been applied, can be made to give beautiful impressions in the ordinary type-press, whilst the finest hair-line that the artist can make will stand equally well with the bolder work." The type-metal cast may be obtained with ease within three hours after the completion of the drawing on the chalk surface, so that the new process has an immense advantage over wood-engraving, not only as regards cost, but also as regards the time occupied between the completion of a drawing and that of the block by means of which copies of it may be multiplied by the printing-press. While thus cheap and expeditious, the new process reproduces the artist's work with an absolute accuracy unapproachable by the most skilful engraver.—*Mechanics' Magazine.*

NEW DOMESTIC IMPLEMENTS.

At the second Conversazione of the President of the Royal Society, these two inventions attracted much attention.

A mechanical contrivance, exhibited by Mr. S. Bourne, appeals to every housekeeper, for its purpose is to preserve liquids from the injurious effects of the atmosphere in casks, or other vessels. It is a "patent Flexible Diaphragm," or thin membrane, so placed as to divide the cask or other vessel into two separate chambers, the lower of which contains the liquid, while the upper one becomes filled with the air that enters as the fluid is drawn off. The membrane, fitted in with a water-tight joint, adapts itself freely to the form of the cask or vessel, expands so as to allow it to be entirely filled, and rests on the surface of the liquid, while the latter sinks, and effectually protects it even to the last half-pint; hence there can be no complaints of the beer or wine growing flat. Moreover, the cask does not become foul as those do in ordinary use, and can be cleaned without unheading by a rinsing with *warm water. And it* may be so contrived as to admit of ice or other cooling substances being placed in the upper chamber during hot weather. Some of Mr. Bourne's models were made of glass to show the action of the diaphragm, and he kept them at work, as well as his elastic valves, which are equally valuable, during the whole evening.

Mr. Cowan's Hydraulic Lift for domestic use showed with what ease articles of any kind, heavy or light, a dinner-service and so forth, could be raised or lowered from one floor of a house to another. As a labour-saving machine, and obviator of the fatigue of mounting stairs with heavy burdens, it is one of the simplest and safest. And Richards's Kath-hydron or ready Fire-engine, which is a flexible bag large enough to contain a few buckets of water, fitted with a hose and jet, is a cheap and convenient article for use in a house or factory. As is well known, many a fire might be prevented by a few buckets of water ready to hand on the first alarm. With this engine the water can be kept ready, and poured forth at any height between floor and ceiling.—*Athenæum.*

THE SCREW AND PADDLE.

THE *Philosophical Magazine* for April contains a profound mathematical paper, by Professor W. G. Adams, on the application of the principle of the Screw to the floats of Paddle-wheels—his object being to ascertain, by the comparison of the pressure of a fluid on a float in the form of the surface of a screw with the pressure of the ordinary flat float, so as to discover whether any advantage would be gained by having the floats of paddle-wheels made in the form of a screw surface. This application was conceived and tried by Dr. Croft, who obtained most satisfactory results in his experiments on small working models; and, in all cases, the new was found superior to the old paddle-wheel. The two kinds of floats have also been compared and tested with larger boats with equal success.

NEW BLOW-PIPE.

THIS new instrument—Hendy's Blow-pipe—combines simplicity and efficiency in a great degree; it consists of an ordinary blow-pipe nozzle, supplied from an india-rubber reservoir. The main portion of the blow-pipe is made with a joint, at which a valve is placed, which is opened when the operator blows, and closed immediately when he ceases. The bag is filled at a single breath, with very little exertion, and when so filled a continuous current of air is forced from the nozzle of the pipe by the mere contractive force of the india-rubber. A rubber hose is attached between the mouth-piece and the pipe, which enables the blower to change his position without disturbing the direction of the current on the object upon which it is turned.—*Mechanics' Magazine.*

Natural Philosophy.

PLANETS, METEORS, COMETS, NEBULÆ, ETC.

At the Meeting of the British Association, the President of the Section of Mathematical and Physical Science, in his inaugural address, remarks:—"The planet Mars has of late been the object of much telescopic research. The supposition that the redder parts of his disc are land, and the greyer parts sea, appears to be established. Recent observations also confirm the view that snow is visible in its polar regions, and the temperature on Mars and our own planet is not very different. The solar radiation in the two cases is, of course, very disproportionate; but the explanation of the result is to be sought in the action of a dense atmosphere, which, as Professor Tyndall has shown, serves to retain large quantities of heat, which would otherwise radiate off into space."

The minor Planets continue to increase in number, and in addition to the amount of attention which they usually receive, they have been the subject of an important paper by M. Serret, who has brought out the first part of a complete theory of Pallas. He states that, in a second part, which has not yet appeared, he has arrived at some curious and unexpected results. Mr. Lassells has given an ephemeris of the satellites of Uranus (now reduced to 4).

Luminous Meteors and shooting stars have now in a great measure been brought within the range of law and observation. The labours of Alexander Herschel and others have shown that not only the periodic showers of August and November may be classed with planetary phenomena, but that even the movements of other meteors may be regulated by similar laws. A member of the French Academy has even gone so far as to suggest that the known depression of temperature in February and May, and its elevation in November, may be accounted for by the position of these clusters of bodies alternately intercepting the solar rays or screening them from radiation into space. In the meantime, the Committee on Luminous Meteors continues its labours in registering all well-authenticated observations of meteors of a mere casual appearance. Its muster will, it may he hoped, some day prove a serviceable repertory for comparison.

In an elaborate memoir presented to the Astronomical Society, M. Hoeck argues that the orbits of Comets generally are not elliptic, but either parabolic or hyperbolic; that these bodies do not in any way belong to the solar system, but that they pass near us in their course through space; and that the configuration of their perihelia and the inclination of their orbits indicate that they lie in groups, fragments of larger bodies. Passing to the more distant regions of space, the Nebulæ have been carefully observed, and their spectra analysed by Mr. Huggins and others.

This analysis appears now to confirm the surmise that many of the unresolved Nebulæ are in fact actually gaseous. In one curious instance, that of the great nebula in the sword-handle of Orion, telescopic and spectral observations appeared to be at variance. The former showed the nebula to be resoluble partially at least into a few bright spots; the latter showed a spectrum of only three bright lines, a criterion of gaseity. The solution of the contradiction is doubtless to be found in the suggestion that the bright spots are not stars, but aggregations of the gaseous fluid. Imagination would lead us to conclude that we have here a cosmic process actually in operation before our eyes, the birth of a stellar group, the formation perhaps of solar systems, the nebular theory realized in fact; but strict scientific induction forbids us as yet to receive this as an ascertained conclusion.

The following is the account read by Mr. Huggins to the Royal Astronomical Society of his latest inquiry into the nature of Nebulæ. He stated that he had discovered, by means of the spectroscope, that the great nebula of Orion was of uniform constitution throughout, and that all parts of it gave a purely gaseous spectrum, varying only in intensity; and that the bright lines were three in number—one very strong, another fainter, and one very faint. Other nebulæ gave continuous spectra, showing their starry nature. Mr. Huggins hopes soon to make further observations with a silver glass speculum of considerable size. He also stated that he thought that the question of a lunar atmosphere, the evidence of which is now all negative, might be tested by the observation of the disappearance of the spectrum of a star when the moon approached; and he reported that he had applied the method on the 4th January last. As far as the experiment went, the result was against the existence of a lunar atmosphere.

LUMINOUS METEORS.

Mr. James Glaisher's valuable Report on Luminous Meteors has been read to the British Association. Its principal points were as follows:—The number of Meteors observed during the past year had been unusually small, partly owing to the cloudy state of the sky, and partly owing to the absence this year of certain acknowledged star-showers—namely, those of January, April, and August. The November shower—although concealed in England by clouds, was observed with considerable interest at Malta. Its greatest display is expected in 1866. A remarkable shower of meteors was observed on the 18th of October, coinciding with a date on which fire-balls have made their appearance in more than average numbers. The radiant-point of this shower is perfectly well defined in Orion. There was a less conspicuous star-shower on the 28th of July, with a radiant equally distinct close to Fomalhaut, the most southerly star observed on our meridian. A number of other accurate observations of star-showers are included in the report. Of large meteors, the greater number took place in December. Two detonating meteors were also observed: the first in England, on the 20th of November; the second in Scotland, on the 21st of February. Observations show that, on the first of these nights, shooting stars were extremely scarce, so that, at Weston-super-Mare and Hawkhurst, only one or two meteors could be counted in an hour. This fact illustrates, in a remarkable manner, the adventitious character of large meteors. A third detonating meteor, on the 30th of April, was doubly observed, at Manchester and Weston-super-Mare, and its height well determined. The nearest approach to the earth was thirty-seven miles. Startling as are the accounts of detonations heard from such a height, it is yet more surprising that the report from such a distance should be brief and momentary. The sounds caused by meteors yet offer much which it is hoped will be explained by further observations.

Interesting matter is given in the Report by Mr. Brayley and Mr. Sorby, "On the Origin of Meteorites, and on the Series of Physical Processes of which they are the Result." It appears, from microscopic examinations of their structure, that aërolites resemble, in their appearance, certain igneous terrestrial rocks; but characteristic peculiarities in their structure evince that this is far from being a complete account of their previous history. Mr. Brayley suggests that they originate in gaseous matter projected from the equator of the sun, and condensed to a solid form in its passage through interplanetary space. A gradual condensation from the vaporous state is said, by Mr. Sorby, to represent more nearly than any other the condition under which they must have been consolidated. In this view of the origin of meteorites, their source is considered to be unique, and they are traced to the energetic forces whose modes of action are considered in solar physics. The bodies thus arising are termed "meteoritic masses," to distinguish them emphatically from all other members of the solar system.

In a "Memoir on Sporadic Shooting Stars," Mr. Newton, basing his conclusions upon a previous knowledge of their height, arrives at some interesting results regarding the number and distribution of these bodies in space. The average height of the centres of their visible tracks is sixty miles above the earth. Their number in the atmosphere daily is seven and a half millions, and if not intercepted in their flight, there would be found in the *space* occupied by the earth at any instant in its orbit, 13,000 of such bodies pursuing different orbits Of shooting stars visible in telescopes, Mr. Newton calculates that the number is at least fifty times greater than the number of those visible to the naked eye. Indeed, there appears to be no limit to their minuteness nor to their numbers. Their velocity is greater than that of the earth in its orbit, and Mr.

Newton supposes they are grouped together according to some law, probably that of rings encompassing the sun, resembling, in their inclinations and dimensions, the orbits of the comets. Mr. Newton, in conclusion, supposes that these bodies, which he terms meteorites, are not fragments of a former world, but rather materials from which new worlds are forming. Meteorites and meteoritic masses, then, constitute two classes of bodies which have to be considered in meteoric astronomy. It is, however, reasonable to presume that the same forces which, in the phase of greatest concentration of the solar system, give rise to *meteoritic masses*, might, in a phase of vastly greater antiquity and of greater extension of the solar orb, have given rise in a similar manner to rings of *meteoroids*.

The Report concludes with a notice of the possible influence of some of the larger streams of meteorites in producing singular periodic anomalies in our terrestrial atmospheric temperature. The Committee request a renewed grant to enable them to continue their Report, and to add to the maps now printed the leading tracks of nearly 2000 meteors contained in the catalogues of the British Association, by which the character and position of 56 radiant points of shooting-stars have already been ascertained and well defined by Mr. Grey.

LIGHT OF THE MOON AND VENUS.

THE comparative intensity of the Light of the Moon and of the Planet Venus has been compared,in a very ingenious manner, by the eminent astronomer, M. Chacornac, of Marseilles, under most favourable circumstances. At three o'clock in the morning of the 20th of June last, the two stars were in conjunction, and could be observed by the photometric apparatus exceedingly well, the images of the two planets remaining for more than two hours undisturbed by the least atmospheric undulation. By employing a magnifying power of only seventy times, the extraordinary image of Venus could be so diminished as to possess only two thousandths of its splendour without ceasing to exhibit all its outlines. The result of the comparison was that the light reflected from a portion of the moon possessing the greatest reflecting power has only the tenth part of that reflected by the surface of Venus.

MAPPING THE MOON.

AN interesting Report of the Lunar Committee of the British Association with reference to Mapping the Moon has been received from Mr. Glaisher (the chairman) and Mr. Birt (the secretary). The arrangement of the Map is such that even the most minute objects might be efficiently designated. The author described three portions of the moon's surface that had been *especially subjects* of observation during the past year. The plain of Dionysius, on which several mountains and craters occur, he considered had resulted from a crack which is now marked by the great rille of Ariadeus. The surface south of this rille was at a lower level than that to the north of it, and the depth of the rille was plainly perceptible by the shadow within it. The Rev. T. W. Webb had drawn the attention of the Committee to a remarkable valley in the northern part of the moon, which Schröter, the old Hanoverian astronomer, had observed, drawn, and named J. J. Cassini. This Mr. Webb had identified in January, 1865. Mr. Birt has since examined this part of the moon, compared it directly with Schröter's drawing, and ascertained that Beer and Mädler saw and drew it, although they say that Schröter's drawing is irreconcilable with the surface of the moon only upon the admission of enormous changes during the thirty years previous to their epoch.

HEAT OF THE MOON.

A PAPER has been read to the British Association, "On the Heat attained by the Moon under Solar Radiation," by Mr. J. P. Harrison. No systematic inquiry into the amount of heat attained by the moon during her exposure to the sun's rays having been hitherto undertaken, the author drew attention to the subject, not only on account of its intrinsic importance, but also as bearing on the question of the dispersion of cloud and vapour which is thought, on the high authority of Sir John Herschel, to be due to the dark heat emanating from the surface of our satellite. It is generally admitted that no heat reaches the most delicate thermometers at the ordinary level of observation; but the fact of a small modicum of heat having been detected by Professor Smyth, at Teneriffe, justifies the assumption that the moon's radiant heat is expended in dispelling light clouds and vapour before it reaches the earth's surface. The fact of there being more clear sky in the second half of the lunation is supported by the testimony of eminent physicists, especially by M. Poey, of the Havannah Observatory, who has found by observation that the lunar halos reached a maximum shortly after the first quarter, but were entirely wanting at full moon. The solar radiation poured upon the moon for so many hours without intermission, in regular succession, but not for an equal period, so far as the parts exposed to our view are concerned, Sir John Herschel describes as "unmitigated and burning sunshine, fiercer than an equatorial noon;" and he adds, that this would probably raise the temperature of the moon far beyond 212 deg. F. This estimate refers to the heat of the moon's hemisphere at the period of opposition. But, on the assumption that the moon's crust is constituted geologically like the earth, different parts of her surface would not attain the same degree of heat. An inspection of any good map of the moon, or one of Mr. De La Rue's photographs, will show that nearly two-thirds of the hemisphere turned towards us is honeycombed with gigantic craters, and covered with the *débris* of most stupendous volcanic eruptions, the region in which Tycho is situated forming a principal part of the whole extent, and being conspicuous to the naked eye from its superior brightness. That region should therefore absorb less heat, in proportion to its reflecting properties. On the other hand, the greater portion of the dark surface of the moon lying to the west of Tycho and forming a succession of plains once considered to be seas, would absorb and radiate heat in the inverse ratio to their non-reflecting surfaces. Another dark region of less extent lies to the north-east of Tycho.

The above facts must be borne in mind in considering the question of the Heat attained by the Moon at the periods of opposition and quadrature. The whole surface of the moon being exposed in turn for from about thirteen to rather more than sixteen days to the solar rays, in speaking of the heat which our satellite attains, it must not be considered that equal surfaces illuminated—*e.g.*, at the first and third quarters—are equally *heated* because so illuminated, or without reference to the duration of the sun's radiation upon them. On the contrary, at the day of first quarter, the region of the moon which has received the rays of the sun for a mean period of nearly three and three-quarter days, after being subjected to the most intense cold during the moon's long night, has been gradually warming up to the time it completes its first quarter; the region opposite the earth having received the heat of the sun's rays for only about four-and-twenty hours—a period manifestly insufficient for any surplus heat to have been absorbed even if the region had been favourable for storing radiant heat. At the period of last quarter, on the other hand, the surface illuminated will have been heated twice as long as at the first quarter—namely, for a mean duration of seven and a half days; and not only so, but at the time when the moon completes her third or last quarter, a similar surface to that at first quarter will have received the heat of the sun's rays for 360 in place of 24 hours, with this additional peculiarity, that the surface generally will be a good absorber of heat. The heat of the moon at the last quarter might, on like grounds, be shown to be greater, or certainly not less, than at the full. It will be sufficient, however, to point out that at the period of maximum heat that portion of the moon's fully illuminated hemisphere opposite to us, and which radiates heat directly towards the earth, is not heated so intensely at the full as at the last quarter, or for a day or so after that phase. The ratio in favour of the latter portion is nearly two to one; whilst the ratio in favour of the last quarter, compared with a corresponding region in the first quarter, is rather more than fifteen to one, the measure being the duration of solar radiation without reference to the surfaces on which it falls. Doubtless the absence of an atmosphere must cause the moon's surface to radiate heat more rapidly than is the case with the earth; still it is impossible to believe but that a considerable quantity of the heat received from the sun is *absorbed at* any rate by the dark plains or "seas" of the moon, more especially as the solar heat is unmitigated and constant for so many of our days, without the intermission of night.

Mr. Harrison exhibited a Curve of Mean Temperature at Greenwich for fifty years, confirming a former one published in the British Association Report for 1859, and showing how exactly the period of the greatest heat of the lunar surface synchronized with the period of greatest mensual cold in the terrestrial atmosphere; and conversely, the period of greatest cold of the moon's surface as coinciding with the period of greatest nocturnal heat at Greenwich.

GIGANTIC TELESCOPES.

THE *Boston Chronicle*, U.S., states that the University of Chicago, Illinois, possesses the largest Telescope in the world, the product of American skill. Heretofore, Harvard College, Cambridge, Massachusetts, has held that honour; but the Clarke Telescope, of Chicago, is to the Harvard as 34 to 21, or more than one-half larger. At the late annual meeting of the Tyneside Naturalists' Field Club, however, an announcement was made by the president, that Mr. Cook, of York, was completing a telescope for Mr. Newall, of Fern Dene, Gateshead, with an object-glass double the size of that of Harvard. The Harvard has a diameter of 18 in.; the Gateshead will have 25½.

The manufactory of St. Gobain, Aisne, France, has been employed six years in fabricating a lens two feet in thickness, which it has given as a present to the Observatory at Paris, for the large telescope in course of being manufactured, the power of which will exceed that of the most powerful instrument known.

SOLAR PHYSICS.

MR. BALFOUR STEWART has described at the Royal Institution the latest discoveries concerning the Surface of the Sun, illustrated by experiments, diagrams, and models, and especially by the exhibition of photographs of the faculæ, spots, &c., taken by Mr. Warren De La Rue, and others, magnified by a lens and illuminated by the electric light. The subject was treated in the following order:—The region above the luminous envelope, termed the photosphere, the photosphere itself, and the region beneath the photosphere.

The phenomena connected with the region above the photosphere were stated to be—1. Dark lines in the spectrum, denoting the presence of vapours of the metals sodium, iron, magnesium, and of other elements above the photosphere, and of a lower temperature than it; 2. A deficiency of luminous rays round the borders of the sun's disc, also denoting the presence of an atmosphere of a lower temperature than the photosphere; and, 3. The red flames and part of the corona seen at a total eclipse, which have been proved by their motion to be connected with the sun. The red flames, by the light they emit, are considered to denote the presence of a dense atmosphere extending above 72,000 miles above the photosphere.

The phenomena connected with the photosphere are—1. The mottled appearance, compared by Mr. Nasmyth to willow-leaves, and by Mr. Stone to rice-grains, when seen by good telescopes of a high power; and, 2, the faculæ, or brighter portions of the sun's surface, generally accompanied by spots when seen near the border, and appearing much brighter than the surrounding parts. They appear to be elevated masses of luminous matter when viewed stereoscopically. As they remain for days suspended in the same position, they are probably of a gaseous or vaporous character, and neither solid nor liquid. The chief phenomena of the region beneath the photosphere are the spots, consisting of an umbra or dark centre and a penumbra; the darkness diminishing from the centre to the extremity, denoting that the centre is of a lower elevation. These spots are probably hollows in the sun's surface. Luminous ridges and detached portions of luminous matter cross over the spots, showing that the whole spot is beneath the photosphere; and the faculæ connected with the spot seen to the left of it seem to prove that the faculæ are the very luminous matter which has been taken from the region occupied by the spot, and which has fallen behind it when elevated. It thus appears that the region below the photosphere is less luminous than it is. The spots, besides partaking of the sun's rotation, exhibit a rotation of their own, moving from left to right, those near the equator moving the fastest. Observation has proved that they have also a ten-yearly period of frequency, the last maximum having been in 1859; and it is very remarkable that their maximum period corresponds with that of the greatest magnetic disturbance. These spots only appear in the sun's equatorial region; and recent observation has shown that they are influenced by the position of Venus, and probably of other planets.

At the Academy of Sciences at Paris a letter from Father Secchi to M. Faye has been read, relating to the Physical Constitution of the Sun. The Father is yet far from convinced of the existence of the phenomena likened to grains of rice or to willow leaves, and considers that they require more profound study at a period when the sun's surface will be more devoid of spots and faculæ, which will be the case in the year 1866, and when it may be ascertained whether their relative positions are maintained. In conclusion, he submits to the able observers at Kew a list of precautions which may tend to eliminate causes of error in their observations.

At the same meeting was read part of a letter from M. Montani, stating that by examining the beautiful photographs of the Moon by Mr. Warren De la Rue, he had recognised the operation of the law of M. Elie de Beaumont, which seems to rule the configuration *of the relief* of our satellite in regard to the direction of the chain *of mountains.*

M. Faye, at a meeting of the Academy of Sciences at Paris, has read a note on his theory of the Spots and Faculæ of the Sun, which he explains by ascending and descending currents, proceeding from the photosphere to the interior, and from the interior to the photosphere. He considers that the observations lately made in England confirm his ideas. He also read a note on the Rotation of the Sun around its Axis, in which he compared the calculations of Carrington and Spœrer, and found the numbers of Carrington to be certainly the more correct.

M. Faye, in relation to the above communication, has reported to the Academy that further study and the receipt of a new table from M. Spœrer have led him to the conclusion that either both these astronomers are in error, or the motion of the sun has been retarded during the six years in question.

At a meeting of the Academy of Sciences at Paris M. Faye made some remarks on a revived hypothesis of M. Erman, which attributes the Darkening of the Sun on certain occasions related in history (such as the Battle of Mühlberg, in April, 1857, when the stars were visible at mid-day) to the interposition of shooting-stars. M. Faye considers that the appearance of a mass of opaque bodies so great as to produce the phenomena of an eclipse, ought to resemble it in its approach and departure and other circumstances. He considers that the hypothesis fails for want of corroborating evidence. M. Le Verrier, speaking on the same subject, regretted that authors who had occupied their minds with the subjects relating to meteorites had not, in their statistics, distinguished the causes which might have influenced the phenomena.

The three preceding abstracts are from the Scientific News of the *Illustrated London News*.

Professor Phillips says, with reference to the new powers of Light, to aid researches into the condition of celestial bodies,—to our countryman in particular belongs the honour of successful experiments on the rose-coloured flames which extend from certain points of the Sun's border during an eclipse, as well as valuable contributions through the same agency to that enlarged survey of the Moon, which, since 1852, the British Association has striven to promote. The inventions of Ronald and his successors have also engaged the solar rays in measuring and comparing contemporaneous phenomena of the same order over large parts of the globe—phenomena some of which are occasioned by those very rays.—*Proceedings of British Association.*

TEMPERATURE OF THE EARTH AND AIR.

M. Becquerel has reported to the Academy of Sciences at Paris the results of his observations of the Temperature of the Earth from one to thirty-six metres below the surface, and the Temperature of the Air to the height of 21·25 metres in 1861-64. In regard to the former question, he states that the temperature goes on increasing from the depth of one metre downwards, except at eleven metres where the temperature was 0·102 deg. above that at sixteen metres. This anomaly he attributes to some geological cause; adding, that at no depth between one metre and thirty-six metres is the temperature really constant. The distribution of heat in the crust of the globe cannot be reduced to an unvarying law in consequence of the dissimilarity of the strata which compose it, and which also are more or less permeable by water. The observations of the air in the years 1862, 1863, and 1864, have given the mean temperatures at the height of 1·33 metres, 10·542 deg. centigrade; at 16·2 metres, 10·975; at twenty-one metres, 11·556. It is remarkable that at six o'clock a.m. the mean temperature at all the above-mentioned heights was nearly the same. M. Becquerel expresses an earnest desire that observations of the temperature of the earth at the depth of at least 200 metres should be made in order to settle various chemical and physical questions.

ICE AND GLACIERS.

PROFESSOR TYNDALL, in the *Philosophical Magazine* for December, gives a summary of a lecture, by Professor Helmholtz, "On Ice and Glaciers." The latter says, "I do not doubt that Tyndall has assigned the essential and principal cause of glacier motion in referring it to fracture and regelation." Professor Tyndall illustrates these phenomena by engravings, and gives a series of descriptions of the experiments of Faraday, Thomson, and others, including some recently made by himself, since Professor Helmholtz's revival of the subject. In a postscript he gives an extract from Professor De la Rive's opening discourse at the forty-ninth meeting of the Helvetic Society of the Natural Sciences at Geneva, in which that eminent philosopher gives an able *résumé* of the present state of our knowledge respecting glaciers, and gives his assent to Professor Tyndall's opinions as to the causes of their phenomena. The paper concludes with a description of an experiment by Mr. B. F. Duppa, made in the Royal Institution laboratory on November 16:—"Pouring a quantity of plaster of Paris into a proper vessel, an ice-ring was laid upon the substance, an additional quantity of the cement being then poured over the ring. The plaster 'set,' inclosing the ring within it. The ring soon melted, leaving its perfect matrix behind. The mould was permitted to dry, and, molten lead being poured into the space previously occupied by the ice, a leaden ring was produced. Now, ice can be moulded into any shape: statuettes, vases, flowers, and innumerable other ornaments can be formed from it. These enclosed in cement, in the manner suggested by Mr. Duppa, remain intact sufficiently long to enable the cement to set around them. They afterwards melt and disappear, leaving behind them perfect plaster-moulds, from which casts can be taken."

FORESTS AND CLIMATE.

M. BECQUEREL has recently laid before the Academy of Sciences at Paris a memoir on Forests and their influence on Climate. He dwells upon the importance of preserving them, as being so highly conducive to national health and prosperity; and refers to Palestine, Syria, and other countries as instances of sterility. In conclusion, he says that Great Britain, which has only 2 per cent. of wooded surface, and Spain, which has only 3 per cent., are tributary to the foreigner for various kinds of wood for industrial purposes. Care should be taken that France, which has still 16·7 per cent., come not into the same condition, in consequence of clearing more woodland than is required for agriculture. The planting of mountains and sandy lands with green trees will be but a poor compensation for the annihilation of forests and woods containing oaks.

THERMOMETROGRAPHIC INDICATOR.

PROFESSOR ZANTEDESCHI, of Padua, has published an account of his modifications of the Thermometrographic Indicator, by which he is able to render uniform the various scales and determine the horary, diurnal, monthly, and annual temperature of Italy. He concludes that the diurnal temperature goes on increasing, and the nocturnal diminishing. He refers to the assertion of M. Flammarion that the temperature of our globe during 2000 years has not diminished the 170th of a deg. centigrade, deduced from the constancy of the length of the day and the relation which exists between this length and the heat of the globe.

THE MICROSCOPE.

MR. WENHAM, in the *Quarterly Journal of Microscopical Science*, gives some notes on the fracture of polished glass surfaces, as observed by the microscope. We quote some particulars relating to the action of the diamond. If a clean cut made with a diamond on a piece of plate-glass be left for a time, the surface in the vicinity of the cut will break up, forming a coarse, irregular line. If the diamond be raised and struck lightly on the surface of the glass, the form of the edges of the short stroke thus made may be plainly seen, using the binocular polariscope. A conical ridge of glass appears to be left with its apex under the line of the cut, and the glass is frequently wedged up on both sides of the ridge, explaining the cause of the double line of fracture which sometimes makes its appearance in polishing out a scratch. This effect may also be exemplified by observing the marks left on a polished-glass surface from the light blows of a steel centre punch. The point of the punch drives in an atom of the glass, and the fracture extends some distance into the interior, expanding downwards in the form of a truncated cone. The polariscope shows that the conical centre is in a state of compression, and that the surrounding exterior portion of the glass is also under strain. In a paper on the application of the stereoscope to the microscope, Mr. John Browning gives some engravings representing the kind of apparatus, together with the optical arrangement, which he found to give the best results, and especially adapted for detecting the spectra of the absorbent bands of blood, the importance of which in criminal cases can hardly be over-estimated; and Mr. Beck gives an illustrated description of a live trap peculiarly suitable for the examination of small objects in water.—*Illustrated London News.*

Mr. Sorby's long-continued microscopic researches have enabled him to achieve results which a few years ago would have been thought impossible. At the second conversazione of the Royal Society, he showed, under the microscope, specimens of meteoric, Swedish, and different kinds of English iron and steel, in which the structure was, so to speak, anatomized, and the several constituents and occasions of weakness could be made out. By examination of these, even an ordinary observer would see why one kind is stronger than another. If continued, these researches may lead to conclusions of importance in the manufacture of iron and steel. In addition to these, Mr. Sorby has made a series of investigations with his spectrum-microscope of a very different kind—namely, into blood-stains. Taking up the fact, established by Professor Stokes, that the presence of blood is indicated by certain absorption bands in the spectrum, he (Mr. Sorby) shows that the minutest trace of blood may be discovered in stains in linen of months' standing. The stain may have been soaked, or painted, or otherwise disguised, but if it has not been treated with strong acid he can still detect the blood, even in a piece of the linen not more than one-eighth of an inch square. Infinitesimal as the quantity of blood therein contained must be, it produces the absorption bands in the minute spectrum, with variations according to the age of the stain. What will our scientific "detectives" say to this? Will they regard it as a natural development of Professor Stokes's researches, of which Justice may avail herself in cases of difficulty?

To facilitate the examination of living objects under the microscope, a new growing slide, as it is termed, has been introduced by Mr. H. L. Smith, an American naturalist. It is composed of two glass plates, three by two in., and about the 1-25th of an inch thick, separated by strips of the same thickness, and cemented with marine glue. One corner of the upper plate is removed, and a very small hole is drilled through the plate at the corner of the space to be covered by a piece of thin glass placed over the object, the growth of which is to be watched. The slide is filled with water by means of a pipette applied to the open corner, and when the covering glass is placed over the little hole, water slowly oozes through by capillary attraction. By this means an object may be kept moist for a period of three days.

About a year since, one of the most eminent living microscopists expressed his conviction that in the production of object-glasses with a 1-25th of an inch focus the microscope had reached its utmost attainable limit of perfection. He added that "it appears impossible to separate or define lines more numerous than 90,000 in an inch, on account either of the decomposition of light, or some other cause. It therefore seems beyond our power ever to discover more of the ultimate composition of bodies by means of the microscope." Yet, an object-glass with a one-*fiftieth* of an inch focus, has since been made by Messrs. Powell and Lealand, and described to the Royal Society by Mr. Lionel Beale. This object-glass possesses *double* the power of the one which we were so lately told, and by so great an authority, was the most powerful we must ever expect to possess, and defines with wonderful distinctness particles which the latter cannot render visible at all. It magnifies 3000 diameters, with the low eye-piece, or, with a Number Five eye-piece, 15,000 diameters—that is to say, in popular parlance, 1,575,000,000 of times! It must immensely increase our knowledge of the lower organisms, and may even aid our researches into the ultimate constitution of matter.

ON GRAVITY AND MAGNETIC INCLINATION.

In the *American Journal of Science*, Mr. P. E. Chase, after remarking on Father Secchi's conclusion that "The phenomena hitherto known of the diurnal magnetic variations may be explained by supposing that the sun acts upon the earth as a very powerful magnet at a great distance," describes some of these anomalies, and points out some relations existing between the gravitation currents and the dip of the needle. By reference to the observations of Sabine, Bache, and others, he finds that the greatest daily disturbance of inclination occurs about noon; that at (magnetically) inter-tropical meteorological stations the dip is diminished, but at extra-tropical stations it is increased in the middle of the day; and that increasing temperature and increasing solar altitude augment the inclination curves. In addition to these conclusions, Mr. Chase states that, in regard to the declination, the currents manifest a tendency to follow the lines of most direct ocean communication between the warmest and the coldest portions of the globe, the general declination being westerly in the Atlantic and easterly in the Pacific Oceans. We have no space for further results, but merely add that, in relation to these questions, Mr. Chase refers to the prophetic remark of Professor Faraday, that "a few years ago, magnetism was to us an occult power, affecting only a few bodies; now it is found to influence all bodies and to possess the most intimate relations with electricity, heat, chemical action, light, crystallization, and, through it, with the forces concerned with cohesion; and we may, in the present state of things, well feel urged to continue our labours, encouraged by the hope of bringing it into a bond of union with gravity itself."—*Illustrated London News.*

SYSTEM OF MAGNETIC OBSERVATIONS.

PROFESSOR PHILLIPS, as President of the British Association, in his inaugural Address remarks:—"By no sudden impulse or accidental circumstance, rose to its high importance that great System of Magnetic Observations, on which, for more than a quarter of a century, the British Association and the Royal Society, acting in concert, have been intent. First, we had reports on the mathematical theory and experimental researches of magnetism by Christie, 1833; Whewell, 1835; and Sabine, 1835; afterwards, a magnetic survey of the British Islands; then the establishment of a complete observatory at Dublin, with newly-arranged instruments, by Dr. Lloyd, in 1838. On all this gathered experience we founded a memorial to her Majesty's Government, made a grant of 400*l.* from our fund for preliminary expenses, and presented to the meeting of this Association in Birmingham, in 1839, a report of progress, signed by Herschel and Lloyd. From that time how great the labour, how inestimable the fruits! Ross sails to the magnetic pole of the south; America and Russia co-operate with our observers at Kew, Toronto, and St. Helena; and General Sabine, by combining all this united labour, has the happiness of seeing results established of which no man dreamed—laws of harmonious variation affecting the magnetic elements of the globe, in definite relation to the earth's movement, the position of the sun and moon, the distribution of temperature, and the situation in latitude and longitude."

At the first reception held by General Sabine, President of the Royal Society in 1865, was a pair of Astatic Needles, constructed and exhibited by Captain Selwyn, which presented effects hitherto unknown to magneticians. They are connected by a slender vertical bar of aluminium; but in the upper needle there is no apparent north pole; in the lower needle no apparent south pole. And when under the influence of a galvanic current, the needles behave in a peculiar way, placing themselves in an unusual angle. The meaning of this has yet to be found out; and it is thought that the investigation may lead to important results in connexion with the phenomena of magnetism generally.

A Magnetic Needle, for showing rapid and minute alterations of declination, has been exhibited at a meeting of the Philosophical Society of Manchester, by Dr. Joule. The following description of it is given in the report of the meeting by the *Chemical News*:—"It consisted of a piece of hardened and polished watch-spring, an inch long and one-tenth of an inch broad, suspended vertically by a filament of silk. The steel was magnetised in the direction of its breadth. Dr. Joule remarked that Professor Thomson had long insisted upon the advantages which would attend the use of very small bars in most magnetical investigations, and had employed excessively minute needles in his galvanometers with great success. Dr. Joule stated his intention to fit up his needle so as to be observed by light reflected from its polished surface or otherwise, by viewing a glass pointer, attached to the bottom of the steel, through a microscope. He believed that, by the latter plan, he should be able to observe deflections as small as one second of an arc."

MONITOR COMPASS.

MR. RITCHIE's Monitor Compass, as used in the United States Navy, is a tall column filled with liquid with the needle atop and the card at the bottom, where it is seen through a glazed opening at the level of the steersman's eye. The two—that is, the needle and the card—are connected by a rod, which is, of course, balanced by the liquid, and so has free movement. But as neither needle nor card were shown in motion, we had no means of judging whether the card obeys the motion of the needles so promptly as, essentially, it ought to do. In any case the mode of construction deserves consideration. The inventor has patented his compasses in Europe as well as America.

COLLISION OF SHIPS.

THE fatal accidents at sea by the Collision of Ships with icebergs have induced Mr. Alexander Bryson to construct an instrument for the purpose of avoiding such dangers. The apparatus consists of—first, a series of electro-magnets acting on three permanently magnetic needles, which make indications on three separate dials; second, the detector proper, a large Melloni's pile of several hundred elements of bismuth and antimony, placed below the foretop of the steamer; third, the galvanometer, which receives a register by the deflection of the needle. When a mass of ice is brought to one end of the Melloni's pile the needle of the galvanometer is at once deflected, the deflection being in the ratio of the proximity or size of the mass to which the heat of the pile is radiating. If an iceberg be on the starboard bow the needle of the galvanometer is deflected and makes contact, by means of mercury, with a battery connected with the usual alarm-bell used in telegraphing. Three bells may be used if required, and an arrangement may readily be made for firing a cannon by means of a detonating fusee. Mr. Bryson has received a medal for his invention from the Royal Scottish Society of Arts, to some of whose members he gave an open-air exhibition of its action, and in whose *Transactions* his description of it has been published.

THE COMPASS AND IRON SHIPS.

M. FAYE has laid before the Academy of Sciences at Paris a method of avoiding the errors of the Compass from the action of Iron, now largely employed in the construction of ships. Two means of correction are used in England and France. In one, suggested by our Astronomer Royal, Professor Airy, the magnetic action of the iron upon the Compass is neutralized by placing near it powerful magnets, the action of which is calculated to produce upon the needle equal effects, but opposite to those of the ship. The other mode, due to M. Poisson, is based upon the observation of these parasitical actions, and the determination of a law therefrom, which has led to the construction of a table of corrections applicable to every indication of the compass affected. In spite of these precautions fatal accidents are still attributed to errors of the compass. In the *Comptes Rendus*, vol. 61, No. 7, will be found details of M. Faye's method and the apparatus employed, which he now publishes in consequence of the publication of the correspondence between the British Board of Trade and the Royal Society. The plan consists of such modifications of the log of the vessels as would show not only the velocity but also the direction of its motion and the errors of the compass, and which, in cases of shipwreck, would certainly determine whether the calamity was really due to those errors.

In the *Proceedings of the Royal Society*, No. 76, we have the correspondence between the President of the Society, General Sabine, and the Board of Trade, on the magnetism of ships (now so much affected by the introduction of iron into their structure, whereby the risk of shipwreck is frequently incurred); and also the correspondence between the Meteorological Department of the Board of Trade and the Royal Society respecting the desirability of continuing the system of coast warning inaugurated by the late Admiral Fitzroy, and its scientific character. Mr. T. H. Babington, in his letter, gives numerous interesting details of the working of the system; and General Sabine and the council speak highly of the system, and the information thereby obtained; they also recommend that the storm warnings should be continued under the superintendence of Mr. Babington, but decline to give any opinion respecting the daily forecasts of the weather.

THE VOLTAIC BATTERY.

MR. GASSIOT has read to the British Association, a paper "On the Change of Form and Colour which the Stratified Discharge assumes when a varied resistance is introduced in the circuit of an extended series of the Voltaic Battery." Mr. Gassiot operates with a battery composed of 4000 insulated glass cells, and instead of sulphate of copper, as used by Professor Daniell, he puts about a tablespoonful of sulphate of mercury into each cell. The elements, carbon and amalgamated zinc, are then introduced into the cells, which are subsequently filled with rain-water. When one of the wires of the battery is inserted in the water, and the other wire touches the moistened surface of the glass, but is not in actual contact with the water, a luminous discharge is produced, entirely filling a tube which is prepared to receive it, without any appearance of stratifications. On depressing the wire, discs of red light are rapidly produced from the positive pole; and on further depression nineteen only of these discs remain in the tube, and these are much increased in brilliancy and distinctness.

NEW ANEMOMETER.

The balloon ascents of Mr. Glaisher would be of very different value if there were no such things as scientific instruments. It is principally the delicacy and perfection of the instrument he takes with him into the "firmament on high" that make his observations so exceedingly desirable. This intrepid *savant* has expressed his approval of a New Anemometer by Mr. C. Cator. The instrument hitherto used for ascertaining the pressure and velocity of wind was made by Mr. Osler. In Mr. Cator's anemometer, the pressure of the wind is measured by two curved levers of equal length acting against each other, their motion being in a vertical plane. Mr. Osler had used springs—a light spring for a light air, and a strong spring for a gale. The pressure-plate, or surface upon which the wind acts, shows the greatest departure from previous forms. This is the base of a cone, the axis of which is horizontal and attached to a bar, by which it is moved backwards and forwards on friction-rollers. This much of the instrument must be out of doors; but a chain attached to the horizontal bar passes down a tube, and is connected with the rest of it within any building fixed upon. At one end of the upper of the two curved levers mentioned there is a fixed weight, and to the opposite end of the under one is attached the end of the connecting-chain. When there is a calm, the point of contact is at the fixed weight. When the wind blows against the pressure-plate outside, it causes the chain to lift up these levers, and then the point of contact moves to the other end; and as the pressure subsides, the levers readjust themselves. Attached to the under one is a string, which draws a pencil to and fro along a cylinder in the direction of its length, which cylinder, revolving on its axis by means of clockwork once in twenty-four hours, is covered with paper, on which the pencil-marks are made. The ground of Mr. Glaisher's approval of this instrument is the preference of curved levers over springs, as well as its inexpensive simplicity.—*Builder*.

IMPROVED BAROMETER.

Mr. W. Symons has effected some improvements in marine and mountain Barometers, and in maximum Thermometers, with indices, which appear to be of value. Marine barometers, as before constructed, were liable to fracture from sudden concussions, such as the firing of a large gun. This is one of the disabilities Mr. Symons has removed by substituting an elastic support for the tube for its usual rigid fixture into the cistern. Mr. Symons has distributed a considerable number of his thermometers, in which he has substituted a composition, the basis of which is clay, for the graphite generally used, which, owing to occasional impurities, sometimes corrodes the mercury and soils the tube, and has been rewarded for his numerous experiments by hearing of no failures. Two French *savans* have also turned their attention to variations of these instruments. The Abbé Jeannon has devised a free-air barometer and thermometer of peculiar sensitiveness; and M. Naudet has constructed a metallic, or "holosteric" barometer.

CLOUD MEASUREMENT.

PROFESSOR CHEVALLIER has devised a little instrument for ascertaining the height of a Cloud. This consists of two horizontal jointed rulers, graduated from the centre of the joint, the unit of gradation being the length of an upright sliding-piece, movable upon either of the rulers. To take the height of a cloud, one branch of the rulers is directed towards the shadow of a cloud, the horizontal distance of which shadow from the place of observation can be ascertained; and the other, with the vertical sliding-piece, is directed towards a vertical line drawn through the point of the cloud which casts the shadow. When the inner edge of the sliding-piece is made to touch the inner edge of the other horizontal ruler, an exact miniature representation of the known horizontal distance of the shadow from the observer is given on the ruler and sliding-piece, as well as the height of the cloud above the horizontal plane on which the shadow falls. Clouds, by-the-bye, have been recently found to exercise a peculiar influence upon photographs of scenery. Views taken beneath the clouds do not reproduce distant details, such as the foliage and stones on hill sides. The magnifying-glass applied to them reveals only a bare and hazy surface, or indistinctness. Those taken above the clouds, on mountain tops, give the minutest details at the distance of miles. The photographs taken by Prof. Smyth, in Teneriffe, exhibit this fact markedly. Those taken at high elevations depict every little bush upon a hill-side 4½ miles distant from the camera.

A REGULATING THERMOMETER.

A THERMOMETER that will control the temperature of the surrounding medium and maintain it at any required degree of heat must be invaluable for hospitals, greenhouses, laboratories, for the hatching of eggs, silkworms, and for any case in which a uniformity of heat is necessary. A new instrument invented by M. Jules Maistre, has perfectly succeeded in accomplishing this object, and it is thus described:—A mercurial thermometer is provided with two pieces of platinum wire, one dipping into the mercury in the bulb, and another entering a certain distance into the stem. These wires are connected with the poles of a galvanic battery, so that when by the application of heat the dilation of the mercury causes it to touch the upper wire the electric circuit will be *complete*. The valve by which heated air is admitted to an apartment *is made to* open and shut by means of a lever attached to an electro-magnet, also in communication with the wires of the thermometer. Supposing that it be required to admit a supply of hot air so as to maintain a temperature not exceeding 86 deg., the upper platinum wire is let down as far as the given degree and the tube closed hermetically. When the expansion of the mercury has reached 86 deg. the circuit is rendered complete, and the electro-magnet raising the lever shuts the valve for admitting the heated air. On the temperature falling below 86 deg. the current is intercepted again by the mercury retreating, the lever falls, and the valve admits more hot air.

This apparatus can be usefully applied to some cases not mentioned by the inventor. The thermometer may be readily connected with an alarm-bell, or series of alarm-bells, in the event of undue heat taking place, or spontaneous combustion, or accident from fire occurring in any dwelling-house, shop, warehouse, store, or in the hold of a ship.—*Builder*.

CHRONOMETER-MAKERS.

Mr. J. Steel, Quarter-Master, R.E., has addressed, from the Ordnance Office, Southampton, the following interesting letter to the *Athenæum*:—

Referring to the opinions of Sir G. C. Lewis and Prof. De Morgan relative to the proportion of merit due to the chronometer-maker, and to the refinements of modern astronomy in determining a longitude, would you kindly allow me space to give your readers an instance, somewhat in detail, of what really is done by men whose duty it is to do this sort of work. Since receiving the *Athenæum* of the 19th inst., my first opportunity of obtaining suitable observations was last night, when by observing the culminations of four stars, I obtained the results for longitude following :—Chronometer fast by μ Hercules, + 7·46; by α Lyræ, + 12·74; by β Lyræ, 3·55; by ξ Aquilæ, 5·36; Mean, + 2·82. Chronometer slow of Greenwich = 5, 39·90; therefore Longitude observed is West = 5, 42·72; but Longitude true is West = 5, 36·40. Now in reducing the observations to this result, I used no longitude tables, such as Margett's, no lunar distance tables, such as Taylor's, no logarithms whatever, no trigonometrical formulæ of any kind, no previous knowledge of the latitude or the direction of the meridian, nor any modern refinement of astronomy. The right ascension of the stars, such as could be supplied by the means employed by Flamsteed 200 years ago, and any altitude instrument, such as a sextant or small alt-azimuth (the latter was used for these observations, but the former is the better instrument in various ways), and a chronometer giving Greenwich time, are more than sufficient for even better results than this. I make no mention of latitude, because it is understood to be an element much easier determined, and to a higher degree of accuracy, than the longitude. Such are the facts; but as to the *opinions* on relative merit, or as to whether the results are equal to such as are obtained at sea by the nautical staff of, for instance, the *Great Eastern*, at the laying of the Atlantic cable, I leave this to every man to form his own. Allow me to add, that few men can possibly enjoy Prof. De Morgan's "Budget" so much as I do. I only wish he would strike at the errors of such writers as Gumpach on the Figure of the Earth with the force shown in his last number.

THE TOPOGRAPH.

This New Surveying Instrument, by Captain Lendy, will enable any one readily to survey a road, sketch a country, find the height of buildings or mountains, and to represent with accuracy the features of the ground of any district. It may be used as a prismatic compass, as a level, or a clinometer, as a plane table with its sight ruler alone, and as a plane table or compass combined to facilitate the finding of stations. Its manipulation is of the simplest kind, and there is no need of scales, measuring-compasses, or protractor; the machine itself protracting the angles and laying down the distances to scale. Its weight is under a pound avoirdupois.

CHRONOGRAPH.

By an appropriately-named Great Trigonometrical Survey, India is to be surveyed as completely as England or Ireland has been, by the Ordnance Survey: and an important part of the operations will be, the determining of differences of longitude. This involves observation of stars, not by the method in use but a very few years ago, which, by relying on the eye, ear, and quickness of apprehension of the observer, left much room for error, but by substituting a Chronograph. The observer, as the star traverses the field of his telescope, has only to touch a small ivory key, and on the instant a dot appears on the sheet of paper wound round the barrel of the chronograph. Connect the instrument with an astronomical clock, and you have a dot for every beat of the pendulum, so that the exact time of the passage of a star can be determined to the hundredth of a second. The chronograph by which these results were shown at the first reception of the President of the Royal Society, 1865, is one of two magnificent instruments constructed in Paris, under the care of Lieut. A. Strange, for use in India.—*Athenæum.*

THE HELIOTROPE.

In topographical surveys, as is well known, much use is made of sun-signals flashed from one high elevation to another, fifty or seventy miles apart. But in practice some difficulty is experienced in so placing the mirror or plate of polished metal at the exact angle for catching the sun and transmitting the flash. This difficulty is overcome in the Heliotrope, invented by Professor W. H. Miller, Foreign Secretary of the Royal Society. It is a small parallelogram of thick silvered glass, from which, at one corner, a portion of the silver about the extent of a pin's head has been removed. The observer looking through this small hole directs the mirror to the sun, and when he sees an image of the sun reflected on the two angles of the glass under the hole, he may then be sure that the mirror is in the true position for flashing the signal.—*Athenæum.*

NEW LEVELLING INSTRUMENTS.

At the second Conversazione of the President of the Royal Society has been exhibited Mr. Browning's New Levelling Instrument, which offers to travellers everywhere, and especially in mountainous regions, a ready means of determining differences of level. The instrument resembles a telescope about nine inches in length. On placing it to the eye, there are seen at the outer end a bubble and a wire; when the bubble appears to be exactly bisected by the wire, the observation is complete, and the difference of level is shown to within two feet, which, for the majority of travellers, would be near enough to accuracy. Doering's Levelling Instrument, exhibited by Messrs. Elliott Brothers, is also worth mention. It is intended for land-surveying generally and railway work, and being hung in gymbals, after the manner of a ship's compass, maintains its level on hilly and uneven ground.

VACUUM APPARATUS, AND DIFFERENTIAL PRESSURE GAUGE.

At the second Conversazione of the President of the Royal Society, Dr. Sprengel's apparatus for producing a vacuum was exhibited by Elliott Brothers, demonstrating the practicability of obtaining a vacuum more perfect than that of the air-pump, and, with a galvanometer specially fitted for the purpose, the same firm showed that the development of heat in the growth of plants could be made apparent. The differential pressure gauge, exhibited by Messrs. Siemens, indicates small differences of air-pressure on an enlarged scale, by two liquids of slightly different specific gravity, which present a permanently distinct line of contact; and their improved differential galvanometer, which has one movable coil and a vernier reading, expresses the resistance to be ascertained without the aid of resistance coils.—*Athenæum.*

MECHANICAL EQUIVALENT OF LIGHT.

For some time past it has been considered certain that Light is capable of producing mechanical effect; but the relative amount of the latter was not hitherto determined. We have now, however, obtained the desired information on this point, by means of the researches of Professor Thomsen, of Copenhagen. He changed the light into heat, and then estimated the mechanical effect which the heat was capable of producing.

For this purpose he caused a beam of light, freed from all caloric rays, by transmission through a layer of water, to pass to a thermopile; and the heating effect thus produced was determined by the deflection of the multiplier.

During these experiments, various modifying circumstances were to be taken into account; thus, the absorption of luminous rays by the water was found to be 0·13, and this was to be allowed for. The indications of the thermomultiplier were compared with the absolute radiation of heat; and it was ascertained that only one-seventh of the entire heat disengaged leaves the flame as radiant heat and light, the remaining six-sevenths being carried away by the heated air; but the more intense the light, the greater the radiation.

The conclusion arrived at was, that a flame whose luminous intensity is equal to that of a candle which burns 126·5588 grs. of spermaceti per hour, radiates per minute, light which, changed into heat, would raise the temperature of 63·28 grs. of water 1·8° Fahr.; and that light, whose luminous intensity is 34·9 times as great as that of the spermaceti candle, would raise 15,434 grs., or about 2 lbs. 3½ oz. avoir., one metre (39·37 in.) high in a second—that is, would perform a unit of work.

The experiments were made with the light obtained from a spermaceti candle, a gas flame, and a moderateur lamp. Solar and electric light have not yet been examined.

Some curious calculations have been founded on the above results. Taking the total light of the sun as equal to 1230 septillions of spermaceti candles, and that it would produce proportional effects, it would lift a weight equal to that of the earth twenty feet per second.—*Scientific Review.*

LIGHT-MEASURING INSTRUMENTS.

M. Soleil has invented an instrument to illustrate the invisibility of light, which he calls a Tenebroscope. It is a tube blackened on the inside, having one end open and the other closed, with a wide opening in the course of its length, by which a strong light is admitted crosswise through it. On applying the eye to the open end of the tube, this stream of light is perfectly invisible; but the raising of a small ivory ball into the course of its rays, by means of a trigger, reveals its existence by reflecting a portion of its light. After realising the fact of the invisibility of light by the optical demonstration thus afforded, we contemplate with a new interest the heavenly bodies set in the firmament "to give light upon the earth, and to rule over the day and over the night." M. Soleil has also invented a new Micrometer, which the Abbé Moigno exhibited to the members of the Association for the Advancement of Science at their Congress at Newcastle-upon-Tyne. It consists of two Ramsden's eye-pieces—one fixed near the object to be measured; the other movable, to suit the vision of the observer, with a ruled glass micrometer-plate placed between them. The Abbé explained that the magnifying power of the eye-piece being ascertained by a comparison of the object as seen directly, with the same object seen through the micrometer, it became, by certain adjustments, applicable to the telescope, microscope, and even to goniometry.

COMBINATION OF LIGHT.

By means of the Stereoscope, Professor Rood, of Columbia College, has been studying the combination which takes place when light of different tints is presented to the right and to the *left eye.* He confirms the statement of De Haldat, Dové, and others, that, when differently-coloured glasses are held before the two eyes, a combination of the two tints takes place in the brain, the resultant impression being the same as would have been produced by mixing the two tints together and presenting the compound colour to a single eye. Vermilion and emerald green produced sometimes a red grey and sometimes a green grey; vermilion and ultramarine gave a red purple; golden yellow and Prussian blue gave a nearly pure grey, &c. The tints were subject to variation. The Professor also examined the effects of the binocular union of complementary tints produced by polarised light.

MEASUREMENT OF LIGHT.

PROFESSOR H. E. ROSCOE has reported to the Royal Society a method of Measuring the chemical action of total Daylight adapted for regular meteorological registration, and based upon a method described by Professor Bunsen and himself in their paper on "Photometrical Measurements." It depends upon the law that equal products of the intensity of the acting light, in the times of insolation, correspond, within very wide limits, to equal shades of dark tints produced upon chloride of silver of uniform sensitiveness, measured by means of a pendulum photometer. In the society's *Proceedings*, No. 70, will be found the method of procedure, and specimens of the results obtained, and a diagram exhibiting the curves of daily chemical intensity at Manchester in spring, summer, autumn, and winter.—*Illustrated London News.*

POLARIZATION OF THE ATMOSPHERE.

SIR DAVID BREWSTER, in a paper in the *Philosophical Magazine* on the Polarization of the Atmosphere, among other conclusions, expresses his opinion that the determination of the place and angle of maximum polarization affords a highly probable explanation of the azure colour of the sky. Sir Isaac Newton considers this colour to be a "blue of the first order, though very faint and little: . . . for all vapours, when they begin to condense and coalesce into small parcels, become first of that bigness whereby such an azure must be reflected." Professor Clausius considers the vapours to be vesicles or flattened bladders, and ascribes the blue of the first order to reflection from the thin pellicle of water. But Sir David, after referring to Mr. Glaisher's balloon observations, expresses his opinion that the exceedingly deep Prussian blue cannot be so produced, but must be caused by reflection from the molecules of the air, whose polarizing angle is 45 deg. The faint blue of the sky at the earth's surface is not blue of the first order, but merely the blue of the second and third order, rendered paler by the light reflected from the aqueous vapour in the lower region of the atmosphere. In the same number we have Dr. W. von Bezold's observations on the behaviour of solid insulators, from which he concludes *that electrical movements* can take place in the interior of insulators; that these movements are occasioned in part only by the action at a distance of the electricities collected upon external conductors; and that they take place much more quickly at high temperatures than at low ones.—*Ibid.*

POLARIZED LIGHT.

WITHIN the last two years M. Dubosch Soleil has applied with great success one of the most complicated laws of light—viz., Polarized Light—to the commercial estimation of the various qualities of sugars. By this process the sugar-refiner, or any other person interested in that product, is enabled to ascertain in half an hour exactly the amount of crystallized sugar there is in a given sample, as compared with the quantity of non-crystallizable, or what is commonly called treacle. M. Dubosch Soleil's apparatus is considered so accurate that the French Government has adopted it to determine the value of raw sugars imported into the country, and the customs duties are levied upon the results given by this instrument. This apparatus, called "Polarizing Saccharometer," is based on the peculiar property which light has when polarized, or when its rays are received at an angle of 35 deg. 25 min. on a plate of tourmaline or a mirror. M. Dubosch Soleil's apparatus enables him to work with polarized light, which presents the various colours of the spectrum in such a way as to enable him thereby to determine the amount of crystallizable sugar in any given quantity of the article sufficiently accurately for all commercial purposes.

VISION UNDER WATER.

MR. FRANCIS GALTON has read to the British Association a paper "On Spectacles for Divers, and the Vision of Amphibiæ." Mr. Galton began by noticing the fact that bathers who open their eyes when they have dived find that they can see nothing distinctly. This arises from their eyes being out of focus. The cause of this indistinctness is, that the water touching the eye converts it, as it were, into a plano-concave lens. To correct this, Mr. Galton attaches to the eye a convex lens of sufficiently high power to counteract the flattening effect of the contact of the water on the lens of the eye. Furnished with spectacles constructed on this principle, a diver can see under water, though not to a great distance, as clearly as in the open air. Mr. Galton added, there were many animals that could see under water, such as the otter, water rats, &c. The cornea of the seal appeared to be remarkably flat, but it was otherwise in the rest of the amphibiæ—in fact, he should say they were notably convex, and this was inexplicable on any theory of the physiologists. A theory to account for the fact has yet to be found.

THE COLOUR OF GOLD.

SOME years ago, when making experiments on the determination of the amount of Gold in native alloys, it was found that when the gold was doubly precipitated from its nearly mutual solution, by the addition of oxalic acid, it occasionally happened that an extremely thin film of metallic gold would attach itself rather thinly to the glass vessel in which the precipitation had been conducted; and when the vessel was dry, this film, with light transmitted through it, showed a fine blue colour, instead of green, which is generally attributed to metallic gold in a very fine state of division. On making experiments, in conjunction with Dr. Lloyd, it was ascertained that when gold is subjected to the action of transmitted light, side lights being excluded, there was no doubt remaining but that blue was the true colour of gold as thus viewed, and not green, and that this colour proceeded from the metallic gold itself.

MOLECULAR PHYSICS.

PROFESSOR NORTON'S Memoir on Molecular Physics, in which he expounds a general theory of molecular forces and molecular constitution of bodies, founded on the latest researches of Faraday, Tyndall, Riess, Schönbein, and other eminent philosophers, is continued in the *American Journal of Science*. This theory is based upon the assumption (1) that matter exists in the three different forms of ordinary or gross matter, an electric ether, and a more subtle universal ether, and that each of these is made up of spherical atoms; and (2) that there are two primary forces—attraction and repulsion. In his latest papers, Professor Norton applies his theory to the elucidation of the various phenomena of electricity and magnetism, and illustrates his views by engraved diagrams.

THE NERVOUS SYSTEM.

PROFESSOR MARSHALL has delivered, at the Royal Institution, a series of lectures on the Nervous System, from which the following extracts are remarkakle:—

In the third lecture the Learned Professor made some remarks on the electric nerve-current, compared with the ordinary electric current, and dwelt on the results obtained by Helmholtz from his elaborate and ingenious experiments, especially those which determined the rate of motion in nerve-current to be about 200 ft. in a second. Professor Marshall then proceeded to trace the gradual appearance of an elementary nervous system in the lowest form of animal life only visible by means of the microscope, to the highly-developed complex arrangement in vertebrate animals, referring to their forms represented in coloured diagrams, and stating how gradually the nerves become instruments of motion, of sensation, and in the *vertebrate animals*, of will. He added that, although systems of classification of animals by their nervous systems had failed, yet evidence of a common plan in the structure of nerves in the animal kingdom was very evident when closely observed. This he especially pointed out by reference to diagrams exhibiting the nervous system in man and in a leech.

Professor Marshall, in his eighth Lecture, gave an exposition of the motor functions with the consideration of physical movements—the combination of mind and matter, which he divided into three kinds—ideational, emotional, and volitional. When sensations are changed into perceptions they become the food of the mind by giving rise to ideas, which are acted upon by attention, memory, association, comparison, analysis, synthesis, and generalisation. Emotions are intellectual sensations, with motional accompaniments, and ideas and emotions are equally motive, reason acting on both. Action in the lowest animals, being brainless, is merely instinctive, reflex, or sensori-motor; but in the higher animals action is found to be more or less physical in proportion to the size and development of the brain. Laughter was especially commented on, as being a sensori-motor act when produced by tickling, but as a psychical one when occasioned by ludicrous ideas, by emotions, or by the influence of the will (as by actors). Imitation, locomotion, and manipulation are special volitional acts. By the help of large coloured diagrams the parts concerned in these acts were fully described, the cerebrum, or brain, the hemispheres and their convolutions and structure, and the functions of each part discussed, reference being made to evidence based upon experiments and the phenomena of disease. The co-ordination of all our actions, so remarkable in man, was ascribed to the cerebellum, or little brain, which seems to act as a guide in these wonderful psychical movements. Paralysis, due to a portion of the cerebellum being injured or diseased, is a painful evidence of the importance of this regulating and controlling power. All these acts are associated with sensation and dependent on it.—*Illustrated London News.*

RESTORATION OF ANIMAL LIFE.

Dr. B. W. Richardson has communicated to the Royal Society an account of certain important experiments performed with the view of inquiring into the possibility of restoring the life of warm-blooded animals in cases where the respiration, circulation, and ordinary manifestations of organic motion are exhausted or have ceased. He states that this memoir is merely preliminary, and intended to show the present doubtful state of our knowledge. His experiments consisted of attempts to produce artificial respiration and circulation, and to increase the temperature of the body. In conclusion, he states that he has shown in his memoir that artificial respiration is only of service when blood from the heart is being still distributed over the capillary surface of the lungs—that the process is simply one of fanning an expiring flame, and of no use when the flame has expired; but he is led to a further conclusion that when the heart has ceased to supply blood to the pulmonic capillaries during the period previous to coagulation the blood may be driven or drawn over the pulmonic circuit, may be oxidised in its course, may reach the left side of the heart, may be distributed over the arteries, and that thus distributed, it possesses the power of restoring general muscular irritability and the external manifestations of life. Hence he infers that resuscitation, under the limitation named, is a possible process; and that it demands only the elements of time, experiment, and patience for its development into a demonstrable fact of modern science.—*Ibid.*

STAMMERING.

M. Chervin, director of the Institution des Bègues at Lyons, has published some curious statistics on Stammering, embracing a period of ten years from 1852 to 1862, and derived from the trustworthy archives of the Ministry of War. They show that within that period 6773 conscripts were exempted from military service on account of stammering, and that the decennial average of such cases is 3 in 1000 for all France, and 5 in 1000 for the department of the Seine. M. Chervin added to his report a map of the geographical distribution of stammerers in France, which shows that the north contains fewer sufferers from this infirmity than the south, the north-east being most free from this defect, and the south-east the most afflicted.

VITALITY OF YEAST.

M. A. Béchamp, in the conclusion of a note on the Physiological Exhaustion and Vitality of Yeast, read at a meeting of the Academy of Sciences at Paris, states that the results of his several experiments are contrary to the opinion of Mitscherlich, who thought that the globules of ferment, well washed with water, are entirely deprived of their property of acting on cane-sugar. M. Béchamp asserts that this yeast still continues to act on cane-sugar, since it has not ceased to live; and that, when it is so exhausted, it is simply reduced to its cellule, and will yet form grape-sugar and alcohol from cane-sugar. "The property of creating fermentation," he says, "is not to be sought in the catalytic action of some chemical compound which it may contain; it dwells—and everything seems to prove it—in the properties of the living cell; it is a consequence of the act of the nutrition of this cell." These conclusions are contrary to the opinion of Liebig, who says—"The insoluble body termed ferment does not provoke fermentation."

Electrical Science.

NEW BATTERIES.

MR. LADD has exhibited to the Royal Institution a new form of Thermo-electric Battery which has recently been devised by M. Marcus, of Vienna, and which appears to constitute a very cheap and simple means of converting heat into electricity. Our knowledge of thermo-electricity dates only from 1832, in which year Professor Seebec, of Berlin, discovered that if a bar of one metal be soldered or otherwise intimately united to a bar of another metal in such wise that the two bars shall form a kind of letter V, and the ends of the bars corresponding to the upper extremities of the two limbs of the letter be united by a piece of wire, an electric current will be generated if the point of junction of the two bars be brought, either by heating or by cooling, to a different temperature from that of the rest of the circuit. By connecting together a number of such pairs of bars, he constructed a thermo-electric pile, or battery, modifications of which, although they have never until now been found of much practical value, regarded merely as a means of generating electric currents, have in other ways been of immense service to science. The metals differ greatly in their thermo-electric properties, bismuth being the most thermo-positive and antimony the most thermo-negative, and a pile constructed of small plates of these two metals, in a mode first practised by Nobili and Melloni, in 1831, constitutes the most delicate means known of indicating minute changes of temperature. This instrument, known as "Melloni's pile," is so sensitive, as a thermoscope, that it is affected by the warmth of the hand held at a distance of several yards from it, and we may safely say that without its agency the important discoveries respecting radiant heat which have recently been made by Tyndall and others, and which are one of the great triumphs of our generation, would have been impossible.

The metals which are positive, in their thermo-electric relations, are bismuth, silver, platinum, copper, gold, tin, and lead, bismuth being the most powerfully positive, and the other metals of the series decreasing in positivity in the order in which they are here named. The thermo-negative metals are zinc, iron, and antimony, zinc being the least negative and antimony the most so, and iron being intermediate between the other two. Thermo-electric currents will of course be powerful in proportion as the couples from which they are obtained consist of a highly positive metal associated with a highly negative one, and it is because the cheaper of the thermo-positive metals—copper, tin, and lead—are thermo-positive in only a very moderate degree, and the cheaper of the thermo-negative metals—zinc and iron—thermo-negative in a but little greater degree, that thermo-electric batteries have been until now confined to very small dimensions, and used only as thermoscopes, and not at all as generators of currents to be employed for technical purposes. No cheaper metals than bismuth, silver, platinum, and antimony possessing equally powerful thermo-electric properties, M. Marcus was led to investigate the thermo-electric properties of alloys, and he has found that these are very different from the mean of those of the constituents of the alloys, and that alloys may be obtained which make as powerful a thermo-element as the most powerful thermo-electric of the simple metals. He finds that an alloy consisting of ten parts of copper, six parts of zinc, and six parts of nickel (the addition of one part of cobalt is advantageous, but is not essential), constitutes a very powerful thermo-positive element, and an alloy of twelve parts of antimony with five parts of zinc and one part of bismuth a very powerful thermo-negative element. Almost equally powerful are an alloy of sixty-five parts of copper with thirty-one parts of zinc as the positive element, and an alloy of twelve parts of antimony with five parts of zinc, but without any bismuth, as the negative element. Both these negative alloys melt at about 600 deg. centigrade, but the positive alloys do not melt under 1200 deg. centigrade. The high temperature which they will thus bear is a very great advantage, since the current yielded by any given thermo-electric circuit will be the more powerful the greater the difference between the temperature of the hottest part of the circuit and that of its coolest part. M. Marcus arranges the construction of his batteries so that only the positive elements shall be directly heated, the negative elements receiving heat only by conduction, and he is thus enabled to have one extremity of each positive element heated intensely by direct contact with incandescent fuel, while the other extremity is kept cool by means of a stream of cold water. He is now making a battery which is to consist of between seven and eight hundred couples, and to be heated by a furnace which consumes two hundred and forty pounds of coal per day, and he expects this battery to yield currents of almost unprecedented intensity. The mode of construction of his batteries we must describe on another occasion, only adding now that the battery exhibited by Mr. Ladd, although of very insignificant dimensions, consisting of only ten small pairs of bars, heated by ten small jets of gas, was powerful enough to enable an electro-magnet round which its current was passed to lift a weight of forty pounds, and that Mr. Ladd is now constructing a larger battery of the same kind, by means of which he expects to be able to produce the electric light at a very much less cost than it has been producible at hitherto. Unless with the exception of magneto-electric machines worked by water power, this new thermo-electric battery certainly promises to prove by far the cheapest source of electricity yet suggested.

Professor Wheatstone has constructed a very powerful Thermo-electric Battery on the principle of that exhibited by Mr. Ladd at the *Royal Institution*. The battery constructed by Professor

Wheatstone consists of sixty pairs of small bars, and its electro-motive force is said to be about equal to that of two of Daniell's cells. The battery was exhibited to a select circle of Professor Wheatstone's friends, and it is stated that "on connecting the terminals of this battery, excited as Marcus's, a brilliant spark was obtained, and about half an inch of fine platinum wire when interposed was raised to incandescence and fused: water was decomposed, and a penny electro-plated with silver in a few seconds, whilst an electro magnet was made to lift upwards of a hundred weight and a half. Bright sparks were obtained from the primary and secondary terminals of a Ruhmkorff's coil connected with the battery. In fact, all the effects obtained from a small voltaic combination were reproduced with ease by this thermo-electric battery." In constructing this battery, Professor Wheatstone found confirmation of the curious fact, first announced by M. Marcus, that the power of a battery of this kind is very greatly increased by frequently re-melting the alloys of which its elements are composed. This is supposed to be due to the repeated fusion breaking down the crystalline structure of the alloys.

Not unnaturally, this thermo-electric battery is exciting the imaginations of men of science, causing them to call up wonderful visions of a future when much of the work of the world shall be done by *sunshine*. Thus, a contemporary suggests that, "like windmills, thermo-electric batteries might be erected all over the country,—finally converting into mechanical force, and thus into money,—gleams of sunshine which would be to them as wind to the sails of a mill."—*Mechanics' Magazine*.

At the Academy of Sciences at Paris, M. Edmond Becquerel has read a note on his new thermo-electric pile, formed with metallic sulphurets, and at the same time presented some Bunsen couples constructed by M. Ruhmkorff, formed of plates of sulphuret of copper. MM. Bunsen and Becquerel appear to have prosecuted their researches simultaneously, and the former may lose some of the credit due to him. M. Becquerel states that by his arrangement he obtained an electric current sensibly constant, presenting an electro-motive force nearly equal to that of a Daniell's element of sulphate of copper.

M. Becquerel has laid before the Academy, an account of his experiments made with a new thermo-electric battery, which he has been led to construct by the surprising results obtained from that of M. Marcus, of Vienna. M. Becquerel also employs the sulphuret of copper (which, like gold, melts only at a temperature between 1030 deg. and 1040 deg. cent.) as a negative element: but, instead of the easily fusible antimony, he makes use of "maillechort" (an alloy, of copper, 55 parts; nickel, 23; zinc, 17; iron, 3; and tin, 2, analogous to our British silver) for his positive element. He states that when the temperature is not too high this battery works well, without either loss or gain of weight. Its *resisting* power is very great, with an equal motor power equivalent *to the resistance* of the telegraphic lines of Daniell's battery, which it might replace. M. Ruhmkorff has constructed a battery of thirty of these elements, under M. Becquerel's directions.

A very promising new form of battery is an ordinary "Bunsen's battery." As the reader is aware, each couple consists of a hollow cylinder of carbon and a cylindrical bar of amalgamated zinc. The latter is enclosed in a vessel of porous earthenware, containing dilute sulphuric acid, and this vessel is placed within the hollow cylinder of carbon, the whole being enclosed in a glass or other vessel containing nitric acid. Some little time ago M. Duchemin discovered that the nitric acid in this battery might be replaced by a solution of perchloride of iron, and the sulphuric acid by a solution of chloride of sodium, or common salt, with great advantages as regards both cost, convenience, and constancy, and he has just announced to the Academy of Sciences that he finds that still better results are obtainable by the use of chloride of potassium instead of sodium chloride. This substitution does not appreciably increase the cost of working the battery, while it greatly increases its electro-motive force.—*Mechanics' Magazine.*

NEW ELECTRICAL EXPERIMENTS.

In the account of some Electrical Experiments reported in *Poggendorff's Annalen*, M. Henrici states that if water containing hydrogen in solution be put into communication with ordinary water by means of a piece of moist paper, and the circuit be closed by a galvanometer, a current will be produced, directed into the galvanometer, from the ordinary water to the water charged with hydrogen. On this fact M. Henrici bases his opinion that a certain number of phenomena, usually attributed to the action of the oxygen of the air, such as oxydisation of iron and other metals, and the putrefaction of vegetable substances, are really due to the decomposition of the atmospheric moisture.

Professor Tait, in a note inserted in the *Proceedings of the Royal Society of Edinburgh*, states that when a horizontal plate is put into a state of rapid vibration, iron filings strewn on the surface, near a point of maximum vibration, are prevented from being scattered to the nodal lines by a magnetic pole held above the plate; but if the pole be held below they are speedily dissipated. If too powerful a pole be used, or if the magnet be held too near the plate, the filings nearest the pole are not dispersed in the latter case. Professor Tait thus explains the phenomena:—The filings tend to place their greatest length in the direction of lines of magnetic forces; and thus, when the pole is above the plate, their upper ends incline towards it, so that the agitation of the plate, combined with the magnetic attraction, brings them nearer to the point immediately below the pole. When the pole is below the plate the upper ends of the filings diverge from the pole, and the agitation sends them outwards, unless the magnetic attraction be considerable.

"MAHOMET'S COFFIN."

As some of our readers may desire to repeat the remarkable electrical experiment of Franklin, bearing on the myth of Mahomet's Coffin hovering between heaven and earth, and lately performed by Professor Tyndall in one of his lectures "On Electricity," at the Royal Institution, we give the points of a description which Mr. W. F. Barrett, the professor's assistant, has inserted in the *Reader*. A piece of gold-leaf, 2½ in. long and 1¼ in. wide, was cut into the form of a kite or fish, placed on a piece of paper, and presented to the knob of a large Leyden jar charged with electricity. When detached by a knife the leaf sprang towards the knob, but stopped within two inches and remained hovering in the air, the tail waving like that of a fish. When the jar was moved the gold leaf followed, and continued to float for nearly an hour. The experiment may be made with a smaller jar, and smaller pieces of gold-leaf.

NEW ELECTRIFYING MACHINE.

At a meeting of the Academy of Sciences in Paris, M. Edmond Becquerel has exhibited and worked an Electrifying Machine, consisting of a plate of indurated red sulphur, the invention of M. Recher, civil engineer. This plate was prepared by the process of M. Charles Sainte-Claire Deville, modified to a certain extent. The sulphur is melted three times consecutively, in a cast-iron vessel, at a temperature between 250° and 300° cent. (482° and 572° Fahr.), being cooled completely, and crushed to a coarse powder after each of the two first fusions, and after the third, poured into a plaster mould. When sulphur has been thus fused three times it has no effect on metals, and retains little of its characteristic odour. Plates of this kind may be made at least four mètres (upwards of thirteen feet) in diameter; the sulphur is extremely hard, offers very great resistance to fracture, and is admirably qualified to replace the glass or hardened caoutchouc plates of ordinary electrifying machines. It is incomparably less dear, is much less hygrometric, and it does not require amalgamated or gilt cushions. The skin of a cat, properly dried, is quite sufficient to afford quantities of electricity equal at least to those obtained with glass plates of the same diameter.—*Illustrated London News.*

ELECTRICITY OF THE OCEAN.

The Paris Correspondent of the *Chemical News* states that an important experiment has been made by M. Duchemin during a holiday at the seaside. He made a small cork buoy, and fixed it to a disc of charcoal containing a small plate of zinc. He then threw the buoy into the sea, and connected it with copper wires to an electric alarum on the shore. The alarum instantly began to ring, and has gone on ringing ever since, and it is added that sparks may be drawn between the two ends of the wires. Thus the ocean seems to be a powerful and inexhaustible source of electricity, and the small experiment of M. Duchemin may lead to most important results.

NEW ELECTRO-MAGNET.

M. Du Moncel has submitted to the Academy of Sciences at Paris a new form of the Electro-Magnet, invented by M. Carlier. In his note the latter says that hitherto an electro-magnet was composed of a cylinder of iron, covered with a helix of metallic wire, through which an electric current passed; and that it was considered indispensable that the different spirals of this helix should be insulated, which was done by enclosing the wire in silk, cotton, gutta percha, or a varnish. M. Carlier, imagining that this covering was unnecessary, constructed electro-magnets with the helix entirely uncovered; and thereby obtained results so extraordinary that M. Du Moncel would not have credited them if he had not himself experimented with the new form of apparatus. He says that the effects are more than doubled. The only condition to be observed is that the different layers of wire should be separated from each other by paper, and that the bobbins should be wood or copper, coated with an insulating material. According to M. Du Moncel, the advantages of the change will be considerable economy in the manufacture of the electro-magnets, much more energetic effects, and the suppression of the extra current. In No. 2 of the *Comptes Rendus* of the Academy more details will be found. At the same meeting a note from the Abbé Laborde was read, in which he described a process of simplifying analysis by the spectrum by means of an apparatus which he terms a "metallic controller." At the next meeting of the Academy M. Du Moncel gave the results of additional experiments, showing that it is currents of quantity which are especially suited to electro-magnets with uncovered wire, and that the extra current is considerably diminished only when the uncovered wire is thick and when a Bunsen's battery is employed.—*Illustrated London News.*

ELECTRO-MAGNETISM.

Professor Tyndall, in his very able course of Lectures delivered at the Royal Institution, illustrated the grand phenomena of Electro-Magnetism, based on the discovery of Œrsted, that the copper wire connected with a voltaic battery in action becomes magnetic, attracts iron filings, and causes deflection of the magnetic needle. It was further shown that, when a quantity of copper, insulated by coating it with varnish, is coiled up in the form of a helix, its attractive power is very much increased; but that, when a piece of soft iron is placed in the heart of the helix, the magnetic power becomes enormous. Evidence of this was abundantly afforded in the heavy weights sustained by the powerful electro-magnet of the Royal Institution employed by Faraday in his elaborate researches. Dr.

Tyndall stated that this power had been employed by Mr. Page in the construction of an electro-magnetic engine; and he exhibited some similar machines now employed in Paris for delicate manufacture—the voltaic battery thus replacing the steam-engine as a motive power.

Dr. Tyndall commenced his concluding lecture with illustrations of Electric Resistance, which increases in proportion to the length of the wire, and diminishes with its thickness (the larger the area the less resistance). He expounded the formulæ of Ohm, and its application to electric telegraphy by Steinheil, who discovered that the return wire might be dispensed with if each end of a single wire were connected with a plate of copper buried in the earth. Dr. Tyndall also exhibited in action a form of Wheatstone's dial telegraph, modified by Siemens. The heat and light of the voltaic battery were next considered, and their intensity proved to depend on electric resistance. Among numerous illustrations it was shown that, when the curved part of a piece of platinum wire (U-shaped) was heated to redness by the current and dipped into cold water, it became a better conductor and was blackened, while the other part became white hot and was fused. The structure of the electric lamp of Duboscq and others, was explained, and the brilliant arc of green light produced by silver placed in it was exhibited on a screen. The latter part of the lecture was devoted to thermo-electricity, currents evolved by heating two metals, and the delicacy of the action of Melloni's thermopile was shown by a galvanometer, indicating the electricity produced by the warmth of the finger. In conclusion, the professor referred to his experiments as having illustrated the great law of the conservation of force, since he had proved that all the physical forces—motion, light, heat, magnetism, and chemical affinity—were able to produce electricity, and could be produced by it.

THE ELECTRICAL TORPEDO.

We have recently had occasion to refer to the experiments which have been carried out at Toulon with this subtle agent; others have since been instituted on a much larger scale, and with extraordinary results. Hitherto the torpedo has not been properly appreciated as a defence in war; but it is now an established fact that it is as available for defence as ironclads and rifled guns are for attack. Mr. Nathaniel J. Holmes, however, and the scientific gentlemen associated with him, have recently made such progress in this new department of military engineering, that hereafter, in all plans for coast, harbour, and river defences, and in all works for the protection of cities, whether against attack by armies on land or by ships afloat, the electrical torpedo will probably play a most important part. The latest experiment made by the French Government at Toulon affords some idea of the amount of destructive power which lies stored up within the electrical torpedo. With a charge of little more than 100 lbs. of gunpowder, a vessel 150 ft. long, and upwards of 40 ft. broad, was instantaneously destroyed whilst floating in deep water in apparent security. At the word of command, given by Admiral Chabannes, a dull crashing sound filled the air, and the devoted craft was effaced from the surface of the water. The portions of the vessel examined afterwards all bore testimony to the tremendous effects of the concussion, even with a water-depth of 16 ft. clear between the ship's bottom and the top of the sunken torpedo, and with a charge of only 100 lbs. of power. Striking as was the result of the experiment performed by Admiral Chabannes, it is said to have been but a rough indication of the power embodied in the new engine of defence. The French Government have signified their intention to repeat the experiment, and to add to it another in which a ship will be annihilated under full sail. Meanwhile, Mr. N. J. Holmes affirms that he has not revealed the secrets discovered by him with respect to the practical employment of the torpedo in warfare. The result of this experiment plainly indicates what may be expected to accrue to even an ironclad, if sailing within range of one of these formidable engines of multiplied power.—*Mechanics' Magazine.*

ELECTRICAL INFERNAL MACHINE.

CONTINENTAL papers notice the invention of a very destructive Electrical Infernal Machine by the maritime Prefect of Toulon. The result of a trial is said to have far exceeded expectation. In the experiment an old ship, 25 yards long by 10 yards broad, was raised from the water, shattered to fragments, and sunk in less than a second at a simple signal from the inventor. The destructive effects of this machine are so terrible, that it was allowed there was no iron-clad vessel solid enough to resist such a shock. What is very remarkable in this new engine of war is, that it is not necessary for the enemy's vessel to strike it in order to produce the explosion, as with the Russian and American submarine torpedoes. The French system is surer, and above all, more expeditious. The electric spark reaches the enemy's vessel and destroys it with the rapidity of lightning.—*Ibid.*

A NEW LOCOMOTIVE.

A NEW Electro-magnetic Locomotive has been invented by MM. Bellet and De Rouvre. This new engine is intended to run on rails, and the arrangement of its parts is somewhat curious. The driving power is given to a single pair of wheels situated at the rear of the engine, as in the Crampton engines. A number of magnets are arranged radially on these wheels, their poles towards the circumference; the voltaic current is conducted from the centre of each wheel to all the magnets in succession, and these latter act directly on the iron rail itself. The inventors seem to have specially in view the postal and telegraphic service. They say:—"This machine may be employed to carry letters and parcels in the interior of towns at the rate of twelve or fourteen miles an hour, on subterranean railroads, connecting the principal post offices; and as the locomotives for such service would be very small, the works would be comparatively inexpensive. Larger machines might run on the existing railroads, and convey despatches at the rate of 120 miles an hour.—*Ibid.*

ELECTRIC SHIP-SIGNALS.

GISBORNE'S Electric Ship-Signals for communication from the captain on the bridge to the engine-room and the man at the wheel, are remarkable for their simplicity and efficiency, with the further advantage that they supply means for the captain seeing how his order is obeyed, for with the dial at his side he can witness the movements of the rudder from starboard to port and the reverse, and note the action of the engine. Indeed, with this apparatus the captain may lie in his cot and keep himself informed of the working of the ship.

NEW SAFETY LIGHT FOR COAL-MINES.

MM. DUMAS and BENOIT have been making some experiments in the French collieries on the application of electricity as an illuminating power in "fiery" coal-mines. Voltaic electricity has been proposed on several occasions, as a means of giving light to the collier in dangerous places. But, under the ordinary conditions, it has not been found practicable to employ it. Dumas and Benoit propose to apply Ruhmkorff's coil machine and Geissler's tubes—to use, indeed, those tubes, with their beautiful auroral light, as a miner's lamp.

The tube, it is now generally known, is filled with some highly rarefied gas, and platinum wires are hermetically sealed into the ends. When the discharges from a Ruhmkorff's coil apparatus are passed through this tube it becomes filled with a mild, diffusive light, which lasts as long as the discharges pass through the rarefied medium. This light is unaccompanied by heat; it cannot, therefore, under any circumstances, explode the fire-damp of our coal-mines.—*Athenæum.*

COMBUSTION BY INVISIBLE RAYS.

PROFESSOR TYNDALL has delivered, at the Royal Institution, a discourse "On Combustion by Invisible Rays." The Professor began by stating that Sir Wm. Herschel, in 1800, discovered the obscure rays of the sun, and proved that the position of maximum heat was beyond the red of the solar spectrum; that his son, Sir John Herschel, succeeded in obtaining a thermograph of the calorific spectrum, which gave visible evidence of its extension beyond the red; and that Melloni proved the existence of a large proportion of *obscure rays* in the flames of oil and alcohol, and from incandescent *platinum.* After exhibiting the beautiful spectrum of the electric light, and explaining the principle and construction of Melloni's thermo-electric pile, he proceeded to explain the arrangement of these apparatus by the employment of which he was enabled to produce combustion, due to the invisible focus of reflected rays from the electric lamp, the light of which was cut off a solution of iodine and bisulphide of carbon; iodine, which is perfectly opaque to light, being perfectly transparent to the obscure rays of heat. It was stated that only five per cent. of the dazzling white light of platinum wire heated in the electric light, four per cent. of the light of a coal-gas flame, and ten per cent, of the electric light, are luminous rays, the remainder being obscure rays of heat. By means of a focus of these obscure rays Dr. Tyndall ignited black paper, a hat box, charcoal, tow, zinc foil, magnesium wire, and a cigar which was smoked for a moment by the Count of Paris. Finally, by holding a piece of blackened platinum in the focus of invisible rays, Dr. Tyndall succeeded in raising it to a white heat, thus actually raising the refrangibility of light, and showing that out of darkness it may be possible to obtain a degree of incandescence equal to that of the sun itself. This effect was first produced by Dr. Tyndall himself; but he ascribed the idea to Dr. Aikin. It is termed "calescence," and is the converse to Professor Stokes's discovery of "fluorescence," the exhibition of the invisible chemical rays of the blue end of the spectrum in a solution of sulphate of quinine.—*Illustrated London News.*

ELECTRO-DYNAMICS.

M. AMPÈRE, in his experiments on Electro-Dynamics, produced indicating currents by making float in a bath of salt or slightly acidulated water a copper wire twisted into a given form, square, circular, &c., one end terminating in a copper plate, the other in zinc. M. E. Duchemin has ingeniously applied the principle to the construction of an "electric buoy," which he forms of a disc of charcoal and a small plate of zinc, both fixed in a cork. When this combination, connected by wire with telegraphic apparatus, was cast into the sea, it was found to act very well. Not only did the tinkling of the bell continue for some weeks, but sparks were drawn between the extremities of the two wires. There is no reason why the portions of the apparatus should not be enlarged, and greater effects thus be produced, which might be made available for telegraphic purposes, since the sea is a great and inexhaustible source of electricity.

Professor Clerk Maxwell (in the latest number of the *Proceedings of the Royal Society*) has published a "Dynamical Theory of the Electro-Magnetic Field," in which he seeks for the origin of the electro-magnetic effects in the medium surrounding the electro-magnetic bodies, and assumes that they act on each other, not immediately at a distance, but through the intervention of the medium. He considers the existence of this medium as probable, since philosophers believe that it is in such a medium the propagation of light takes place, its properties being:—1. That the motion of one part communicates motion to the parts in its neighbourhood (transverse vibrations.) 2. That this communication is not instantaneous, but progressive, and depends on the elasticity of the medium as compared with its density. Professor Maxwell, after referring to the researches of Faraday, Thomson, and others on the subject, and expressing his own opinions, defines light, according to his theory, as consisting "of alternate and opposite rapidly-recurring transverse magnetic disturbances, accompanied with electric displacements; the direction of the electric displacement being at right angles to the magnetic disturbance, and both at right angles to the direction of the ray."—In the same number Dr. Bence Jones gives an account of some remarkable experiments in relation to animal chemistry, showing the production of diabetes by the application of cold. Rabbits were placed in ice by Dr. Dickenson and Professor Brücke, and both investigators found a great increase in the quantity of sugar in the urine after the application of cold for periods varying from four hours to seven hours and a half. Professor Brücke states that the difference was so great as not to require any quantitative experiments to determine it.

HEATING OF THE LEYDEN JAR.

CONCEIVING it probable that the glass plate of the Leyden jar must be heated by the charge and discharge, Dr. Werner Siemens has arranged an apparatus by which even small heating effects can be recognised with certainty. The result of the experiments made therewith quite answered his expectations. The construction of the apparatus is as follows:—He covers with silk a fine iron and equally fine German-silver wire, cut into pieces about a decimetre in length, and each German-silver wire is soldered to an iron wire. These wires are so laid upon a glass plate covered with a cement of resin and shellac that the solderings of 180 wires, without touching, occupy a space of about a square decimetre. By pressing with a warm iron the wires are fused into the cement, and thus fastened upon the plate. After the adjacent free ends of the wires are soldered together so as to form a battery of 180 elements, a second glass plate, also covered with cement, is laid with the cemented surface upon the first. By careful heating, the cement between the glass plates is softened, and a portion of it, with the individual air-bubbles which it encloses, pressed out. The thermo-pile stands thus in a surface of cement, free from air, exactly in the middle of a glass plate about five millims in thickness. The middle of the glass plates covering thus all the inside solderings is provided on both sides with tinfoil armatures about a decimetre square, which are furnished with insulated wires. The free ends of the thermo-pile are also furnished with copper wires, by which they are connected with a delicate reflecting galvanometer. The entire apparatus, including the external solderings, is carefully protected from any change of temperature. Dr. Siemens found that a short succession of changes and discharges, by means of a voltaic inductor of about an inch striking-distance, was sufficient to drive the scale of his galvanometer out of the field, and this, too, in the direction due to the heating of the solderings between the armatures. After the charges the deflection returns very slowly to zero. It disappears entirely only after some hours. It is independent of the direction of the discharge, and apparently proportional to the number of charges, and to the striking-distance to which the apparatus was charged. The motion of the scale begins at once, and then proceeds regularly. But if one of the armatures be touched with the finger, the scale remains stationary two or three seconds before beginning its motion, which usually terminates outside the field of view.—*Mechanics' Magazine.*

ELECTRIC LAMP.

AT a meeting of the Academy of Sciences at Paris M. Foucault has presented a new regulator of the Electric Lamp, constructed under his superintendence by M. Duboscq. The new apparatus is stated to be less complicated and more portable than those now in use, and to have given much satisfaction when tried at the lighthouse of La Hève, near Havre. The stability of the light is said to be assured by the variations of the interpolar distance being rendered nearly insensible.

ELECTRICITY OF MINERAL WATER.

M. E. LAMBRON has laid before the Academy of Sciences at Paris, the interesting results of his researches on the Electrical character of the Mineral Waters at Bagnères-de-Luchon, showing that when the sulphureous water was received into a glass vase it gave rise to an excess of positive electricity in the upper layers, due to the incessant chemical changes going on under the influence of the air and the carbonic acid which it contains, while in the lower layers an excess of negative electricity was produced. A transient current was established when the two electricities were connected by means of a piece of platinum. M. Lambron gives further details in his note, and considers that there is reason to believe that the electrochemical currents of sulphureous waters may have some effect on the human economy.—*Illustrated London News.*

Chemical Science.

THE SPECTROSCOPE.

MR. RUTHERFORD has succeeded in improving the construction of the Spectroscope. The means of improvement are described in *Silliman's Journal* for March. The plates of glass forming the bi-sulphide of carbon prisms are cemented with glue and molasses, and the stopper rendered perfectly tight by a little molasses. When a good prism refused to define the sodium line, it was found that, after a violent shake, it would for a few minutes define beautifully, but gradually settled into its former condition. In order to overcome this inconvenience, a quantity of the bisulphide of carbon is filtered into a tall glass jar, where it is allowed to remain undisturbed for two days. The liquid having arranged itself according to its density, the prisms are filled from a faucet at the bottom of the jar. Thus, instead of having layers of varying density in each prism, the density is the same in each, though not the same throughout. In the instrument figured, six prisms are arranged at the angle of least deviation for the ray under observation. In order to make this adjustment without the labour it generally involves, Mr. Rutherford has devised an ingenious mode by which all the prisms are simultaneonsly moved with one motion of a milled head.

SPECTRUM ANALYSIS.

THE earliest experiments with that marvellous method of enquiry into the chemical constitution of bodies which is known as "Spectrum Analysis," showed it to be capable of detecting inconceivably minute quantities of the metals of the alkalies and the alkaline earths—such, for example, as one 195,000,000th of a grain of sodium, one 70,000,000th of a grain of lithium, one 60,000,000th of a grain of potassium or barium, and 100,000,000th of a grain of calcium. Equally small quantities of certain of the non-metallic elements, and especially of the four halogens—fluorine, chlorine, bromine, and iodine, have not hitherto been detectible by spectrum analysis, although immensely-smaller quantities of them have been detectible by this method than by any other at present known; but Mitscherlich has just succeeded in finding a process by which spectrum analysis may be made to indicate the presence of almost as infinitesimal quantities of chlorine, bromine, and iodine as it will of sodium. He well dries the substance to be examined, and then mixes it intimately with half its weight of sulphate of ammonium and one-tenth of its weight of oxide of copper. This mixture he places in a globular enlargement of a combustion-tube. Even *this, however*, is nothing to what we know of gold; for Muncke found, some few years ago, by calculation from, on the one hand, the size of the smallest piece of gilt silver wire, the gold on which was distinguishable by means of a microscope magnifying a thousand times, and, on the other, the quantity of such wire that a given weight of gold is capable of covering, that a grain of that metal admits of being divided into *ninety-five thousand millions* of *visible* parts,—visible, that is, by the aid of a microscope of the power referred to. A sovereign is thus capable of division into ten millions of millions of visible particles, being ten thousand times as many such particles as there are men, women, and children in all the world; and who shall say how many "ultimate atoms,"—each, there would seem reason to believe, in a state of inconceivably rapid movement, and probably having, like the globe on which we live, two motions: one on its own axis, and the other round some point external to itself, and thus constituting a kind of miniature planet,—each of these astoundingly small portions is made up of? The human mind is staggered by the grandeur of the stellar creation; but the wonders of the systems of worlds are surely paralleled by the wonders of that system of atoms which each smallest appreciable speck of matter seems to constitute.

There are three instances illustrative of the marvellous minuteness of the particles into which we know that bodies can be actually divided. One-eighth of a grain of indigo dissolved in sulphuric acid is capable of giving to 300 oz. of water a sufficiently deep blue colour to be distinctly visible in a single drop of the water. As in 300 oz. of water there are about 125,000 drops, in one drop of the blue solution there would be just about one 1,000,000th of a grain of indigo; the visible blueness of the drop thus proving that indigo may be divided into portions weighing not more than one 1,000,000th of a grain each. It is not to be supposed, of course, that the portion of indigo in each drop of the solution is all in one piece, but if it were, its bulk would not exceed one five-hundred billionth of a cubic inch. The case of the silver in sea water is still more wonderful, except that the presence of silver in a solution so dilute as that of this metal in sea water cannot be rendered appreciable to the eye, as is the presence of indigo in the solution just mentioned. It is well ascertained, however, that silver exists in the ocean in the proportion of one part of silver to one hundred million parts of sea water, and as it is impossible to doubt that the elements contained in any aggregate of drops of sea water exist in their due proportion in each individual drop, it follows that in each grain of sea water there is one one-hundred millionth of a grain of silver.—*Mechanics' Magazine.*

THE METALLOIDS NOT SIMPLE BODIES, BUT COMPOUNDS.

POGGENDORF'S *Annalen* contains a paper by A. Mitscherlich, on the application of the spectroscope to the detection of very minute quantities of chlorine, bromine, and iodine, at the close of *which the accomplished* author makes the very remarkable "preliminary announcement" that his recent researches upon the spectra of the metalloids have convinced him that nearly all those bodies, hitherto regarded as elements, are really compounds. The opinion has long been growing that many of what are at present taken for elementary substances must eventually prove to be otherwise, and it would certainly seem that, of the sixty-six substances at present usually considered as elements, some, at least, are not unlikely to be removed from that category before long. Many a theory has obtained universal acceptance on very much slighter grounds than the facts which are known respecting ozone and antozone afford for the supposition that oxygen is a compound body; there are constantly arising seeming new proofs,—we recorded two in one week only a very short time ago,—of the soundness of the suspicion, first expressed by Berzelius, that nitrogen is not an element; and now, one of the most profound of living chemists announces his conviction that scarcely one of the eleven other metalloids is a simple body. Shall we find at length, as was taught by Swedenborg, that there is only one really "simple," "elementary" substance, and that the essential difference between one body and another is merely a difference of form,—in other words, that all the various kinds of matter are composed of the same kind of primary particles, but that in different substances these primary particles are differently arranged; or will it prove, as is perhaps more probable, that there are two primary elements, one of them positive, and the other negative?—*Mechanics' Magazine.*

DIFFUSION OF GASES.

Mr. G. F. Ansell has put on record, in the *Chemical News*, that he has observed, in the course of his experiments, that Gases diffuse more slowly through india-rubber than through biscuit-ware. Now, he has found that, when a glass cylinder was intercepted at its middle by a plate of biscuit-ware, securely cemented in, and one end of the cylinder was covered with a thin sheet of india-rubber, and diffusion was then allowed to proceed through the india-rubber, the gas (coal gas in a very marked degree) which had diffused through the india-rubber remained between that substance and the biscuit-ware, exciting considerable force, although the other end of the cylinder was perfectly open to the atmosphere. The reason is obscure; but Mr. Ansell is inclined to think that two forms of the gas may exist—one which will permeate india-rubber and not biscuit-ware, and vice versâ.

DIFFUSION OF GASES IN COLLIERIES.

At the inquest on twenty-six bodies killed by a colliery explosion at Tredegar, Mr. Lionel Brough, the Government Inspector of Mines for the district, has called attention to a natural law with which physicists are familiar, but, unfortunately, not so well known to the generality of colliery managers, which occasionally played an important part in explosions. The law of diffusion of gases here referred to is not a chemical combination, but simply a mechanical mixture of two or more aëriform fluids. In the undisturbed quietude of the night, and consequent freedom from motion, there is more than usual opportunity for this propensity to exercise itself; and it is remarkable that the air that human beings breathe, and the fire damp that is permitted to stagnate under ground, possess the very attributes of diffusion, and that in a high degree, on account of the great difference in their specific gravities, the law of the speed with which gases commingled being just in proportion to that very difference in their weights. Such diffusion makes the mouths of levels, headings, crossings, &c., where gas has accumulated, excessively dangerous to be approached by naked lights.

MODIFICATION OF THE LENOIR GAS-ENGINE.

A very valuable improvement in the Lenoir Gas-Engine has been effected by M. Hugon, of Paris. Hitherto, the explosion of the mixture of coal-gas and air employed in these engines has been effected by means of the voltaic spark, but M. Hugon effects it by a contrivance which is at once somewhat cheaper and much more regular in its working. To the slide or other valves regulating the admission of gas and air into the cylinder he attaches little burners, supplied with gas under pressure, and he so arranges that the flame from these burners shall explode the mixture in the cylinder at the proper time. These little jets are blown out by the explosion, but are afterwards re-lighted by an outer jet, which is kept constantly burning. This simple improvement seems likely to considerably diminish the uncertainty and irregularity which have hitherto characterised the action of the gas-engine.—*Mechanics' Magazine.*

NOXIOUS EFFLUVIA FROM MANUFACTURES.

The Report made by Dr. Letheby and Mr. Bazalgette, of the Metropolitan Board of Works, after the inspection of certain manure and chemical works in the neighbourhood of the northern and southern outfalls of the main drainage of the metropolis, has been printed. By the report it appears that large and very offensive operations are carried on in the neighbourhood of both the northern and southern outfalls; and that the putrid and other vapours emitted from the works are diffused into the atmosphere and wafted to a considerable distance. No precautions whatever are in use to prevent the escape of the noxious effluvia, and it is a question whether the effluvia may not be a serious nuisance to the work-people, who will have to reside at the drainage works.

GASES OF THE BLOOD.

MM. Estor and Saintpierre, having analysed the Gases of the Blood, and determined the variations in the amount of oxygen in different parts of the circulating system, assert that the blood is more impoverished in oxygen when proceeding from the heart to the members than when traversing the general capillary vessels. They also assert that the property of absorbing oxygen is not exclusively confined to the blood and muscles, but appertains to other tissues; that it is a phenomenon which is independent of the respiratory combustion.

PREPARATION OF OXYGEN.

A note by Fleitmann, in the *Annalen der Chemie und Pharmacie*, on a Method of Preparing Oxygen, shows that when a strong solution of chloride of lime is gently heated with only a trace of freshly prepared peroxide of cobalt, a stream of oxygen is evolved and chloride of calcium is formed. The evolution of the gas is very regular when the mixture is heated to 70° or 80°. All the oxygen is given off, no chlorine acid being formed. The point most to be attended to is to use a perfectly clear solution of chloride of lime: a milky or thick solution froths.

M. Carlevaris, of Genoa, has obtained oxygen in great abundance by heating together manganese ore and silicious sand. Hardly had the mass attained to a red heat when oxygen, disengaged by the action of silicic acid upon the oxide of manganese, came off very copiously. He calculates the production of the gas in this manner would cost about 40 centimes the square metre.

HYDROGEN FLAME.

Mr. W. F. Barrett, of the Royal Institution Laboratory, has communicated to the *Philosophical Magazine* an account of some physical effects produced by the contact of a Hydrogen Flame with various bodies. When conducting experiments for Professor Tyndall on the nature of the radiation emitted by various solids heated by means of a hydrogen flame, Mr. Barrett perceived a deep blue colour to arise on the surface of several of the substances examined, as soon as the flame came into actual contact with the body. Careful examination of this coloration showed that the colour was restricted to the place where the hydrogen was in combustion, giving in section an image of the construction of the flame. The blueness was proved to be due to no foreign element in the gas. It appeared on various substances, taken at random, such as pieces of granite, metal tubing, but not on all substances; and a classification of the substances experimented upon, according to the effects produced, led to no information as to the cause. Mr. Barrett then imagined it to be a new kind of fluorescence, differing from that discovered by Professor Stokes. An experiment revealed the source of the phenomenon, and succeeding trials proved that it was entirely due to the combustion of sulphur deposited on the surface of the body. An old block of granite, when the hydrogen flame was applied, showed the blue colour vividly on every part; but, when the block was split and the flame was brought into contact with the newly-fractured surfaces, not the faintest trace of colour was seen. These experiments show that among foreign ingredients in our atmosphere sulphur, either free or in a state of combination, occupies an important place—probably derived from our coal fires. Mr. Barrett describes other phenomena of the combustion of hydrogen.—*Illustrated London News.*

NEW APPLICATION OF GASEOUS AMMONIA.

M. Charles Tellier has proposed to the Academy of Sciences at Paris the use of Gaseous Ammonia as a source of Motive Power —not when steam is applicable, but as a substitute for steam in omnibuses on common roads, for example, and locomotives in tunnels. He founds this use of ammonia on its great solubility in water, its easy liquefaction, its capability, at ordinary temperatures, of affording utilisable pressure, and of having its vapours superheated without necessitating recourse to high temperatures; and, finally, the facility of recovering from the utilized vapours the latent heat they contain, and transmitting it to those which are about to be evolved—effects produced simultaneously by the mere solution of the gas in water. He affirms, that if a certain quantity of liquefied ammonia is stored up in a close vessel, and there is placed in its vicinity about three times as large a bulk of water, the liquid ammonia may be vaporised, and a motive force—which may be looked upon as constant—of from eight to ten atmospheres obtained, the latent caloric of gasefication being continually supplied by the caloric disengaged during the solution of the gas in water. He calculates that 10 kilogrammes (about 22 lbs.) of the liquefied gas would furnish one horse-power for an hour; 20 kilogrammes (44 lbs.) of the gas, or a two horse-power for an hour, and 60 kilogrammes (132 lbs.) of water, being sufficient to enable an omnibus to traverse Paris.—*Reader.*

HYDROSULPHIDE OF AMMONIA AND SULPHIDE OF COPPER.

Professor Bloxam has read to the Chemical Society a paper "On the Action of Hydro-sulphate of Ammonia upon freshly precipitated Sulphide of Copper," in which the author showed that the solubility of the latter was due to the formation of a peculiar double sulphide, containing one atom of mono-sulphide of ammonium united with two atoms of ter-sulphide of copper. Although the existence of the ter-sulphide in a separate state was unknown, the chemical reactions of the double salt appeared to warrant the adoption of the proposed formula. The new compound was obtained in the form of *vermilion-red* crystals, very like chromic acid, which were prone to decomposition, and immediately split up by boiling water into the ordinary black sulphide of copper and a yellow solution of sulphide of ammonium.

PURE CARBONIC ACID GAS.

THE Paris Société d'Encouragement de l'Industrie has awarded its Platinum Medal to M. Ozonf, the celebrated manufacturer of seltzer-water and soda-water, for the simple and ingenious method by which he obtains Pure Carbonic Acid Gas with which to aërate those beverages. M. Ozonf burns coke in a furnace lined with refractory fire-clay, and supplies the furnace with sufficient air to effect complete combustion. The products of the combustion, consisting chiefly of carbonic acid gas and nitrogen, he first passes through water, in order to cool them, and at the same time to free them from mechanically admixed impurities, and then forces into the first of a row of receivers filled with solution of carbonate of soda. Except the last, which is open to the atmosphere, each of these receivers has a pipe passing from its upper part to the lower part of the next. The carbonate of soda in these receivers absorbs the carbonic acid contained in the gaseous mixture which is forced into them, becoming thereby converted into bicarbonate of soda, and the other elements of that mixture pass off from the last of the row of receivers into the air. When the solution of carbonate of soda with which the receivers were originally charged has become wholly converted into solution of bicarbonate, it is pumped into a boiler, in which it is heated by steam to 212° Fahrenheit, at which temperature the bicarbonate of soda gives off its second equivalent of carbonic acid and is reconverted into ordinary, or mono-carbonate. The carbonic acid so evolved is mixed with vapour of water, but is otherwise perfectly pure, and the aqueous vapour in association with which it leaves the boiler can be readily separated by condensation. M. Ozonf effects this condensation by carrying through a reservoir of cold water the pipes which convey the gas from the boiler to the gas-holder. The solution of carbonate of soda left in the boiler is used to re-charge the receivers. As the portion of carbonate of soda first used will thus serve over and over again, *ad infinitum*, no carbonate of soda being actually consumed in the process, the cost of the carbonic acid obtained by this method is very little more than that of the coke which supplies the carbon for it, labour and wear and tear being quite insignificant items. While, therefore, both simple and highly effective, M. Ozonf's process is also very cheap.—*Mechanics' Magazine.*

PHOSPHORESCENCE IN CONNECTION WITH STORMS AND DISEASE.

DR. C. MOFFATT has read to the British Association a paper, the results of which, he stated, were that phosphorus becomes luminous and ozone periods commence on the approach of Storms, and if a storm sets in during a luminous or ozone period, the luminosity increases in brilliancy, and the ozone in quantity. Dr. Moffatt then referred to tables he had prepared from observations on the luminosity of phosphorus, ozone, and the prevalence of diseases in connection with the system of meteorological telegraphy, instituted by the late Admiral Fitzroy. From these it appeared that all the periods of luminosity commenced with the setting in of the atmospheric conditions of the approach of which cautionary telegrams gave warning. Of diseases, 80 per cent. of apoplexy, epilepsy, and sudden death occurred on the days on which phosphorus became luminous.

RESEARCHES ON OZONE.

MR. J. SMYTH, jun., has read to the British Association a paper on "An Apparatus for the Determination of Ozone, and Experiments made therewith." The author, being interested in linen-bleaching, took daily meteorological observations for several years, in which he directed particular attention to ozone. He found the usual methods of testing its presence in the atmosphere unsatisfactory, which he shows by reference to a diagram chart of all the elements of the weather in 1864, prepared by him. He was, therefore, led to devise the above apparatus, the principle of which is, by means of a large aspirator, to draw the air at a considerable velocity through a small tube, so as to impinge at its opening into a tube of larger diameter, against an extended surface of test-paper. This ozonometer consists of two brass or opaque glass tubes or boxes about 2 in. long and 2 in. in external diameter, the smaller of which screws or fits tightly into the larger, and is about an eighth of an inch shorter; its extremity at the point of the screw is grooved for an india-rubber band, which holds the test-paper stretched across its mouth. The entrance tube, a quarter of an inch in diameter, is screwed or fitted into the centre of the solid extremity of the larger box, about an eighth of an inch from the centre of the test-paper. A small pipe from the solid extremity of the smaller box communicates with the aspirator, which the author prefers should be made on the plan of Dr. Andrews, of Queen's College, Belfast—viz., a gasometer of a capacity of about 80 gallons is connected by means of cord to a clock, on which an extra weight is slung; this weight raises the gasometer at a uniform velocity, over which the pendulum gives complete control: a counterpoise is used to support the weight of the gasometer. The author showed from a table of experiments, made by this improved ozonometer, that there is not much difference in the quantity of sensible ozone in two masses of air of equal volume, moving at different velocities, in different directions, and under different hygrometrical conditions. Also, that the test-papers in the ordinary ozone-cage do not register high enough. A more extended series of experiments may, however, somewhat modify these results.

OZONE TESTS.

M. Hozeau, of Rouen, has made a series of investigations, extending over four years, upon the amount of the action exerted by the atmosphere, at different seasons, upon the iodised paper used as a Test for Ozone. He finds that this action is always greater in spring than in summer, and in autumn than in winter. It is least in February, begins to increase in March, and reaches its maximum in May and June.

CHOLERA AND OZONE.

Dr. Allnatt has addressed to the *Times* the following letter, dated Frant, Sussex, August 24, 1865:—

"During the past month there has been a manifest diminution of atmospheric ozone. On three days only has the *maximum*, or 10 deg. of Schönbein's scale, been attained. To-day, however, both my exposed ozonoscopes are at a *maximum*. Yesterday the test stood at 4, which is very low in this elevated and comparatively uncontaminated atmosphere.

"In the original reports, soon after the discovery of ozone, it was stated that the extension of cholera was greatly facilitated by a diminution of elemental ozone. In 1855, at Strasbourg, the invasion of cholera coincided with a period of antozone, and the decline of the epidemic was accompanied by the return of ozone. If, as has been supposed, the proto-carburet of hydrogen is the vehicle which contains and distributes the poisonous germ or leaven of cholera, it would, *à priori*, be conformable to theory that ozone should combine with this carburetted hydrogen and destroy it; and subsequent experiments have proved the fact.

"Ozone is, therefore, itself destroyed by the act of decomposing organic poisons. It would be interesting to learn from carefully compiled statistics the comparative degree of its manifestation in countries at present suffering from an invasion of pestilential cholera; and what diminution of ozone, if any, has occurred since the accession of the epidemic.

"It is a curious fact that influenza, which in this country has sometimes preceded the cholera, should be so manifestly augmented by a superabundance of ozone as to lead certain pathologists to conclude that it is the very principle of this form of zymotic disease. A medical practitioner, in a recent report from Western Australia, states that diphtheria itself has been traced in certain districts to follow the course of an abnormally high manifestation of ozone.

"In hospitals, and in sick rooms in every dwelling-house occupied by cholera patients, a factitious atmosphere of ozone should be constantly maintained. It may be produced with facility, modified as occasion requires, and a notable quantity maintained in every inhabited place within an affected district during a dearth of ele*mental* ozone.

"*Chymical* ozone is produced by the following process:—

"Take a piece of clean phosphorus, about half an inch long, which has recently been carefully scraped; put it into a clean two-quart bottle at a temperature of about 60 deg. Fahrenheit, with as much water as will half cover the phosphorus; close the mouth slightly, so that if inflammation take place no harm may happen, and leave it. The formation of ozone will quickly occur, and its presence will be indicated by a luminous condition of the phosphorus and the ascent of a fountain-like column of semi-translucent vapour. In less than a minute the test will show ozone, in five or six hours it will be comparatively abundant, and then, the phosphorus being removed and the acids formed at the time washed out, the bottle may be closed and the contents used for diffusion when required.

"The air in its normal state contains one ten-thousandth part of ozone; when the proportion is raised to one two-thousandth part it is sufficiently powerful to kill small animals and occasion death by suffocation. Its employment, therefore, will require skilful regulation."

Dr. Allnatt has also addressed to the *Times* the following communication, dated Nov. 6:—

"We have just passed through an extraordinary period of elemental antozone. Whatever difficulty chymists may experience in isolating and holding this fleeting body, it would appear that nature has no such obstacles attending her manipulations. Dr. Meissner states that antozone is formed whenever ozone exists; that there cannot be, in fact, ozone without its congenital antagonistic principle. Dr. Faraday states that one of the diagnostic characteristics of antozone is that it restores that which has been rendered purple by ozone to its white or colourless condition.

"Now, let us see what evidence has been afforded within the past week of the existence of this remarkable substance in its natural and insulated state.

"On the 2nd inst. the test slip exposed in the morning was acted on with considerable energy, and manifested in a few hours nearly 5 degs. of coloration when compared with the chromatic scale of 10 degs. During the night, however, an antithetical period occurred, and the tests were almost totally deprived of their hue and reduced to their primitive white.

"On the following evening, at 5 o'clock, finding the test (a new and peculiarly sensitive one) which had been exposed since the morning, still manifesting no signs of reaction, I placed side by side three other slips of various shades of colour, which had been previously subjected to the full action of atmospheric ozone, and one of which exhibited a maximum hue. These were simultaneously exposed during the night, from 5 p.m. to 10 the following morning—a period of 17 hours. For the sake of subsequent comparison, I cut these slips into tallies, and on the morning of the 4th I found the coloured tests were becoming completely blanched, and that even then they were almost as purely colourless as the unexposed ozonoscopes themselves. No rain had fallen during the night, and if any had occurred the slips would have been effectually protected from its influence.

"These conditions lasted till noon, when suddenly the decoloured ozonoscopes showed symptoms of reaction, and at 6 p.m. were all recoloured of an uniform tint of about 3 degs.

"To-day, Monday, the 6th, the elemental conditions having undergone but slight apparent modification, so energetic has been the generation of ozone that the tests are blackened to an extent almost beyond the maximum of Schönbein's *graduation*."

NEW EXPLOSIVE SUBSTANCE.

This highly Explosive Compound was discovered in 1847 by M. Sobrero, a pupil of M. Pelouze. It is formed by acting on glycerine, the sweet principle of oils, with nitric acid, and consists of one part glycerine and three nitric acid; it is an oily liquid, heavier than water, and is soluble in alcohol and ether. Its properties are very remarkable. It produces such a powerful effect on the nervous system, that a drop of it placed on the tongue causes a headache of great violence, which lasts several hours. It is highly explosive, and ten times more powerful than gunpowder. M. Nabel, a Swedish engineer, availing himself of this latter property, has used it with great effect in mining, and with a diminution of expense to the amount of 50 per cent. It requires a smaller chamber than gunpowder, and a mere fissure will do, if lined with clay to prevent the fluid from escaping. The nitro-glycerine is first poured in; then water, which floats on its surface; and there is no necessity for tamping. Ignition is effected by means of a slow match, having a percussion cap at one end. The explosive effect of this compound has been proved, by experiments, to be very great. In one instance a perpendicular hole, 1¼ in. in diameter, was bored 14 ft. from the outer side of the rock, which is dolomitic; and was tamped at the depth of 7 ft., as its lower extremity was found to communicate with a cavity filled with clay. A pint and three-quarters of nitro-glycerine was poured in, and filled up 5 ft. of the hole. The result of the explosion was the production of two fissures, one 50, and the other 20 ft. long—an immense mass of rock being separated from the main body. In another experiment, a hole was made of the same diameter and depth, at 10 ft. distance from the face of the rock. The charge was a pint and a half, and filled about 2 ft. of the hole, which happened to be enlarged, from natural causes, in one place. Sand was placed above the nitro-glycerine. The rock was rent, and a large portion of it shattered; the whole amount thrown down being about 3500 cubic ft. The gases produced by gunpowder would have been lost in the cavities.—*Mechanics' Magazine.*

M. Nabel has communicated to the *Philosophical Magazine* a note on the results of the blasting experiments, made with nitro-glycerine, at Vieille-Montagne-mine. It appears the use of this substance is very simple, economical, and effectual, and that it can be employed under conditions which preclude the employment of gunpowder. In the same number is inserted an account of M. Tresca's method of producing cylinders of ice by pressure through orifices. Professor Tyndall has already shown that ice can be moulded to any shape by pressure in a mould. M. Tresca observes that his experiments prove, in addition, that ice may be pushed into a thread, in accordance with the geometrical law of this kind of flow. In another note, M. Vionnois states that, being on the *manœuvring* ground at Nancy, in an extensive plain, the echoes of the troops firing were very distinctly heard, yet, instead of being sharp, they were slightly confused and prolonged. The trees of an English garden, separated from the manœuvring field, could alone have produced this phenomenon; the leaves were thus reflecting surfaces. This fact, he says, enables us to understand how the explosion of the electric spark may be reflected by the vesicular vapour of clouds, and the sound be softened and prolonged through the inequality of the distances and of the successive reflections.—*Illustrated London News.*

SCHULTZE'S GUNPOWDER.

For a considerable time past attempts have been made to substitute gun-cotton for Gunpowder, over which it possesses certain advantages, accompanied, however, by disadvantages which have hitherto prevented its adoption. Captain Schultze, of the Prussian Artillery, appears to have got rid of these latter. In composition, his powder resembles gun-cotton, and hence possesses its good qualities; in form it resembles gunpowder, and hence its superiority over gun-cotton. Gunpowder and gun-cotton resemble each other much more than might at first be supposed. Gun-cotton is cellulose, in which three atoms of water are replaced by three atoms of nitric acid. Wood consists of cellulose, along with certain other substances. Schultze gets rid of these latter, and then forms a compound equivalent to gun-cotton; but being in grains of any desired size, it is not liable, like gun-cotton, to an explosion so rapid that, without certain precautions, it would burst the gun. While gun-cotton is six times as dear as gunpowder, and, as to its useful effect, only three times as powerful, Schultze's powder is much cheaper than gunpowder, and four times as powerful. It does not foul the gun like gunpowder, and the products of its combustion are harmless, transparent gases.

In making this powder, any wood may be used, but the harder kinds answer best. The wood is first to be cut into sheets of a thickness equal to the diameter of the intended grains; the latter are formed by punches into small cylinders, which constitute the future grains; granulation is thus performed at a period of the process that involves no danger. To remove from these grains all their constituents but cellulose, they are boiled for eight hours in a strong solution of carbonate of soda, which is changed as often as it becomes discoloured; they are then kept stirred in running water for 24 hours; they are next kept stirred for two or three hours in a solution of chlorine, or of chloride of lime; after which they are washed in cold, then in hot water, and finally kept in cold running water for 24 hours. One part by weight of the grains thus prepared are placed for six hours in a mixture containing forty parts by weight concentrated nitric acid, and 100 parts concentrated sulphuric acid, the vessel containing them being kept cool by a refrigerating mixture, or by cold water circulating round it. The grains are now taken out, drained, and kept for two or three days in cold running water, after which they are boiled in a weak solution of carbonate of soda, next immersed for 24 hours in running water, and finally are well dried. They are now similar in composition to gun-cotton, though, it is stated, not yet explosive; and are next to be stirred about for ten minutes in a solution of some compound containing oxygen and nitrogen—nitrate of potash, for example, or of barytes, or what is better, a mixture of both of these—at a temperature of 112° Fahr.; after which they are dried at a temperature of from 90° to 112° Fahr. They are now nitro-cellulose, or a compound containing the same elements as gunpowder, and for certain purposes—mining, for instance—possess great advantages over that substance. If used in the tunnel under Mount Cenis, the work would be much more rapidly accomplished; as the workmen could return to their occupation immediately after the explosion, and would not, as at present, be obliged to wait a considerable time, that the noxious gases might be dissipated.—*Mechanics' Magazine.*

GUN COTTON.

MR. FAIRBAIRN has read to the British Association the Report of the Gun Cotton Committee, which states that after the Newcastle meeting of the British Association, the Committee drew the attention of the Minister of War to the usefulness of gun-cotton, and in January, 1864, the Government named a Committee, of which General Sabine was appointed chairman. The Government committee are still prosecuting their inquiries, and after they shall have reported, the Committee of the Association will be prepared to take action. Mr. Fairbairn said there might be some doubts as to the application of gun-cotton for military purposes, and the Government have instituted strict inquiries into the subject. As soon as the Government Commission reported, the Committee would deal with the matter. He might state that certain improvements had lately been made in the manufacture of gun-cotton, which was now formed in cakes and afterwards cut into pieces.

SPONTANEOUS ALTERATION OF GUN-COTTON.

REFERRING to the spontaneous alteration of Gun-cotton, M. C. Blondeau, in a paper upon the subject, states that, in the first place, the cotton parts with some of the nitric acid, and is changed into nitrated cotton, still filamentous but not explosive, showing no trace of an organic acid. The next stage is a change into a gummy mass, which is composed of xyloidine and oxalhydric acid. This transformation is accompanied by the evolution of binoxide of nitrogen. After this the gun-cotton undergoes several modifications, culminating in the production of glucose and oxalic acid. The foregoing changes took place slowly in the dark, but *in diffused light* they took place more quickly. In direct sunlight *the modifications* are somewhat different. The mass soon becomes a deep yellow colour, and is then soluble in water. The aqueous solution heated with potash evolves ammonia, which, the author believes, exists in combination with a portion of undecomposed cotton.

NEW CALORIMETER.

The Calorimeters now employed are of limited application: the ice-calorimeter being specially devoted to determining the specific heat of bodies, the object of the water-calorimeter is to ascertain the amount of the heat disengaged by the combustion of bodies, or by the combination of different substances. With the water calorimeter the boiling-point cannot be attained without giving uncertain results, which are also limited to the amount of water that the apparatus can contain. M. Bolley has therefore constructed a Steam-Calorimeter, which receives successively fresh quantities of water, and gives accurate results when the weight and temperature are correctly ascertained. He states that every molecule of water may be made to absorb at least 540 units of latent heat, which may be applied in the valuation of the heat of combustion. The details of the construction of M. Bolley's calorimeter are given in the *Bulletin of the Chemical Society of Paris.*

VALUE OF FUEL.

Dr. A. T. Machattie's paper "On the Chemical Composition and Calorific Value of Fuel," for which he received the Silver Medal of the Royal Scottish Society of Arts, contains a summary of experiments, with tabulated results. The fuels examined were dried wood and peat, coal, charcoal, and coke. The elements of these fuels in producing heat are carbon, oxygen, hydrogen, and a little sulphur. The useless and injurious elements are nitrogen and mineral ash. By means of a calorimeter, Dr. Machattie ascertained the relative powers of the combustible elements, and has printed in a tabulated form the units of heat each can produce and the quantity of water which one pound of each can convert into steam from the temperatures of 32 deg. and 60 deg. Fahr. He finds that the calorific value of all kinds of fuel is not the same, either in regard to the quantity or intensity of heat produced; and that we must therefore consider them in regard to their steam-raising and thermal or pyrometric effects. In our furnaces a loss of heat is sustained by the latent heat of water vapour when fuel is damp, by the latent heat of the water vapour when the fuel contains hydrogen, and by permitting the gases produced during combustion to escape by the chimney at a high temperature. Carbon is decidedly the best substance for fuel, and the nearer our fuels approach pure carbon the better they are. It requires so little oxygen for combustion, and therefore produces so little carbonic acid, and does not involve a large quantity of nitrogen from the air.—*Illustrated London News.*

SCALE IN BOILERS.

As incrustation is the sole cause of the destruction of Boilers, we do not see why owners do not employ some means to obviate the evil. The thickness of an eggshell between the water and the iron compels the use of 15 per cent. more fuel to generate steam; and, as a crust one-fourth to one-half in. is no uncommon occurrence, the immense waste of fuel and the more rapid burning of the iron are readily seen. Repairs to some of the western boilers cost 2000 dols. a year; this and the fuel wasted might both be saved if the boilers were kept clean, as iron cannot burn with water next it. Boilers using pure water have been run over thirty years without one dollar of repairs; hence will be seen the advantages and necessity of preventing scale. The item of stopping works "to scale boilers" is no inconsiderable amount; the apparent loss of the day is trifling, but in large establishments, where large capital is idle—the men off on a frolic, not to turn up when wanted—should induce every mill-owner to save this lost day, which need occur but once in six or twelve months if no scale formed. As proof, boilers in New York are cleaned but once a year, the water being pure enough to incur no risk of burning from incrustation formed in that time; boilers elsewhere could be run as long if kept free from scale. We therefore urge engineers and others to adopt some means to prevent scale, and as the incrustation powder invented by Mr. H. N. Winans, of New York, has proved a reliable and uninjurious article for this purpose during the last ten years, and many of our citizens recommend it, we are confident it will save time and money where scale exists.—*Scientific American.*

MINERAL AND METALLURGIC CHEMISTRY.

PROFESSOR W. A. MILLER, President of the Chemical Section of the British Association, in his inaugural address, makes passing allusion to some of the processes of Mineral and Metallurgic Chemistry, such as the improvements in the details of the process for preparing magnesium, the comparative facility with which the recently-discovered metals thallium, rubidium, and cæsium and their compounds may be obtained, and the application by Redtenbacher of his observation of the sparing solubility of their alums to the extraction of the new alkalies from the lithium residues of commerce. Of indium, too, the latest of the newly-discovered metals revealed by the spectrum, it must suffice to say that it has been obtained in quantity which places its existence as a distinct metal beyond question. An extensive branch of industry is now springing up in the improved methods of voltaic deposition of the metals. Weil has, by the use of an alkaline solution of tartrate of copper, contrived to coat iron and steel with a tough, closely adherent sheathing of copper, by simply suspending the articles to be coated by means of a wire of zinc in the metallic bath. No battery is required. Lead and tin may in a similar manner be deposited on copper, iron, or steel, if the oxide of tin or of lead be dissolved in a bath of strong solution of caustic soda.

USE OF GLYCERINE FOR MOISTENING MODELLING CLAY.

Cosmos records some experiments on the use of Glycerine instead of water for moistening modelling-clay. Clay, first well dried and then rendered plastic by admixture with glycerine, was kept in a hot room for two months, at the end of which time its plasticity had not in the least diminished. Clay rendered plastic by glycerine would seem to be capable of being used over and over again indefinitely, just like wax; with the advantage over wax of always retaining the same consistence and degree of plasticity, neither being hardened by cold nor softened by heat.

SIEMENS'S REGENERATIVE FURNACE.

SIR W. ARMSTRONG, in characterizing the importance of this invention as scarcely to be over-estimated, says: "Few persons are aware of the prodigious waste of heat which takes place in all Furnaces where it is requisite to communicate a high temperature to any material. If, for example, a mass of material is to be heated to a temperature of 2000° by flame of a temperature of 3000°, it is plain that the heating gases must, in the ordinary furnaces, escape at a temperature equal to that of the material, and thus carry off with them a heat which will, when the maximum temperature is attained, amount to two-thirds of the whole heat and combustion. The Regenerative Furnace arrests a large proportion of this fugitive heat, and adds it to the gaseous fuel which supports the combustion of the furnace. Wastefulness must always be deprecated in mechanical processes, but considering how much the greatness of this country is dependent upon her resources of mineral fuel, and with what prodigality we are now drawing upon these resources, any wholesale wastefulness demands especial reprobation, and renders the introduction of more economical methods of consumption a matter of national importance." The regenerative gas furnace not only prevents waste of fuel, but it also prevents smoke. Smoke may be altogether prevented, and is, in fact, inexcusable in the case of ordinary steam-boiler furnaces; but in his, Sir W. Armstrong's opinion, no means has yet been introduced by which its prevention can be effected in manufacturing furnaces heated directly by coal. If gas were substituted for coal, and the regenerative principle applied, the nuisance and disfigurement occasioned by smoke would be entirely avoided in nearly all manufacturing processes.—*Proceedings of the British Association.*

QUALITATIVE ANALYSIS FOR METALS.

PROFESSOR BLOXAM has read to the Chemical Society "Notes upon the *General Routine* of Qualitative Analysis for Metals;"

which comprehended an examination of the mode of reducing binoxide of tin by fusion with cyanide of potassium, and of the processes for detecting magnesia and small quantities of zinc. The mineral constituents of filter-paper had likewise been submitted to a critical examination, and were found to consist of clay, ferric oxide, and carbonates of lime and magnesia, besides traces of phosphate and sulphate of lime, potash, and soda, and oxides of lead and cobalt. In the course of discussion, Dr. Odling called in question the propriety of adopting a formula for the new double sulphide which demanded an uneven number (seven) of sulphur atoms.

NEW METAL.

INDIUM, the latest-discovered and as yet least known of the metals—it is only about a year and a half since it was first detected—is being carefully studied, not only by its discoverers, F. Reich and Th. Richter, but also by C. Winkler, who has contributed some account of his researches upon it to a recent number of one of the German scientific journals. He describes it as a "lustrous metal resembling platinum in appearance. It is malleable, and may be cut with a knife. It is not easily oxidized in the air. Heated in a crucible to a bright red heat, it is volatilised, and burns with a violet blue flame to oxide, which appears as a yellow deposit on the sides of the crucible." It would thus appear to belong to the same class of metals as zinc, cadmium, and magnesium. It has "only one oxide; In O, which is of a straw-yellow colour. This oxide dissolves in acids, forming colourless salts." The metal itself is likewise readily dissolved by most acids. Three separate determinations gave respectively 35·874, 35·927, and 35·955, as its atomic weight. Considering its malleability and freedom from liability to oxidise, indium might be of considerable use in the arts, if it were obtainable in quantity, but as yet it has only been found in the zinc ores of Freiberg. Reich and Richter obtain it direct from those ores, but Winkler prefers to obtain it from manufactured Freiberg zinc, in 10,000 parts of which there are 448 parts of indium.—*Mechanics' Magazine.*

GLUCINUM AND ZIRCONIUM.

GLUCINUM and Zirconium, the former being the metallic base of the emerald, and the latter that of the zircon and the hyacinth, are metals of which chemists know very little. They have hitherto been obtained only from very rare and costly minerals, and by reduction from their haloid salts by means of potassium. A paper in *Cosmos* suggests, however, that these two metals, and also the still less known ones, yttrium, erbium, terbium, cerium, thorinum, lanthanum, and didymium, probably exist much more abundantly than has hitherto been supposed; and states that they all admit of being isolated by an exceedingly simple electrolytic method, consisting merely, in each case, in immersing in a solution of a salt of the metal which it is desired to reduce, a plate of zinc and a plate of platinum, duly connected together. The metal is then gradually precipitated upon the platinum plate.

NEW SOURCES OF THALLIUM.

Two new sources of Thallium, both yielding that metal in greater abundance than any of the sources of it previously known, have been discovered within the past twelve months. At Juliushutte, near Goslar, the water which has been used for washing the pyrites of Ramelsberg is evaporated in immense quantities for the sake of the sulphate of zinc contained in it. Bunsen has found that this water contains about 0·05 per cent. of chloride of thallium, and that the thallium can be readily extracted from it. If sheets of zinc be immersed in the water, as the zinc dissolves there is obtained a metallic deposit which consists of cadmium, copper, and thallium, in the proportions, per 100 parts of zinc dissolved, of 8 parts thallium, 22 parts copper, and 57 parts cadmium. On treating this deposit with dilute sulphuric acid, the copper remains unacted upon, but the cadmium and thallium dissolve, with evolution of hydrogen, and on adding iodide of potassium to the resulting solution of the sulphates of cadmium and thallium a precipitate of pure iodide of thallium falls. The other new source of thallium is an ore of manganese which has recently been examined by Professor Bischoff, of Lausanne. This ore contains not less than 1 per cent. of metallic thallium, but the locality in which the ore occurs is unfortunately not known. All that is needed for the extraction of the thallium from it is to dissolve the ore in sulphuric acid and treat the solution with metallic zinc. The same ore contains also appreciable quantities of vanadium and lithium.—*Mechanics' Magazine.*

NEW SOURCE OF TELLURIUM.

The curious metal, or metalloid, which Klaproth named Tellurium, has hitherto been one of the rarest of known substances, found only in a very few localities—chiefly in Hungary and Transylvania—and there only in such minute quantities that its selling price in England has never, we believe, fallen below 10s. per ounce. In a paper, however, on the mineralogy of South America which is contributed to the January number of the *Philosophical Magazine* by Mr. David Forbes, F.R.S., we are told of an ore of bismuth which contains not less than 5 per cent. of tellurium. This ore occurs in Bolivia, about two-thirds up the mountain of Illampu, which is the highest of all the peaks of the Andes, towering to nearly 25,000 feet above the level of the Pacific Ocean. It is thus far from being convenient of access; still, the demand for bismuth has sufficed to set men mining it—at an altitude of 15,000 feet, and only slightly under the line of perpetual snow—so that we may expect tellurium, as well as bismuth, to be soon very much cheaper than hitherto.—*Ibid.*

ALUMINIUM, ETHIDE, AND METHIDE.

Dr. Odling has delivered, at the Royal Institution, a discourse "On Aluminium, Ethide and Methide." He began with referring to the great abundance of the metal Aluminium in the crust of the earth, existing in clay, granite, slate, &c.; the ruby, emerald, and other precious stones being merely tinted granite; yet it is hardly ever found in connection with organic life. Its compounds, however, have not received very much attention from chemists, and much diversity of opinion still exists regarding its atomic proportions and formulæ. Dr. Odling has endeavoured to settle the questions by showing, first, the relation which exists between the atomic proportions of metals and their specific heat (determined by the accurate measurement of the quantity of ice they can melt when heated to 212 deg.); and, secondly, by ascertaining the quantity of a metal which is contained in two volumes of its gaseous compounds —*i.e.*, its chloride, bromide, ethide, and methide. The results of the researches of Cahours, Deville, and others on aluminium chloride not agreeing with Dr. Odling's method of solving the problem, he stated that Mr. Buckton and himself, by adopting the method of Dr. Frankland and M. Duppa, proceeded to form compounds of Aluminium with the gaseous hydrocarbons Ethyl and Methyl, derived from alcohol. (Specimens of these substances were exhibited and their spontaneously-inflammable character shown.) The examination of these new compounds corrected the anomalous results derived from the chloride, and confirmed the atomic weight and molecular formula deducible from the specific heat of aluminium. The quantity of aluminium which has the same specific heat as 108 parts of silver was found to be 27·5 parts, which is, therefore, the atomic proportion of aluminium. Our limited space precludes our giving further details of Dr. Odling's chain of chemical reasoning, which was elucidated by experiments and diagrams.—*Illustrated London News.*

NEW MINERAL.

A new mineral has been discovered by Mr. W. E. Brown in a cargo of phosphatic guano from an island in the Caribbean Sea. Mr. G. E. Moore, who has communicated an account of it to the *American Journal of Sciences*, names it Brushite, after the eminent mineralogist, Professor Brush, of Yale College. The mineral is found in the guano as seams, varying from a fourth to an eighth of an inch in breadth, in the form of small but very perfect crystals of a yellowish white colour. When heated in a closed tube before the blowpipe the mineral whitens, and at an incipient white heat gives off water. Chemical analysis revealed the presence of lime, phosphoric acid, and water, with barely discernible traces of magnesia and alumina. In the polarising microscope it showed a vivid succession of colours.

MINERAL VEGETATION.

The Paris Correspondent of the *Chemical News* refers to the following scientific curiosity:—If a crystal of sulphate of copper or sulphate of iron be put into a very dilute solution of silicate of potash, a sort of mineral vegetation grows up of the same colour as the sulphate. In fact, a miniature forest may be obtained at the bottom of a jar, and by placing the crystal on the top of a layer of well-washed sand coloured with a little bichromate of potash, the appearance is given of an artificial soil greatly resembling a natural gravelly deposit.

REDUCTION OF CAST IRON TO STEEL BY CARBONIC ACID.

Some specimens of Steel Cutlery formed in this way have been exhibited at the Polytechnic Institution of New York. They were formed at first of cast-iron, and having been packed in an air-tight box with carbonate of potash, soda, or lime, were placed in a furnace, and subjected to a bright red heat for two days.

The carbonic acid set free by the high temperature, in this process, is decomposed, becoming carbonic oxide by forming carbonic oxide with more or less of the carbon of the cast-iron; the five per cent. of carbon being reduced to 1¼ or 1¾, so as to form steel; or, if required, being entirely removed, so as to form malleable iron. The process will answer with grey cast-iron, which contains uncombined carbon, but white cast-iron is better for the purpose. The grey iron is first reduced to white, which contains no carbon in excess. The steel produced in this way is not of the very best kind, it is true, but it answers well for hammers, shovels, &c., and for agricultural implements generally.

FINELY-DIVIDED IRON.

To obtain finely-divided iron, M. Bischoff recommends that pieces of a very rich iron ore should be placed in a flame furnace with a combustible substance fitted to reduce it to an oxide. The heat should not be sufficient to melt the metal. Finely-divided iron is useful for many purposes, especially in the manufacture of aniline colours, during which the iron is reduced, and may thus be used for an indefinite number of times. When the iron powder is employed to precipitate copper, the iron ore containing several hundred parts of copper is taken, such as that of Ireland and Spain. According to M. Bischoff, the iron reduced by his process acts energetically upon coppery solutions and precipitates the metal with great promptitude. To obtain copper in powder, M. Low recommends, as an *expeditious way, the* plunging a piece of zinc into a saturated solution of sulphate of copper to which has been added its volume of hydrochloric acid. Hydrogen is disengaged with effervescence, and copper is deposited in a spongelike form, which is transformed into a powder when agitated. This should be washed in hot water, and dried in a current of hydrogen.

SILICIUM IN IRON.

Dr. Phipson, in a paper read to the British Association, states that he has found several samples of iron, which were reported as yielding very different qualities of Bessemer steel, to be of precisely similar chemical composition; and, following up the subject, he comes to the conclusion that the difference in the quality of the steel arose, not from differences in the total quantity of silicium, but from the manner in which it occurred, as free or combined.

ENGRAVING IN RELIEF ON ZINC.

M. Boëttger has communicated to the *Journal für Praktische Chemie* the following simple process for Engraving in Relief on Zinc:—He dissolves one part of dry chloride of platinum and one part of finely-powdered gum-arabic in twelve parts of water, and with this solution writes on a plate of clean zinc with a quill pen. The writing appears black, by reason of the zinc decomposing the chloride of platinum, and so causing "platinum black" to be deposited. Before the writing is quite dry, he plunges the zinc for a few moments into a solution of double cyanide of gold and potassium, whereupon the whole plate becomes covered with a very thin film of metallic gold. He then immerses it in nitric acid diluted with sixteen times its weight of water, which, while leaving the gold firmly adherent to the platinum-black writing, causes it to peel off all other parts of the plate, thereby exposing the zinc, wherever not written upon, to the solvent action of the acid. That action is allowed to proceed until the writing is left in the desired degree of relief.

COPPER IN THE ANIMAL KINGDOM.

A series of researches with respect to the occurrence of Copper in the Animal Kingdom which has recently been pursued by Dr. G. L. Ulex, has resulted in establishing that that metal is one of the most widely disseminated substances in nature. It has been known for some years that copper exists in the blood of some of the lower animals, especially the mollusca, but its existence in the blood of the higher animals was not established when Dr. Ulex undertook the investigations in question. Dr. Ulex, however, found copper *in every animal in which he searched for it*, and among these animals were mammalia, birds, amphibia, fishes, crustacea, *insects*, arachnida, annulata, echinodermata, entozoa, polypi, and *sponges*—man, the horse, the ox, the lynx, the teal, the common fowl, the tortoise, the common lizard, the common adder, the brown frog, the eel, the haddock, the common shrimp, Spanish flies, spiders, earth-worms, star-fishes, and sea-anemones. Dr. Ulex concludes that copper exists in the bodies of *all* animals, and remarks: "As animals live, in part directly and in part indirectly, upon plants, it follows that it must occur in all plants; and as plants derive their mineral constituents either from the soil or from sea-water, copper must be generally diffused through both those media." Copper had previously been frequently detected in soils—Sarzeau and Commaille had each failed to find any plant in which it did not occur, and both Durocher and Malaguti, and Field and Piesse, had found it in sea-water. It is doubtless universally diffused.—*Mechanics' Magazine.*

COPPER AND PHOSPHORUS.

Mr. Abel has read to the British Association, a paper "On the Compounds of Copper and Phosphorus," detailing experiments made to ascertain if phosphorized Copper would be more effectual as a material for the manufacture of cannon than the alloy in general use. Mr. Abel found that an ingot of copper, 1 in. in area, broke under a strain of about 25,000 lb.; that of a similar ingot of gun-metal required 32,000 lb.; whilst copper combined with 5 per cent. of phosporus required 38,389 lb., and with 1·4 per cent. of phosphorus the strain that the ingot would bear was upwards of 47,000 lb. Still, practical difficulties prevent the application.

THE ACTION OF SULPHIDE OF LEAD, WITH REFERENCE TO PICTURES.

In the Chemical Section of the British Association for Science, Dr. D. S. Price has read a paper "On the Action of Sulphide of Lead, and its bearing upon the Preservation of Paintings in Picture Galleries." The author had been led to an investigation of this subject by observing that in the glass cases at the Crystal Palace, which are painted with white lead, substances which emitted sulphurous vapours did not cause a darkening of the surface of the case, excepting where it was protected from the direct influence of the light. A number of experiments were subsequently tried on the action of light on sulphide of lead produced by the action of sulphuretted hydrogen on lead paint. A board painted with white lead was exposed for several hours to the action of sulphuretted hydrogen gas, until the surface had acquired a deep brown or chocolate colour. Glasses of different colours were then placed upon it. It was then exposed—one portion being at the same time covered with an opaque medium, and another left wholly exposed. The board which had been thus painted was exposed to the action of the light, and several impressions were photographed by the light acting through the glass. The glasses employed were red, *blue, yellow (silver)*, smoke, and violet. The results were that the portions, as before observed, exposed to the light were bleached, those protected remaining unaltered, while intermediate effects were produced with glasses of different colours; drying oils, when exposed to the action of light, rapidly bleached; and when boiled oil was used, still further action was produced.

Professor Hofmann, confirmatory of the lecturer's remarks, also observed that blue, which had become faded, when exposed to light assumed its almost original brightness. This accorded with the evidence of Mr. Farren, who had exposed a picture to the light, when the blue portion which had greatly faded became restored.

Mr. George Wallis, of the South Kensington Museum, also made several observations, and instanced the fact that some old picture dealers, not very careful of truth, were accustomed to make new pictures look like old ones by the method described. He did not know whether he ought to say so, as it would probably go forth to the public; but it was a fact that the air of South Kensington was purer and better for the preservation of pictures than that of the National Gallery. A landscape exhibited by the lecturer had a very amusing appearance—the parts covered by an opaque medium retaining their original colours; those portions exposed to the light looking as if mellowed down by age, or rather as if they had undergone an extraordinary whitening process.

LEAD POISONING.

Poisoning by drinking water which has acted on lead happens far more frequently than is often suspected, and the mode in which the water is rendered poisonous is frequently difficult of discovery. A Correspondent of the *Times* states that, from a rural parish where the drinking-water is got from draw-wells, and there are neither leaden pumps nor leaden pipes to contaminate the water, several of the peasantry went lately to the neighbouring county infirmary, suffering from lead poisoning. Careful investigation led to the discovery of the source of the evil—the so-called "tinned" kettles in which the water used for tea and for cooking was boiled. It was ascertained that the "tin" with which the kettles were lined was an amalgam of tin and lead. The adulteration of tin with lead is one of the most common frauds. It is of very great importance to public health that some way of escaping from poisoning by leaded tin should be discovered, and it would be desirable that we should know whether there is any coating for iron which would resist heat and the ordinary action of water, and which could be substituted for what is called "tin." About a year ago a French patent was taken out for such a coating, and the coating is said to have stood very severe tests of heat and acids. Such a coating has also been discovered lately in England. Anyone giving accurate information respecting such coatings would confer a boon upon the public. A very ready test for lead in water consists in taking two tumblers and filling one with water which is known not to have been in contact with lead; the other being filled with the suspected water. Dissolve in each about as much bichromate of potash as will stand on a groat. By daylight the water in each tumbler will be of the colour of pale sherry and water. Cover the tumblers so as to keep out dust, and let them stand in a warm place in a room with a fire in it for twenty-four hours. If the suspected water be free from lead, it will still have the same colour as the other, but if there be lead in the water it will have a more or less opalescent tint, as if a drop or more of milk had been put into it. If there be a great quantity of lead in the water, a very slight film of lead will be deposited on the glass.

CHEMICAL RESTORATION OF ANCIENT GLASS.

Mr. Crace Calvert, in his Cantor Lectures, has the following information upon this point:—"It has been for a long time a disputed question," says Mr. Calvert, "whether the stained windows we all admire in old cathedrals could be restored in such a way as to resume the brilliancy they had at the time they were placed there by the artists. At all events, there is now no doubt that this can be effected by the process discovered by my eminent master, M. E. Chevreul, as is proved by the application of it in connexion with the restoration of stained windows existing in a well-known church in Paris—that from which the tocsin of St. Bartholomew was sounded,—'St. Germain des Près.' The process devised by M. Chevreul is highly practical; it consists in removing the stained glass from the windows, and dipping it for several days, first, in a weak solution of carbonate of soda of a specific gravity of 1.068, then washing it, and dipping it for several hours in a solution of muriatic acid of a specific gravity of 1.080. On the glass being washed and dried, it will be found as brilliant and beautiful as when it came from the hand of the manufacturer. M. Chevreul has found that the dim and dirty appearance which stained glass assumes by time is due, especially in large towns, to the various products of smoke being first condensed on the glass by fog and rain, and then, becoming oxydised, they act as a cement to various mineral matters, such as chalk, gypsum, oxide of iron, &c., which help to impoverish the transparency of the glass. The alkali acts upon the organic matter and dissolves it, while the muriatic acid removes the minerals. The durability of glass placed in our monuments is extraordinary, when we bear in mind the curious results published some years since by the eminent chemist, Pélouze, who observed that when window, bottle, and other varieties of glass were reduced to a fine powder, and mixed with water, they were soon acted on, yielding a large quantity of silicate of soda to that fluid, amounting in several cases to eight or ten per cent. in cold water, and even to thirty-six per cent. when the finely pulverised glass was boiled in water; and that, in many cases, it was a definite compound which was dissolved from the glass—namely, a silicate of soda, composed of three equivalents of silica and two equivalents of soda. M. Pélouze explains the extraordinary difference in the effect which water produces on glass when in large masses or plates, as compared with its influence on the same substance when reduced into a fine state of powder, by assuming that, in the first instance, water does not act because it seldom remains sufficiently long in contact with the glass to act upon the elements which compose it; while, in the second case, there exist numerous points of contact between the fluid and the solid body, thus facilitating the action of the fluid on the solid material. I am inclined to think that the peculiar molecular condition which the surface of glass assumes, when manufactured in plates or otherwise, must exercise a great influence on the property which glass has to resist the action of water. If it were not so, how could be explained the limited action which watery fluids, such as wine, cause upon the interior surface of a bottle, though they remain in contact for many years? I can conceive glass assuming a peculiar surface by the pressure of the atmosphere, thereby producing a homogeneous one susceptible of resisting the action of water. A similar instance occurs in the case of polished steel, or of the rolled surface of wrought iron, or the skin of cast iron, which resists the chemical action of either air or acids in a far greater degree than does the interior of the substances which compose those metallic bodies."

Among M. Pélouze's latest discoveries is that of the fact that "selenium will colour glass less powerfully than sulphur, and thus that the resemblance between those metalloids extends to their action on the earthy and alkaline silicates. One per cent. of selenium will communicate to glass a beautiful orange tint, 'resembling that of some varieties of topaz and zircon hyacinth.' The tint communicated to glass by sulphur is yellow."

AVENTURINE.

M. Pélouze has made a communication to the French Academy in which he discloses his method of making *Aventurine*. The secret of the composition of this substance has long been in the hands of Neapolitan jewellers. They derived it from a Venetian workman, who is stated to have hit on the materials accidentally, whence its name, *aventura*. M. Pélouze's *aventurine* consists of 80 parts of oxide of iron, 40 parts of protoxide of copper, and 300 parts of powdered glass, submitted to a high temperature for twelve hours and then allowed to cool gradually. A better quality of *aventurine*, and far superior to that originally made in Venice, may be prepared by mixing 40 parts of bicarbonate of potash, 50 of carbonate of lime, 100 carbonate of soda, and 150 of sand.

ARTIFICIAL RUBIES.

Many chemists have endeavoured to produce artificial diamonds, *but hitherto* with invariable failure. Most of the other gems, *however*, have been produced artificially, the artificial stones having exactly the same composition and properties as the natural ones. Rubies have till now been the most difficult gems to produce artificially, but MM. Ste. Claire-Deville, Caron, and Troost have communicated to the Paris Academy of Sciences a method by which they can be made with ease. A mixture of fluoride of aluminium with a small quantity of fluoride of chromium is placed in an earthen crucible which has first been carefully lined with calcined alumina, after the fashion in which it is customary to line crucibles with charcoal. In the centre of this crucible, in the midst of the mixture of fluorides, is placed a small platinum crucible containing boracic acid. The outer crucible having been well covered, the whole is exposed to a temperature sufficiently high to volatilise both the boracic acid and the fluorides. The vapour of the boracic acid then decomposes that of the fluorides, with formation of fluoride of boron and deposition of crystals of the mixed oxides of aluminium and chromium. If the fluorides were originally mixed in the right proportions, these crystals will have exactly the same composition, and exactly the same colour, lustre, specific gravity, and other properties, as the most perfect natural rubies.

NEW COLOUR.

A NEW colour, called "Green Cinnabar" is stated by a foreign contemporary to be prepared in the following manner:—Prussian blue is dissolved in oxalic acid, chromate of potash is added to this solution, which is then precipitated with acetate of lead. The precipitate, well washed, dried, and levigated, gives a beautiful green powder. By varying the proportions of the three solutions various shades of green may be procured. Chloride of barium or nitrate of bismuth may be used in place of sugar of lead.

NEW BLACK DYE.

VARIOUS methods of preparing and using the Black Dye obtained from aniline are described by M. Lauth in the Bulletin of the Chemical Society of Paris. In January, 1863, a process was announced by Mr. John Lightfoot, of Accrington, which has been found to be unsatisfactory. In 1864, M. Cordillot made known his method, which, with great improvements, was found to be deficient in giving intensity and retention of colour. M. Camille Köchlin has modified and improved the process of Mr. Lightfoot in such a manner as to permit of its application on a large scale; but the tissue is often injured in dyeing. The black thus produced is quite special. It has a velvety appearance, is quite insoluble in water, boiling soap, alkalies, and acids. Acids change the colour to green, and alkalies restore the black. Concentrated chloride of lime gradually destroys the black, which, however, returns again after a long interval of time. The black is now manufactured by MM. Muller, of Basel.—*Illustrated London News.*

NEW COMPOUNDS OF COAL-TAR.

Professor Frankland, in a lecture at the Royal Institution, has given an illustrative explanation of the processes employed in producing from liquid Coal-tar, the refuse of gasworks, not only paraffin and paraffin oil, but also the brilliant colours—mauve, magenta, &c. The paraffin manufacture was first explained, and fine specimens of the oil and candles were referred to. It was stated that chemists, by distilling coal had obtained no less than fifty new compounds, three of which—benzol, phenylic-alcohol, and aniline—are the sources of the celebrated coal-tar colours, and all contain the same compound, organic radical phenyl, although differing very much in their properties. It was shown that in the manufacture of colour, benzol (discovered by Faraday) is converted into aniline, by heating it first with nitric acid and then with acetic acid and scraps of iron. By heating aniline with bichromate of potash and sulphuric acid were produced mauve, and by heating aniline with arsenic acid or corrosive sublimate, magenta was obtained. Blue and violet dyes were prepared by heating magenta with aniline. The following facts are remarkable examples of the commercial results derived from abstract scientific researches, especially those of Dr. Hofmann: to Mr. Perkin we owe the dye mauve :—"30 cwt. of coal yield 360 lb. of tar, which furnish 18 lb. of naphtha, containing 6 lb. of benzol; 6 lb. of benzol give 5 lb. of aniline, which produce 1 lb. of magenta; 1 lb. of magenta will dye 650 lb. of silk or 900 lb. of wool—the latter being the average produce of 160 sheep: 4 lb. of coal will dye 1 lb. wool." Professor Frankland exhibited the properties of the coal-tar colours by dyeing cotton, wool, and silk in the presence of the audience, and referred to numerous specimens lent by Messrs. Simpson, Maule, and Nicholson.

ACTION OF CHROMIC ACID ON ANILINE.

M. Georges Delvaux has reported to the Paris Academy of Sciences some facts relating to the action of chromic acid on aniline. When two parts of aniline are added to one of chromic acid, dissolved in eighteen or twenty parts of water, a brown precipitate is formed in a few minutes. After a few days the mixture is filtered; and when the precipitate is dissolved in boiling water, a liquid is obtained which dyes silk and wool a light violet. When ammonia or carbonate of soda is added to the cooled liquid, it acquires the property of dyeing these materials a yellowish red. The solubility of this substance in ammonia and carbonate of soda, without decoloration, shows a difference to the salts of rosaniline. It is also soluble in benzine; and when dissolved in hydrochloric acid it assumes a green tint; the red reappearing when water is added.

MAGENTA AND ITS DERIVATIVE COLOURS.

MR. FREDERICK FIELD, F.R.S., has read to the Royal Institution a paper "On Magenta and its Derivative Colours obtained from Coal-tar." He began with a brief history of the oily base aniline, procured by M. Bechamp, through the action of nitric acid and other re-agents on benzole, a hydro-carbon discovered in oils by Faraday, in 1825; and in coal-tar by Mansfield, in 1849. In 1856, Mr. W. H. Perkin showed how an oxydation-product of aniline—the well-known mauve—might be employed as dye. Magenta, or rosaniline, is another product of aniline. Mr. Field showed how this base might be prepared in various ways. The action of nitrate of silver, of nitrate of mercury, of corrosive-sublimate, of arsenic acid, and of iodine on aniline, all gave rise to a bright crimson colour. In its tintorial power, no other dye can be compared to magenta. One grain in 1,000,000 parts of water produced a red colour; in 10,000,000, a rose pink; in 20,000,000, a blush; and even in 50,000,000, a decided, evident glow. When magenta is heated with iodide of ethyl a new base is formed, which was discovered by Dr. Hofmann, and named "Ethyl-rosaniline." This substance gives a most beautiful violet tint. Aniline acting upon the salts of magenta also yields violet and blue dyes of great beauty and power; and by the action of aldehyde a green is produced, which, unlike most other shades of that colour, appears equally brilliant by artificial and natural light. Mr. Field availed himself of the electric and magnesium lights to display the aniline colours, and exhibited magnificent specimens of the dyes in their manufactured condition, and silks dyed with them. For the former he was indebted to Messrs. Simpson, Maule, and Nicholson; and for the latter to Messrs. Hands and Co., the celebrated silk dyers of Coventry. One of the specimens of violet dye was valued at £700. This and the two preceding abstracts are from the *Illustrated London News*.

PRESERVATION OF WOOD.

A PROCESS for the Preservation of Wood, suggested by M. Hossard, a surgeon at Angers, is based upon the property of expansion by heat and condensation by cold, possessed by all porous bodies. The wood, when deprived of vegetable juices and resins, is well heated and then dipped into a cold solution of dye stuff. This solution is immediately absorbed by the pores of the wood, which contracts by the cold, and is thus rendered unattackable by insects.

THE NATURAL ALKALOIDS.

PROFESSOR FRANKLAND has thus illustrated, at the Royal Institution, the properties of the Natural Alkaloids, crystalline bodies, of which very fine specimens were exhibited, principally supplied by the Pharmaceutical Society, Caffeine (also called theine), obtained from tea and coffee, and theobromine have analogous properties; they check the waste of the muscular tissues, and enable the animal system to obtain work from non-nitrogenous substances—thus enabling men to live on a lower diet. These alkaloids also contain tannic acid and an aromatic oil. From cinchona, or Peruvian bark, are obtained the invaluable febrifuge quinine, and other less valuable alkaloids, chinchonine and aricine. From nux vomica is procured strychnine, which causes death by tetanus. Its intense bitterness has led to the absurd notion of its being used in brewing. Tobacco affords the alkaloid nicotine, a very poisonous substance a drop of which kills a strong dog in three minutes. The various alkaloids derived from opium are more interesting medically than chemically—morphine being the chief. In the latter part of the lecture the Professor considered the organic carbonic acids, and gave several experiments elucidating their structure. These acids include the fatty and aromatic acids—formic, acetic, stearic, benzoic, &c. By means of the electric light and a screen, were exhibited the beautiful crystals of caffeine, produced by heating some leaves of tea during the lecture: and also showed some living ants and the reaction produced on test-paper by the formic acid emitted from their stings.

ALKALI WORKS.

Dr. Angus Smith has presented his first Report under the Alkali Works Act of 1863. It is a singularly satisfactory report. If the escape of muriatic acid is less than 5 per cent. the Act has been perfectly successful, and already there is not in his list an instance in which the escape amounts to 5 per cent. The average is but 1·28 per cent.; 26 works are condensing 100 per cent. When the inspection began 40 per cent. of the gas was in some instances allowed to escape, and 16 was a very common amount. The alkali-makers themselves seem surprised at the ease with which they have succeeded. Dr. Smith describes the method of inspection and testing, and the measures adopted for condensation. He says it was his belief that the expense of the necessary alterations would in many cases be counterbalanced by the saving of payments heretofore made for damages done by the escape of muriatic acid. The owner of one large establishment states that for the last four years he paid 150*l.* a year for damages. The expense of his alterations to bring condensation within the requirements of the Act has been 300*l.*, and, considering this as capital, condensation is a saving of expense. In some cases the muriatic acid sent into the atmosphere was actually much wanted in the works for the production of chlorine. Dr. Smith feels quite unable to say anything regarding the change in the neighbourhood of alkali works, or the effect on the growing crops. Several letters, as early as the summer of 1864, gave a flattering account of roses which grew where none had grown for years, and of fruit-trees which had begun to blossom after having long ceased. Vegetation is peculiarly sensitive. Mr. Balmain, in St. Helen's, after passing gas from his condenser through nitrate of silver, led it among growing flowers covered with a glass shade. These flowers appeared healthy for a fortnight, but suddenly in two hours they died; a less perfect condensation had occurred for a short time, but so delicate were the flowers that, although they clearly showed this difference, it could not be traced by any other method. This occurrence proves that great progress has been made in the art of condensing.

THEINE.

THE alkaloïd Theïne has been found by Dr. Daniell in the kola nut, the fruit of the kola, or Sterculia acuminata, much used for food in Central Africa. The specimen crystals shown by Dr. Attfield at a meeting of the Pharmaceutical Society are stated, in the report given in the *Chemical News*, to resemble more closely those obtained from tea than from theobromine. Professor Bentley, in reporting the discovery to the Society, considered it very important, since it added one more order of plants to those known to contain theine. He thought also that, as kola is closely allied to the order which includes cocoa, perhaps theine might be found in theobromine.

THE ORGANIC ACIDS.

PROFESSOR FRANKLAND has thus illustrated, at the Royal Institution, the Organic Acids. He began with oxalic acid, which is a frequent constituent in the juices of plants (garden rhubarb, wood-sorrel, &c.), and exhibited its artificial production by heating (1) molasses with nitric acid, and (2) sawdust with caustic potash. He showed its property of taking away ink-stains and iron-mould in linen, and referred to its great employment by calico-printers. Lactic acid, which is formed during the fermentation of a large number of organic substances, and which exists in sour milk, sauer kraut, and the gastric juice was next dwelt upon, together with its homologue, leucic acid. Professor Frankland next considered the interesting group termed mesoxalic acids, which include the acid found in apples, currants, &c. (malic), in grapes, &c. (tartaric), and in amber (succinic). The lecture was concluded with an account of some of the large number of organic compounds which contain metals. In most of these the metal is linked to the organic part by oxygen (*e.g.*, in ethylate and acetate of sodium); but in some (the metallo-organic bodies) the metal is directly combined with the organic radicals. The processes by which these latter bodies are formed were described and illustrated; and the great energy of their affinities was strikingly shown by the way in which several specimens manifested their high degree of spontaneous inflammability. When permitted to come into contact with the atmosphere they ignited with violence, and the flame rose nearly to the roof of the theatre.

PYROGALLIC ACID.

A very valuable process has been discovered in France, whereby the Pyrogallic Acid, so largely consumed by photographers, can be made in much larger quantities and at cheaper rates than hitherto. By means of the old process, 100 parts of gallic acid yielded but 25 or 30 per cent. of pyrogallic acid. By the process just made known to the Academy of Sciences at Paris, by M. de Luynes, 100 parts of gallic acid are made to yield 60 parts of pyrogallic acid. The new process is a somewhat complicated one, and the pyrogallic acid is first formed in solution instead of in its usual state.

SANTONIC ACID.

It is stated in *Cosmos* that Santonic Acid, an extract of the flowers of Santolina, exercises a specific effect upon the retina. When a dose of eight or ten centigrammes has been taken, a species of intoxication is produced, during which all objects appear to be yellow; with a stronger dose everything becomes violet-coloured. M. E. Rose has made a series of experiments with this substance by means of the solar spectrum; but the results are stated to be not quite satisfactory. Chromatism and achromatism are only accessories of vision. They may be modified by a variety of circumstances, and have not yet been subjected to any general law.

NITRIC ACID.

M. Dietzenbacher has communicated to the Paris Academy of Sciences a note on some of the properties of Nitric Acid. In the boiling state this is a most energetic oxidising agent, and fuming nitric acid also when cold acts in the same way. It becomes also exceedingly powerful when mixed with the sulphuric acid of Nordhausen. The writer reports several powerful effects produced by this combination. Gunpowder, gun-cotton, phosphorus, charcoal, and lampblack were burnt, but the metals readily oxydised were not affected.

IODIDE OF POTASSIUM.

At the Academy of Sciences at Paris, M. Payen has reported the results of his researches on the Iodide of Potassium, a compound now much employed in medicine, especially to counteract the injurious effects of certain businesses, such as painting and white-lead making. M. Payen shows how important it is that this compound should be free from the carbonate of potash, and not contain iodine in excess, in order that the physician may not be deceived in its action. M. Chevreul added some remarks, supporting M. Payen's views and suggesting inquiry into the purity of the medicines now employed by pharmaceutical chemists.

DISCOVERIES IN SALT-MINES.

PROFESSOR VOELCKER describes, in the *Journal of the Royal Agricultural Society*, his visit (with Dr. Gilbert) to the German Salt-mines at Stassfurth, which, since 1855, not only furnish annually 50,000 tons of pure salt, but have been a perfect mine of discovery for chemists and mineralogists. Here have been found fine natural deposits of potash which will probably become exceedingly valuable; and also a new salt, named carnallite, after M. Von Carnall, the director of the Prussian mines. Stassfurth alone produces 250 tons of crude potash salts daily. Specimens of these have been sent to England, and are about to be analysed. In his third communication, Professor Voelcker gives the results of elaborate researches into the functions of soda salts in agriculture.

PHOSPHORUS.

M. BAUDRIMONT has communicated to the Academy of Sciences at Paris an account of his experiments upon the nature of White Phosphorus, which have led him to conclude that it is neither a hydrate nor an allotropic condition of normal phosphorus, and that it is not the result of devitrification. He considers it to be merely ordinary phosphorus irregularly corroded on the surface, and unpolished, so to say, by the combustive action of the air dissolved in the water. This slow combustion is accelerated by diffused light, and ceases when the aqueous fluid contains no more oxygen in solution.—*Illustrated London News.*

NEW PHOSPHATES.

M. VOELCKER has described to the British Association some newly-discovered Phosphatic Deposits at Cwmgynen, in the district of Llangynog, in North Wales, consisting of about two miles of deposit, mainly of a black phosphatic limestone, and another of a similar nature of black shale. This discovery would prevent the necessity of going in future to France for phosphates.

THE ORGANIC WATERS.

PROFESSOR FRANKLAND has devoted his fifth lecture on "Organic Chemistry" to the consideration of the structure and properties of Organic Waters, comprising alcohols, ethers, and ethereal salts. The alcohols (a numerous class) consist of water (hydrogen, 2; and oxygen, 1), in which one of the atoms of hydrogen is replaced by a compound basylous, organic radical, like ethyl. Wood spirit (or methylic alcohol) was the alcohol first examined. It is usually obtained by the distillation of wood, but has been artificially produced by Berthelot from marsh gas, through the agency of chlorine, as was shown by experiment. Much advantage has been obtained in the arts by spirits of wine being made duty free when mixed with a certain quantity of methylic alcohol. Common or vinic alcohol, produced by the fermentation of saccharine matter, is the intoxicating principle of all beers, wines, and spirits. When pure it is very mobile (and hence is used in spirit-levels), never solidifies, and is therefore used in thermometers for low temperatures; it is very inflammable, and boils at 78·4 centigrade. The gunpowder test for proof was shown. Powder wetted with under-proof spirit would not explode on ignition; it did so with proof spirit. The qualities and peculiarities of various spirits and wines were described, and the results of the researches of Dr. Bence Jones exhibited in diagrams. In brandy the quantity of alcohol is about 53 per cent.; in rum, 72; in whisky, 59·4; in port and sherry, about 21; in strong ale 10·5; in cider, 6·8. The cost of a gallon of pure alcohol, as contained in the following spirits and wines, was stated to be—in brandy, 49s.; rum, 28s.; sherry, 85s.; port, 119s.; claret, 142s.; champagne, 172s.; in ale and stout, only 15s.

CHEMISTRY OF WINE.

THE Chemistry of Wine is still occupying the attention of the most advanced French chemists. M. A. Béchamp, in a communication to the Academy of Sciences at Paris, defends his own views as to the cause of the maturing of wines. In his lectures on the vinous fermentation he had stated that all the elements which wine contains—succinic, acetic, phosphoric, tartaric, œnanthic, and other acids, glycerine, alcohols, ethers, extractive matters, &c.—act upon each other. From the slow action of the acids on the alcohols arise new ethers; and the alcohols, becoming more or less oxydised, form odorous aldehydes. Later still, when in the bottles, these reactions in the wine continue, till at length it acquires all its value, and its bouquet is developed. M. Béchamp describes the experiments which induce him to maintain his opinion that wine is brought to maturity by means of a fermentation provoked by organisms which succeed to the alcoholic fermentation, properly so called. A wine (he says) may contain these organisms and yet not be spoilt; and, however paradoxical it may appear, wine is ripened and improved by an influence analogous to one which may injure it. The production of these organisms ought, then, certainly to be favoured.

M. Pasteur has laid before the Academy a *résumé* of his latest researches on the preservation of Wines. Among the results are the determination of the nearly exclusive influence of oxygen in the making of wine; its maturing or change from the state of new wine to old; and the formation of parasites and deposits, &c. New wine, from which the air is thoroughly excluded, does not form deposits, change colour, or receive a bouquet; but, when the air is admitted in darkness, but more rapidly in light, the influence of the oxygen appears in the formation of deposits; the taste of new wine is entirely lost; the colour becomes that of wine 10 or 20 years old; and the taste and bouquet are those of Spanish or

Madeira wines which have had a long voyage. The desired object, then, is to obtain these advantages without the formation of parasites, which M. Pasteur states may be ensured by heating the wine for a few minutes to a temperature of 60° or 70°, whereby, he asserts, it will acquire an extraordinary resisting power to all the maladies which may attack it. He considers that he has solved the problem of the indefinite preservation of wines, and their easy transport, in a complete and satisfactory manner. It now remains with proprietors to learn to profit by the results of scientific investigations.

M. Pasteur has reported some further results of his investigations into the Chemistry of Wine, in a note on the three different kinds of deposit which are found in them. The first, which is well known, is due to the crystals of bitartrate of potash, or of neutral tartrate of lime, or of a mixture of these two salts. They do not collect on the sides of the bottle, but are heavy enough to settle in a small mass. The second kind of deposit, often confounded with the preceding, but which is quite distinct from it, is due to brown-colouring matters, which cover the sides of the bottle, particularly the side next the soil on which it is laid. This colouring matter sometimes appears in the form of translucid leaflets, and at other times that of granulations resembling organised cellules, almost perfectly spherical. These two deposits are not considered injurious. The third kind of deposit, which is very troublesome and dangerous, is formed by cryptogamic vegetation. For M. Pasteur's recommendations in regard to the preservation of wine we refer to his note in the *Comptes Rendus*, vol. 60, No. 22.—*Illustrated London News.*

THE ANALYSIS OF WATERS.

It is well known that chemists are at variance as to the best method of calculating the weighed results of Waters. The many discrepancies which occur in the analysis of such by different chemists are no doubt due to the existing difference of opinion as to the states of combination of the various salts held in solution. A Correspondent of the *Chemical News* gives a process which he has for some time worked, which gives most satisfactory results, and shows beyond doubt the true composition of the saline matters. An ordinary potable water generally contains the chlorides of calcium, magnesium, potassium, and sodium (the chloride of calcium in extremely minute proportion); the sulphates of these alkaline earths and alkalies, with carbonate of iron, lime, magnesia, and silica. One gallon or so of the water is brought to complete dryness at 212° Fah., lixiviated several times with boiling absolute alcohol, filtered, and washed with hot alcohol. This may be marked "alcoholic solution," and contains the chlorides only of calcium, magnesium, potassium, and sodium. This filtrate is boiled with water until all the spirit is driven off, and the chlorine and bases *ascertained* in three different portions. These results are calculated into chlorides; the chlorine serves as a check. The residue insoluble in the alcohol is gently dried, boiled several times with water, filtered, the filtrate divided into three parts, and the lime, magnesia, potash, and soda, with the sulphuric acid, determined. Calculated into sulphates, the sulphuric acid acts as check.

The part insoluble in the water contains sulphate of lime (much of which has not been dissolved by the water), carbonate of lime, magnesia, peroxide of iron, and silica. It is dissolved in dilute hydrochloric acid, the silica filtered off, the filtrate divided into two parts, and the sulphuric acid found in one, the iron, lime, and magnesia in the other. The sulphuric acid is calculated into sulphate of lime, and the excess of lime found into the carbonate; the iron and magnesia into carbonate. (The sulphate of lime found in the water solution is to be added to the sulphate got at this stage.) The escape of chlorine from the chloride of magnesium on evaporation of the water to dryness is most minute, so that any objection on this score is removed, since it seems the large quantity of alkaline chlorides always present prevent this. The total residue, organic matter, and silica should be determined in another portion of the water. In the evaporation of the water for analysis a large beaker or basin is preferred. The advantages of this process are the solubility of the chlorides alone in alcohol, the solution of the sulphates in water, and the carbonates, &c., in the acid.—*Mechanics' Magazine.*

BRINE OF SALT MEAT, ETC.

Dr. Marcet in his remarks on the Brine of Salt Meat and on the distribution of albumen through muscular tissue, states that in November, 1862, he began the use of Professor Graham's process of dialysis as a method of separating the salt from the brine of salt meat; and succeeded in obtaining, after periods varying from eighteen to thirty-six hours, a liquor possessing a strong taste of soup, and hardly distinguishable from soup made in the ordinary way. He hoped that the soup might have been found available as food in Lancashire, but it proved to be deficient in the crystalloid constituents and the juice of flesh—the phosphates, lactates, kreatine, and kreatinine which are present in the flesh, and which pass into the brine, being lost while the brine was being dialysed. This decision therefore nullifies the sanguine hopes held out in regard to the utilisation of brine some time ago in popular works. Further researches led to his combining brine with a concentrated solution of chloride of zinc, and thereby obtaining lactate of zinc and the double chloride of zinc and kreatinine and kreatine. He also was struck by the large proportion of albumen contained in brine. His paper contains details of a series of remarkable dialysing experiments on the flesh and viscera of sheep, pigs, and other animals, showing how much albumen is diffused therein. He also describes a method of salting meat by enclosing it in bladders previous to plunging it into brine, thus preserving in the meat the phosphates, &c., which are lost in the common process. The meat so prepared was found to taste well, and to be more wholesome and nutritive than meat salted by direct immersion in brine.—*Illustrated London News.*

COD-LIVER OIL.

THE subject of Cod-liver Oil extract is just now receiving the consideration of our chemists. At present, two patent preparations are sold in these countries, but they have very different values. One, which is sold under the name of saccharide of cod-liver oil, has been carefully investigated by Dr. Attfield, of the Pharmaceutical Society, and has been by him pronounced to be an imposture. It is not the extract of cod-liver oil, but is simply powdered milk sugar, and does not contain a trace of chlorine, bromine, iodine, phosphorus, or sulphur. The second preparation is sold under the name of cod-liver dragées, and is really a useful watery extract of the principles contained in the cod's liver. This has been examined by the editor of the *Chemical News*, who testifies to its genuineness.—*Illustrated London News.*

VEGETABLE OILS.

M. C. SCHAITNER describes a new method for extracting Vegetable Oils, such as those from cotton, flax, poppy, mustard, &c. The seeds are first crushed or partly pressed, and then the cakes are digested—with or without heat—in closed vessels with the lighter petroleum oils. The matters are then pressed or percolated with fresh oil, and the oily solution is submitted to distillation. The petroleum oils employed are those which distil at a temperature below 212° Fahr., and are on this account easily separated.

GUTTA PERCHA AND CAOUTCHOUC.

PROFESSOR WILLIAM ALLEN MILLER, president of the Chemical Society, has reprinted the Report of his researches upon the decay of Gutta percha and Caoutchouc, with especial relation to telegraph cables. As general results of his inquiries, he found that, whenever gutta percha had been completely submerged in water, no injurious change had occurred, sea water appearing to be eminently adapted for its preservation; on the other hand, alternate exposure to moisture and dryness, especially with access to sunlight, was found to be very destructive to gutta percha, rendering it brittle, friable, and resinous in aspect. Dr. Miller also found that the prolonged action of air, moisture, and light, effected analogous changes upon India-rubber, though somewhat less rapidly. Details are given of the experiments made upon pure and commercial gutta percha, submerged cables, decayed and damaged cables, &c., pure India-rubber, and various compounds.

TO DISTINGUISH COTTON FROM LINEN.

M. Böttger has published a new method of Distinguishing Cotton when mixed with Linen. A piece of the suspected cloth, about eight or ten centimetres long and four centimetres broad, with the edges unravelled, is plunged into an alcoholic solution of aniline red, consisting of eight grains of crystallized fuchsine and sixty grammes of alcohol. After a few moments the cloth is withdrawn from the bath, and washed till the water remains colourless. The cloth while still moist is placed in a little capsule containing ammonia, for several minutes. In a short time the cotton threads appear perfectly white, but the linen threads retain a beautiful rose colour.—*Illustrated London News.*

STARCH AND CHLOROPHYLL.

Dr. W. Hinds has read to the British Association a paper "On the Identity of the Origin of Starch and Chlorophyll." Starch, whether chlorised or unchlorised, is so universal that nearly all the green vegetation represents so much starch distributed through the exposed tissues of plants. The almost universal green of nature is mostly amylaceous, and could supply fuel at least in the matter of animal food.

M. Fremy has reported to the Academy of Sciences at Paris the results of his chemical researches on the remarkable substance chlorophyl, the green matter of the leaves of plants. He has demonstrated that, when it is subjected to the double action of hydrochloric acid and ether, it gives rise to a yellow substance, which M. Fremy names phylloxanthine, soluble in ether, and to another substance named phyllocyanine, which is soluble in hydrochloric acid, colouring it blue. M. Fremy has studied these two substances very attentively. He finds that phylloxanthine is a neutral body insoluble in water, but soluble in alcohol and ether. It possesses a considerable tinctorial power, analogous to that of chromic acid, and differs considerably from the colouring matter in yellow flowers, since it takes up a magnificent blue on the application of concentrated sulphuric acid, while the latter becomes red when so treated. Phyllocyanic acid is also insoluble in water and soluble in alcohol and ether, giving to those liquids an olive colour, with red and violet tints. M. Fremy does not consider chlorophyl to be a simple mixture of blue and yellow substances, but an immediate green principle of excessive mobility, which, under the influence of several reagents, and probably by the action of vegetation, undergoes numerous modifications, and thus produces a variety of colours.—*Ibid.*

CHEMICAL ACTION OF LEAVES.

M. Boussingault reported the result of his very interesting researches on the Chemical Action of Leaves at a meeting of the

Academy of Sciences at Paris. Hitherto carbonic acid has been considered to be the only source of all the carbon which enters into the vegetable organism. Saussure experimented with the view of ascertaining whether carbonic acid alone is reducible by the leaves of plants. He had already affirmed that the presence of oxygen is necessary for the accomplishment of this phenomenon of reduction, having experimented on plants which died in pure carbonic acid. He assigned a proportion of eight of carbonic acid gas and ninety-two of oxygen as a condition favourable for the absorption of the gas by leaves. He, however, experimented with the entire plant, leaves and roots. Now, as the actions of these organs differ, it was necessary to submit each to special experiment. M. Boussingault pursued his researches in this direction, and has determined that the presence of oxygen is essentially necessary to the decomposition of carbonic acid by leaves, and also that the neutral gases, hydrogen and nitrogen, produce exactly the same effect. Hence he concludes (1) that leaves placed in the sunshine in an atmosphere of pure carbonic acid will not decompose this gas; (2) that leaves in the sunshine placed in carbonic acid and mixed with common air, oxygen, hydrogen, or nitrogen will produce the decomposition. He derives other consequences from his experiments. Phosphorus, he says, does not burn in pure oxygen, but does so in oxygen mixed with nitrogen or hydrogen.—*Ibid.*

CATALYTIC ACTION OF ORGANIC SUBSTANCES.

M. Schönbein has shown that the Catalytic Action of Organic Substances is not confined to diastase, emulsine, myrosine, gluten, saliva, and similar bodies, but is diffused throughout the animal and vegetable kingdoms. He has found that the peelings of raw potatoes and the roots of the dandelion possess the power of transforming starch into sugar; and M. Leucks has transformed the starch of these peelings into glucose, by keeping them for ten or twelve hours in a temperature of from 45 to 50 deg.

CHEMICAL PHYSIOLGICAL RESEARCHES.

M. Eugène Peligot's memoir containing his chemical and physiological studies of the Silkworm has been read at the Academy of Sciences at Paris. Our limited space prevents us from giving any details beyond the following conclusions:—The development of the worm proceeds by the transport and assimilation of the nitrogenous matter contained in the mulberry-leaf; a considerable portion of the carbon is given off as carbonic acid during respiration; there does not appear to be any exhalation of nitrogen during the growth of the animal; and the loss of hydrogen, determined by analyses, seems to correspond to such a loss of oxygen as may be admitted when a portion of the alimentary substance disappears during nutrition in the form of water. M. Jodin reported his studies on the asphyxia of the leaves of plants, especially produced by plunging them in mercury. He attributes their death to "mercurial intoxication."

DETECTION OF BLOOD-SPOTS.

Some little time ago MM. Pfaff and Erpenbeck made some researches on Spots of Blood, the results of which may often be found of use in helping to bring the crimes of murderers home to them. Blood-spots, as we are all aware, are of a very bright red colour at first, and become first brown and then black with time. The red colour begins to change from the second day, the spot becomes visibly brown by the third day, and after a few months it is black, with a yellowish tinge. The age of any given spot of blood may thus be roughly judged of from its colour; but MM. Pfaff and Erpenbeck have sought, and found, a means of judging of the age of spots of blood much more precisely. Their test consists of observing the length of time which it requires for a solution of arsenious acid to so far dissolve away the spot "as to render its edges barely distinguishable from the surrounding substance." They find that the time needed is about fifteen minutes when the spot is from one to two days old, from fifteen to thirty minutes when the spot is from three to eight days old, from one to two hours when the spot is from a fortnight to a month old, from three to four hours when the spot is from four to six months old, and from four to eight hours when the spot has been in existence for a year or more. They have made over a thousand experiments without meeting with a single exception to the rule that the time required for a solution of arsenious acid to so far dissolve away a spot of blood as to render its edges so indistinct as to be scarcely recognizable, always bears a certain fixed and definite relation to the age of the spot.

SPONTANEOUS GENERATION.

A new champion of the doctrine of Spontaneous Generation has appeared in the field in the person of M. V. Meunier, who, in a paper read to the Academy of Sciences, at Paris, attacks M. Pasteur on his own ground, that distinguished chemist having asserted that an infusion of organic matter being made to boil in a balloon provided with a long crooked neck never experiences any alteration, the sinuosities of the neck preventing the germs held in suspension in the atmosphere from penetrating into the balloon. M. Victor Meunier thence argues that if a crooked neck is an insuperable barrier to such germs, any number of similar necks must have the same effect. Starting from this idea, and keeping in mind the well-authenticated fact that no germ can resist the temperature of ebullition, M. Meunier has employed a balloon with nine crooked necks, and selected meat and beans for the requisite putrescible substances. The result of the experiment was the formation of a species of mouldy vegetation.

CHEMICAL TOY—"PHARAOH'S SERPENT."

An ingenious piece of parlour magic has been originated in Paris. According to the *Chemical News*, a pastille is placed on a plate, a light is applied, and in a moment the pastille swells up and seems to uncurl itself, and something very much resembling a snake appears on the plate. The preparation made use of is sulphocyanide of mercury (mercurous sulphocyanide), which swells up when heated, and gives a very bulky laminated mass. Some nitrate of potash is mixed with the sulphocyanide, so that the heat may be applied within the mass, and the snake-like appearance of the residue is caused by the form in which the mixture is made up. Since vapour of mercury is given off in the combustion, it will not be advisable to repeat this experiment many times in one evening in a small room. This novelty has been very extensively reproduced in England.

NEW CHEMICAL TREE.

The formation of a Chemical Tree by crystals of sulphate of copper in a very diluted solution of silicate of potash is described by M. Jules Faivre. On the bottom of the vase, covered with well-washed sand, should be placed some pieces of bichromate of potash, and the sulphate of copper should be sprinkled over the sand. The tree rises vertically, and gives out branches, inclining towards the horizon, at an angle common to all, and more acute in proportion as the solution is more concentrated.

CHEMISTRY OF CHEESE.

The Chemistry of Cheese has been elaborately studied by M. Brassier, and the results of his labours appear in a series of tables in the new number of the *Annales de Chimie*. He began with new cheese containing all the elements of milk, casein, butter, and the lactine which had escaped by pressing, and investigated all the phenomena, including the invasion of the surface by an abundant cryptogamous vegetation, the gradual change to an unctuous condition, the development of the odour and taste due to the formation of small quantities of ammonia, of fatty acids, of leucine, and of the peculiar acrid principle discovered by Proust. M. Brassier's paper will doubtless be welcomed by agricultural chemists.

LIEBIG'S EXTRACT OF MEAT.

In the year 1847 Professor Liebig, who had been prosecuting inquiries into the nature of Meat, described a process by which an Extract of Beef and Mutton may be prepared which will neither become rancid nor mouldy, even when kept long in a warm or damp atmosphere. His extract, to which the name of "Extractum Carnis Liebig" has been given, contains the soluble matter of thirty times its weight of flesh free from all fat. It is admirably suited for making soups. One pound of it, if boiled with a few slices of bread, potatoes, and a little salt, suffices to make broth for 128 men, and of a strength which is not to be obtained in the best hotels. The extract is stated by Professor Liebig to contain the essential and important ingredients of meat which are lost by salting. Hence, if added to salted and smoked meats, it imparts to them all the nutritive qualities of fresh meat. It has been introduced into the Bavarian pharmacopœia with great success, and has proved of great efficacy in cases of want of nutrition, indigestion, and bodily weakness. In the Royal Pharmacie of Munich 5000 lbs. of meat are employed yearly in its preparation. "In the supplies of a body of troops," says M. Parmentier, an eminent French authority, "the extract furnishes the wounded soldier with a restorative which, with a little wine, immediately renews his strength wasted by loss of blood, and enables him to support removal to the nearest field hospital." It may be kept unchanged under unfavourable circumstances in cellars, and in moist, warm atmospheres. Liebig states that he has seen samples from the Pharmacie at Munich, which have been preserved fifteen years in vessels stopped with a simple cork, or with paper, which exhibited no signs of deterioration. As in all cases it may be used as a substitute for meat in beef tea and soups, he believes that if it could be introduced at half or one-third of the price now paid for it, it would be a real blessing to the people of Western Europe.

In the present state of the English meat-market attention has been drawn to this substance. It is evident that if it possesses all the qualities ascribed to it, and that it does so we have the best reason to believe, it might become a substitute for a very great part of the fresh meat used in England. Professor Liebig, seventeen years ago, earnestly drew the attention of his correspondents in Podolia, Buenos Ayres, and Australia to the manufacture, and offered his advice and assistance to those who were desirous of being acquainted with the proper method of preparation. It was not, however, till within the last two years that there appeared a prospect of his wishes regarding it being accomplished. M. Liebert, of Hamburg, who had spent many years in South America and among other places in Uruguay, where thousands of oxen and sheep were slaughtered merely for their hides and fat, had resolved to ascertain among scientific men in Europe if this meat could not be saved and turned to profitable account. Having seen an allusion to the Extractum Carnis in *Liebig's Letters on Chymistry*, he went to Munich, where he was introduced to the Laboratory of the Royal Pharmacie, and made acquainted with the minutest details of the process of preparation. He returned to Fray Bentos, in Uruguay, and there established a manufactory, with the object of putting his project into execution. In a country without industrial resources he encountered many difficulties in constructing and adjusting his machinery, and it was only at the end of last year that he forwarded the first results of his manufacture to Europe. It was carefully examined by Professor Liebig, who agreed that it should be designated by his name, if it did not betray the slightest trace of fat, the presence of which would cause it to become rancid, or prevalence of gelatine, such as is to be found in the ordinary soup tablets, or *consommé*, which would render it liable to become mouldy, and consequently change its properties in a high temperature or moist atmosphere. He stated, at the same time, that if it did not possess these qualities he would be the first to proclaim its worthlessness. He found, however, that the samples far exceeded his expectations, and, from having used the extract ourselves, we are prepared to assent to this statement.—*Times.*

MANUFACTURE OF SUGAR.

A Commission, which included the eminent chemists Dumas, Pélouze, and Peligot, has reported to the Academy of Sciences at Paris, in most favourable terms, of the process, invented by M. Alvaro Reynoso, of Havannah, in which freezing is employed in the manufacture of Cane Sugar and Beetroot Sugar. A congelation has been applied in this country by Faraday and others, in the separation of salts from their solution, the ice obtained being equal in purity to distilled water.

A long memoir by Dr. Icery, President of the Chamber of Agriculture in the Mauritius, has been read to the French Academy; it describes his researches on the juices of the Sugar-cane, and the modifications which it undergoes during its extraction—a subject now attracting much attention.

ELECTRO-CHEMISTRY.

Of all metalloids, arsenic is most easily isolated by electricity, for it is almost as good a conductor as a metal. By means of an apparatus (known as *simple* in Electro-Chemistry), all the metalloid they contain may very rapidly be extracted from arseniferous substances. Place a solution of arsenical matter in a platinum vessel, plunge a zinc wire into the liquid, and the arsenic will appear on the platinum; by prolonging the action the whole of the arsenic is extracted from its compound. This method may be varied in different ways, and renders valuable service in medico-legal researches; it is much superior in sensibility to the process actually in use.—*Mechanics' Magazine.*

STANDARDS OF LENGTH.

Mr. James Yates has read to the Chemical Society a communication on the best material for the Mural Standards of Length, in which, after commenting on the properties of various metals which had been employed, he suggested the use of ordinary brass, covered with a thin coating of gold, on which fine lines or divisions could be engraved in such a manner as to remove the film of gold in those parts. By the action of the air upon the exposed portions of the brass distinctly-marked lines would soon be formed, of a black or greenish-bronze colour, upon the bright gold ground. Mr. Yates suggested also the use of a platinum coating instead of gold. During the discussion at a subsequent meeting, various other materials for the standards were recommended—viz., glass, electrotyped copper, porcelain, platinum, gun-metal, &c., each possessing its peculiar advantages.

STATISTICS OF MAGNESIUM AND MAGNESIUM LIGHT.

Unlike sun-light, burning Magnesium affords a perfect spectrum. This renders it capable of showing all the colours of objects, which, however, are in some cases slightly modified by it, on account of the preponderance of blue rays; but it is specially rich in the invisible actinic rays. The light emitted by a wire, the one-thousandth of an inch in diameter, is equal to that of seventy-four stearine candles of five to the pound; three feet of it are burned per minute, or a quarter of an ounce per hour, the cost of which, at the present price, would be about 2s. 6d. Seventy-four stearine candles would, however, in the same time, consume 2 lbs. of stearine, which would cost 2s.: 40·4 cubic feet of 12-candle coal gas would be required to produce the same effect, and would cost about 2¾d. The dearness of magnesium arises from the dearness of sodium required in obtaining it. Sodium is now 10s. per lb., and 1 lb., under the most favourable circumstances, would be required for a pound of magnesium. But increased demand will, no doubt, cheapen sodium, and render in other ways also the production of magnesium more economical. Already the Magnesium Metal Company have reduced the price of magnesium more than 50 per cent. Gas produces only about one-half the heat emitted by candles giving the same light, but its heating power, nevertheless, is productive of great inconvenience; magnesium gives off 265 times less heat than gas. Gas and candles vitiate the air by the production of watery vapour and carbonic acid; magnesium is free from this objection, but it has inconveniences of its own: a large quantity of calcined magnesia is thrown off as a fine powder, which soon renders the atmosphere of a room intolerable. This would be no objection in photography, in which it is used only for very short periods, and very little in lighthouses; but for ordinary purposes it would render *some* peculiar mode of ventilation, which is yet to be discovered, *indispensable.* At best the magnesium can be only an imperfect substitute for sun-light; its light has been found to be only the 1-525th of that of the sun on a bright November day; but, at the same time, its chemical effect was ascertained to be the 1-36th of that of the sun.

An extensive series of experiments has recently been made in France with a view to testing the suitability of the magnesium light for lighthouse purposes, and for signalling at sea. The result of these experiments appears to be that, for the applications in question, the light of burning magnesium is not only by far the most effective that we are yet acquainted with, but also the most convenient, and, even with magnesium at its present comparatively high price, by much the cheapest. The only light which in the least approaches it in power is the electric light, but, for equal apparent areas of light-giving surface, the electric arc does not give more than two-thirds as much light as a magnesium flame, and whereas the electric light requires for its production very complicated apparatus, difficult of transport, costly to work, and very liable to get out of order, all that is required for the production of the magnesium light is a supply of magnesium wire and a match to light it, while enough magnesium wire to supply a light-house for a whole night could easily be carried in a waistcoat pocket. As regards cost, M. Gaudin, of the Bureau des Longitudes, who has gone very minutely into that question, reports that, for signalling at sea, with magnesium at thirty shillings an ounce—its price has been lately reduced to twelve shillings an ounce—the magnesium light need cost only one penny per signal, for signals visible for twelve miles at noon-day, and for thirty-six miles at night. By means of burning magnesium, the commander of a ship at sea might illuminate the ocean on every side of him, as often as he chose per night, and at a cost of only a few shillings per time, sufficiently to enable him to see any object which at the same distance from him he could see by day, and might thus prevent any vessels which wished to elude him having any better chance of doing so at midnight than at broad noon.

Castings can now be made of magnesium, although only a short time ago it had been prophesied that they could not accomplish that object, as it would so soon take fire. Magnesium could not be soldered. A good deal has been done towards cheapening the metal, and if supplied in large quantities now it could be had at a great reduction in price.

The American Magnesium Company of Boston have commenced the manufacture of magnesium from dolomite or magnesian limestone by the Sonstadt method, and are producing the metal, both crude and refined, in considerable quantities. The principal use of this hitherto very rare metal is to burn for light. It is burned in the form of fine wire. The light is achromatic, intense, has good actinic properties, and is very penetrating. Hence colours can be distinguished as in sunlight; a wire a hundredth of an inch in diameter gives a light equal to seventy-four stearine candles, actinograms (*ambrotypes and* the like) can be taken as by daylight, and the light can be seen twenty-eight miles at sea. Its actinic power is shown by the fact that while its intensity is but 1-225th that of the sun at noon on November 13, its photographic power is 1-36th that of the sun. The heat it yields in burning is infinitesimal compared with gas, oil, or candles.—*Mechanics' Magazine.*

Professor C. Piazzi Smyth, in a letter from "East Tomb, Great Pyramid," writes:—"The Magnesium wire light is something astounding in its power of illuminating difficult places. With any number of wax candles which we have yet taken into either the king's chamber or the grand gallery, the impression left on the mind is merely seeing the candles and whatever is very close to them, so that you have small idea whether you are in a palace or a cottage; but burn a triple strand of magnesium wire and in a moment you see the whole apartment and appreciate the grandeur of its size and the beauty of its proportions. This effect, so admirably complete, too, as it is, and perfect in its way, probably results from the extraordinary intensity of the light, apart from its useful photographic property, for, side by side with the magnesium light, the wax candle flame looked not much brighter than the red granite of the walls of the room. There come parties—often many parties—of visitors to see the Pyramid every day without fail, and they come amply provided, too, with all sorts of means and appliances to enjoy the sight—*i.e.*, with everything but the needful magnesium wire; and one waistcoat-pocket full of that would be worth a whole donkey-load of what they do bring up to enable their souls to realise the ancient glories of the internal scene."—*Athenæum.*

M. Carlevari, of Genoa, in a letter to the Abbé Moigno, editor of the *Cosmos*, says that he has totally renounced the use of carbonate of magnesia, giving the preference to the chloride of magnesium, which, when combined with small ordinary gas-flames and burnt in common air mixed with one-sixth its volume of oxygen, produces the most beautiful light in the world. He states that he has constructed for the purpose lamps of a very simple principle and easy to manage, which he has applied to photography with great success.

D. E. Fournié has availed himself of the magnesium light as a means of investigating the interior of the throat by means of the laryngoscope. The rays of the lamp constructed by M. Mathieu-Plessy are projected on the small mirror placed at the base of the throat, which throws them upon the trachea and larynx, which parts are reflected in the mirror. By placing a double convex lens with a long focus before the mouth of the person, the image is greatly magnified, and a perfect knowledge of the state of the throat is obtained. By this means Dr. Fournié was enabled to examine a small tumour on one of the vocal cords with perfect accuracy.

M. Schrötter has reported to the Academy of Sciences of Vienna that he has successfully employed the light produced by the combustion of magnesium in the exhibition of the phenomena termed *fluorescence*, due to the very large amount of chemical rays which it possesses, and which render it efficacious in the operations of photography. He found, by experiment, that dry chloride of silver assumed a blue colour when exposed for a few seconds to the magnesium light; and that platino-cyanide of barium showed great sensitiveness. Several bodies which become phosphorescent after having been exposed to sunlight during eight or ten minutes acquired this property after exposure to the magnesium light for a few seconds only.

A paper has been read to the Chemical Society "On the Phosphide of Magnesium," by Mr. T. P. Blunt. The author prepared this body by passing the vapour of phosphorus over heated magnesium in the state of filings; the metal becomes incandescent and is converted into a pulverulent substance having the appearance of lamp-black, and very stable in its chemical nature. The composition of the product is expressed by the formula Mg_3 P.

LIME AND MAGNESIUM LIGHTS.

At the second Conversazione of the President of the Royal Society, the flashing night and day signals, invented by Captain Colomb, R.N., for land and sea service, was exhibited by Mr. W. Nunn, including the Lime-Light, which can be seen at a distance of twenty miles. This lime-light was tested with the Magnesium-Light exhibited by Messrs. Johnson, Matthey & Co., and for a time showed a brilliant disc upon the brightness of the other; but the magnesium having been intensified by the operators the lime was thereby outshone. The value of the lime-light for the purpose intended is, however, not in the least affected by this result. Messrs. Johnson and Co. showed also a large (comparatively speaking) magnesium valve, produced by casting, and had a heap of small coils of magnesium wire for the visitors to carry away. This fact alone demonstrates the progress that has been made in cheapening the manufacture of this metal; for, a few years ago, the price of magnesium was forty guineas an ounce.—*Athenæum.*

OPTICAL CRYSTALLINE BODIES.

In a communication to the Chemical Society, Mr. W. A. Tilden states that he has established by experiment the existence of several new members of a group of Crystalline Bodies remarkable for their optical properties, one of the best known examples of which is the iodo-sulphate of quinine, or artificial tourmaline of Dr. Herapath.

CHEMICAL ACTION OF LIGHT.

The experiments upon the Chemical Action of Light, which have for some time past been occupying the attention of Dr. Hermann Vogel, of Berlin, have resulted in a discovery which cannot but have an important influence upon the art of photography. Scarcely any *phenomenon* has more puzzled chemists than the fact that, whereas light has no action whatever on *pure* iodide of silver, the presence with that salt of a little nitrate of silver renders it exceedingly sensitive to the action of light; and the puzzle was only increased by Poitevin's discovery that iodide of silver can be similarly "sensitized" by tannin. Dr. Vogel's researches leave no doubt as to the *rationale* of these facts. He shows that there is an exact analogy between the chemical action of light and that of heat. Heat, for example, will decompose oxide of gold or oxide of silver without any other body being present, but can decompose oxide of iron or of manganese only when such oxide is in contact with some substance, such as carbon or hydrogen, which can combine with the oxygen of the oxide as fast as it is liberated. The similarity between the action of heat upon the oxides of the noble metals and that of light upon certain haloid salts, and especially chloride of silver, has long been recognised; and now, Dr. Vogel shows that there is as close a similarity between the action of heat upon oxide of iron, in contact with carbon, and that of heat upon iodide of silver, in contact with either nitrate of silver or tannin. Chemists have long been aware of an important difference between the results of the action of light upon chloride of silver and those of its action upon sensitized iodide of the same metal. They have long known that, whereas free chlorine is given off when light acts on chloride of silver, free iodine is not evolved by the action of light on sensitized iodide of silver; but no one, until Dr. Vogel, seems to have suspected this non-evolution of iodine to be due to what Dr. Vogel shows to be its true cause,—namely, *the absorption by the sensitizing substance of the iodine which the light separates from the sensitized iodide.* Dr. Vogel proves conclusively, not only that this absorption takes place, but also that it is simply by virtue of their power of absorbing iodine, or rather of combining therewith, under the influence of heat, that the presence with iodide of silver of either nitrate of silver or tannin enables light to decompose that compound, just as it is by reason of the power of carbon to combine with oxygen, under the influence of heat, that the presence of that element enables heat to decompose oxide of iron. Dr. Vogel moreover shows—and it is herein that the practical value of his discovery consists—that, so far from nitrate of silver and tannin being the only bodies which will sensitize iodide of silver, that salt is rendered sensitive to light by *any* substance capable of readily absorbing iodine.

The number of substances which can be used as sensitizers for iodide of silver is thus very great; and an excellent authority anticipates that some of those which have not hitherto been employed in this capacity must be "capable of application in modes which will give new powers to photography." He looks to Dr. Vogel's discovery "inaugurating a new era, in which dry-plate photography shall entirely supersede wet processes."—*Mechanics' Magazine.*

INVISIBLE RADIATION.

PROFESSOR TYNDALL'S researches "On Calorescence" have afforded opportunity for a repetition of the experiments by which some of the phenomena of Invisible Radiation are demonstrated. As all acquainted with optical science have long known, Professor Stokes has possession of the violet end of the spectrum, where he makes the invisible rays manifest themselves as *fluorescence;* and now, Professor Tyndall takes possession of the red end with his *calorescence*. The spectrum could not be in better hands, and we may hope that it will be made to reveal and elucidate yet more of the phenomena of light and heat. One fact brought out in Professor Tyndall's paper will be prized by those desirous to pursue the experiments; it is, that bichloride of carbon may be used with safety as the opaque solution, instead of the very dangerous bisulphide, with which accidents have frequently happened.

PROGRESS OF PHOTOGRAPHY.

As the art of Photography progresses, the importance of attention to minute scientific details becomes more and more manifest. This leads us to refer to the results of the investigations of Mr. A. M'Dougall, on a mode of measuring the relative sensitiveness of photographic papers, which has appeared in the *Journal of the Chemical Society*. This gentleman has endeavoured to represent the degrees of sensitiveness by the reciprocals of the times during which the several papers must be exposed to a constant source of light, in order that they may attain the same tint, as determined by the monochromatic soda flame; and he has made use of the law established by Bunsen and Roscoe, that equal degrees of tint upon sensitive chloride of silver-paper are produced by equal products of the intensity of the acting light in the time of exposure. The papers tested contained nitrate of silver, and the chlorides and bromides of sodium, potassium, ammonium, and barium; their sensitiveness was found to be constant within the limit of experimental error, and, therefore, that the influence of the metal upon the sensitiveness of the papers is not appreciable.—*Illustrated London News.*

Photo-Relief Engraving.—To transfer the photographic image obtained in a camera to a suitable printing surface, so that faithful impressions may be obtained with rapidity, and, above all, with cheapness, is a problem which for many years has occupied the attention of photographers. Of all the methods hitherto suggested, those which depend upon the employment of "bichromatized gelatine"—that is, gelatine impregnated either with bichromate of potash or ammonia, have given the greatest promise of success. We may state, by way of explanation, that when a film of this substance is exposed to light, it is rendered insoluble in water. Upon this fact is grounded the following process, the invention of Mr. Walter *Woodbury*:—The first step is the exposure in a solar camera of the negative—which is taken in the ordinary manner—in contact with a film of bichromatized gelatine supported on a plate of talc. By this operation, as we have before stated, the parts acted upon by the light are rendered insoluble: a stream of hot water removes all the soluble portion of the film, leaving a faithful transcript of the negative in relief. A *cliché* of the gelatine film is then taken in soft type-metal, by means of a hydraulic press. This *cliché* forms the printing surface. The ink is a solution of gelatine coloured with any suitable colouring matter. It is poured hot upon the surface of the plate, upon which a piece of paper is then placed. A gentle pressure is applied, and maintained sufficiently long to permit the gelatine to set. The gelatine film adheres to the paper and forms the picture. It will thus be seen that the shades of the picture are produced by the varying thickness of the gelatine—that the picture is, in fact, a cast of the metal *cliché*, but so thin, that when the print is dry it is impossible to see or even to feel that it is in relief. By using an "ink" of the ordinary photographic tone, it is a matter of the greatest difficulty to distinguish Mr. Woodbury's pictures from the ordinary photographic prints. He has read a paper to the Photographic Society, when he gave a practical illustration of his process, so far, at least, as the printing is concerned. The number of prints which can be obtained per hour by one man working three presses simultaneously is about 200. Beautiful effects are obtained by taking impressions upon opal glass instead of paper.—*Abridged from the Reader.*

Printed Photographs.—Mr. John Pouncy, the well-known photographer, of Dorchester, has experimented in his newly-patented process of Printing Photographs, direct from the negative, in printer's ink, before a party of professors, at King's College, London. The *rationale* of the process appears to be that the light hardens the ink on the surface of the paper, just in proportion as it passes through the negative; the part not acted upon by the rays remaining soluble, and being easily removed by washing with turpentine. Mr. Pouncy also exhibited speciments of photography in ceramic colours for transfer to biscuit-wares.

Lunar Photographs.—At a meeting of the Literary and Philosophical Society, Mr. A. Brothers has exhibited an interesting series of Photographs, taken during the Eclipse of the Moon, on the evening of Wednesday, October 4th. Commencing at 8·45, when the moon was nearly full, the negatives, twenty in number, were taken at intervals of about twelve minutes until 12·45, and they show the progress of the eclipse throughout. The effect of the penumbral shadow of the earth is distinctly visible on the negative taken at 9·15, and also on the one taken at 12·32. An attempt was made during the middle of the eclipse to obtain the photographic image of the entire surface of the moon; but it was found that the portion covered by the earth's shadow had no effect on the plate after an exposure of fifteen seconds, although distinctly visible in the telescope. It was noticed that the southern limb of the moon showed the copper-coloured tint often seen during total lunar eclipses, and to this cause may be attributed the non-actinic effect on the sensitized plate. An exposure of about one or two-tenths of a second gave the fully illuminated surface of the moon perfectly; but the parts covered by the penumbra were not defined, while an exposure of three seconds gave the outline of the earth's shadow with great distinctness, and an exposure of two seconds brought out some of the details within the penumbra. Some of the negatives were obtained almost instantaneously. The telescope with which these pictures of the moon were taken is an equatorial of 5in. aperture and 6ft. focal length, driven by clockwork. This telescope gives the image of the moon about 11-16ths of an in. in diameter, but by using a Barlow's lens this size is increased to 1¼in., and with this addition the 18th negative of the series was obtained in two seconds.

Casket Portraits.—One of the most curious novelties of the Dublin International Exhibition was the production of "Casket Portraits," contributed by Mr. Swan, the inventor. The contrivance is, in fact, neither more nor less than a real stereoscope, in a different form from that well-known instrument. Without being conscious of it the observer has before his eyes, as in the ordinary stereoscope, a picture composed of two different photographs superposed, each one separately visible to one eye and invisible to the other. These two pictures, placed at right angles on the two sides of two rectangular prisms, with their hypothenuses in contact forming a quadrangular block of glass, are covered to the eye, one from the back surface by refraction, and the other from its hypothenuse by reflexion, after having been refracted upon it by the other prism. By the optical law of the angle of incidence and reflection, the reflected image is seen only by one eye, the axis of which coincides with the reflected ray, and is invisible to the other eye; and by the law of refraction the other image is seen only by the eye the axis of which coincides with the refracted ray, and is invisible to the other. So that when the observer is placed exactly in the position from which each eye has the exclusive perception of the image, whose perspective belongs thereto, the two images coalesce on the two retinæ, and the stereoscopic perception is brought out in all its beauty and force.

The Invisible Photographic Image has long been the subject of discussion. The general opinion, that no chemical decomposition takes place, and that neither liberation of iodine nor reduction of silver occurs, and that the change in the iodo-bromised plate in the camera is a purely physical one, has been latterly opposed by two distinguished photographers, Dr. Vogel and Major Russel. In the *American Journal of Science* will be found Mr. Carey Lea's account of his experiments, which, he states, "close the controversy in favour of the physical theory."

Collodio-Chloride of Silver.—It has been found by Mr. G. Wharton Simpson, that if nitrate of silver is dissolved in collodion, and a few drops of solution of chloride of sodium are added, the chloride of silver which results does not, as might be supposed, precipitate, but, on the contrary, remains, at least for a considerable time, in suspension: the collodion being, by reflected light, white like opal glass, but by transmitted light perfectly transparent. If sufficient nitrate of silver has been used, a vigorous image is obtained with this collodion on paper; and as, unlike albuminised paper, all the sensitive salts it contains are combined in one inert vehicle, no conditions calculated to produce change, and therefore deterioration of the picture, are present. With albuminised paper, the quantity of silver salt must become less in the sheets successively coated, as the solution of sensitive salts is being constantly exhausted; there is, therefore, no uniformity among them. On the contrary, the last sheet coated with the collodio-chloride has the very same amount of the sensitive salts as the first: a perfectly uniform result must therefore be attained with it.

M. Dubroni's Apparatus.—His camera is a small box of yellow glass, and within this all the operations which it is necessary to perform beyond the reach of actinic light are effected by the use of very simple contrivances. After the collodion has been applied to the plate, it is fixed in its place in the camera, and the sensitizing solution is conveyed to it by means of a glass pipette furnished with an india-rubber bulb. When a good coating is obtained, the excess of nitrate of silver is sucked up by the same pipette, and returned to the bottle. After exposure the developing solution is conveyed to the plate in the same way with another pipette. To avoid mistakes, M. Dubroni makes the pipette for applying the nitrate of silver of blue glass, and that for the developer of red glass. The fixing and washing are, of course, carried on outside the camera.

Enlarged Photographs at the Dublin Exhibition.—Mr. Mayall has shown a series of portraits of the fine head of the poet laureate, Alfred Tennyson, all printed from one negative, and that negative scarcely an inch square, demonstrating a complete mastery over a "new solar camera process by which photographs of any dimensions up to the life-size are produced direct without the aid of handwork," and, it may be added, entirely free from exaggeration or distortion. The series consists of one small impression same size as the negative itself, and seven or eight enlarged prints, each one larger than its predecessor until the full life-size is attained. Except for the difference as to size, the portraits appear to be identical—the same expression, the same warmth of tone, and the same sharpness of detail. In the very largest there is no loss of definition; it appears, indeed, to have been printed direct from some magnificent negative of the same dimensions. Enlarged photographs have long been common enough, but they have also looked common enough, and no wonder, for the old enlarging process yielded but a dirty impression, of a rough, blanket-like texture, which had to be worked to evenness by the brush. Mr. Mayall appears to have reformed this altogether. The process of printing and magnifying small negatives by direct printing through the medium of gigantic reflectors and condensers is due to Monckhoven, of Belgium: its successful adaptation to portraiture in England is due to Mr. Mayall and his clever sons.—*Art Journal.*

Photography in Surveys.—At the Academy of Sciences, Paris, General Morin has presented, on the part of M. Lanssedat, Professor of the Polytechnic School, a new and perfectly successful application of Photography to Topographical and other Surveys. In this instance, the plan was one of Grenoble and the environs, to a scale of 1-5000th, extending over 20 square kilomètres, obtained by two photographic lenses of 50 and 25 centimètres focal distance. With these, in 60 hours, at distances varying from 1500 to 4530 mètres, 29 views were taken from 18 stations. These views were transported to Paris, and studied and reduced in the office, a plan having been laid down as perfectly as could have been done by the ancient mode, after several weeks' or perhaps months' labour on the ground.

We learn from the *Photographic News* that, the facsimile of a Will being required in great haste, leave to photograph it was requested. Permission was granted; but, as the time was winter, the day dull, and the hour late, and as so explosive a preparation as the oxy-hydrogen light could not be allowed among so many important documents, it was believed the permission could not be used. Fortunately, one of those concerned thought of the magnesium light; and by means of three small magnesium wires twisted together, an excellent negative of the will was obtained in seven seconds.

At the Royal Geographical Society, a description has been given by Messrs. F. and R. C. Galton, of a new application of photography to the delineation of mountainous districts, whereby stereoscopic slides of the ordinary size could be printed for the use of tourists and strategists. By taking stereoscopic views of good models (previously coated temporarily with white paint), and giving an index of names of places on the back of each slide, referring to numbers or letters on the picture, all the advantages of a model could be given in a portable form, which could be viewed with a common eye-glass stereoscope, to be carried in the waistcoat pocket.

Natural History.

ZOOLOGY.

THE DARWINIAN THEORY.

Dr. Collingwood has drawn the attention of the Literary and Philosophical Society to the investigations of three foreign naturalists, bearing upon the Darwinian Theory. The first of these was Fritz Müller, who had written a work entitled "Für Darwin," in which he examines the theory by the test of the development of the crustacea, and the results he arrives at are corroborative of the correctness of Mr. Darwin's views. The second was Dr. Walsh, of America, who has been investigating the variations of insects dependent upon the nature of their food plant, and comes to the conclusion that he cannot discover where varieties end and species begin, and is disposed to consider that varieties strengthen and become species, and that the difference between them is merely one of mode and degree. The third was M. Matteucci, who has described an apparently rudimentary electric organ in the ray analogous to that known in the torpedo, and the existence of which might be considered as linking the perfect electric organ of the latter with non-electrical fishes.

DOMESTICATION OF ANIMALS.

A paper has been read to the British Association "On the Domestication of certain Animals in England between the Seventh and Eleventh Centuries," by Mr. J. Thrupp. This paper, which had been previously read at the Ethnological Society of London, but not yet published in their *Transactions*, gave a valuable account, derived from the actual examination of ancient documents, of the amount and character of the domestication of various animals in England during the period stated. First, animals thoroughly domesticated were noticed—horses, pigs, sheep and poultry. Secondly, animals imperfectly domesticated, such as goats, deer, hawks, &c.; and a third class, canaries, parrots, &c., which, when opportunity presented itself, would escape to savage life. The essay gave at length the domestication of the pig, with the laws and charters relating to its protection. Horses came next in the work of domestication, about the tenth century, when it was unlawful to ride on horseback, and even kings were accustomed to hunt on foot. This restriction was afterwards withdrawn, and riding, hunting, and fighting on horseback came into use. Bees were domesticated between the sixth and seventh centuries; and, being found very profitable, the nobles, clergy, and laity all conspired for the protection of that insect. Hawks were next introduced, but with the introduction of fire-arms went into disuse. Weasels and cats brought the subject up to the eleventh century.

PATAGONIANS AND FUEGIANS.

A PAPER has been read to the British Association, "On the Natives of Patagonia and Terra del Fuego," by the Rev. W. H. Sterling. The mission station to which the author belonged was stationed on Falkland Islands, and the mission ship coming to England for other purposes, it presented a favourable opportunity of bringing a few of the natives, four of whom were on the platform. These natives belonged to the island of Terra del Fuego. There was undoubtedly an affinity between their race and the Patagonians, but the habits of life and the circumstances under which each lived were very different. The Patagonians were generally spoken of as giants: this was an error; forty of them had been measured, and their average height was about 5 feet 10 inches. The Fuegians were a shorter race. The Fuegians were very much harassed by the weather, for they had scarcely anything to wear besides a strip of seal-skin. Their diet was fish. They were canoe Indians. He had never discovered any traces of cannibalism, and even their taste for beef, mutton, and other flesh food had to be acquired.

PARASITES IN DENTINE.

PROFESSOR WEDL states that, while examining some sections of human teeth, which had been macerated for a few days in water, he found that the cement and the peripheral layers of Dentine were furrowed by microscopic channels, in which he soon recognised small parasitic plants (fungi) closely resembling those which perforate the shells of mollusca. They do not attack teeth till after death; so that they have nothing to do with caries. He has since ascertained that they have been in action from a high antiquity, as many teeth of fossil fishes and mammalia exhibit unequivocal traces of their action.

A CHINESE GIANT.

A CHINAMAN, by name Chang-Woo-Gow, has been exhibited at the Egyptian Hall, Piccadilly, and will extend his exhibition through France and America. In his suite there are Mr. Marquis Chisholm, acting aide-de-camp; Chang's wife, and female attendant; two Chinamen, and Chung Mou, or Rebel boy—a dwarf. Chang himself, although only 19 years of age, is 7ft. 8in. in height. He is good-looking for a Chinaman, and possesses the air of dignity so remarkable in his countrymen, if placed in anything like favourable circumstances. He "chin-chined" his visitors like a king, and constantly fanned himself like a Chinaman. The contrast to Chang is a Rebel boy—Chung Mou—who is 30 years of age, and only 3ft. high. He is not a very attractive specimen of humanity. Chang's wife is 19 years of age. She has the simple, placid, insincere countenance of the ordinary Chinese woman. Her feet are of the small, distorted sort—some of the Chinawomen, in the north, have the smallest and most perfectly formed natural feet in the world, say at Shanghai or Ningpo, or anywhere between or adjacent. It is true that their faces and figures are the opposite of good, but they are gentle, simple, harmless creatures, with very smooth skins and elaborately got-up hair. In this little show of six Chinese there are also the *quasi* maid of the *quasi* Mrs. Chang. There are likewise two Chinamen on the establishment—one is Kwan Tung, a compradore—*i.e.*, a sort of house steward, manager, or factor. He seems about 25 or 30 years of age. He is said to be a Christian disciple of Dr. Henderson, missionary at Shanghai. He writes English perfectly, and makes translations to and from that and his own language with ease and fluency. The other is a shroff. His name is Ah Sook, and he speaks some "pigeon" English. Chang has brought his own coffin with him, and he has made a contract with Mr. Chisholm to the following effect—that "in case of my dying in a foreign country, which 'Jos' will or will not decree, I shall not complain if Mr. Chisholm will send my body properly embalmed to my parents in Fychow," properly spelt and pronounced Hwy Chow.

HOMOLOGIES OF THE LOWER JAW.

Dr. Humphry, of Cambridge, has read to the British Association a paper "On the Homologies of the Lower Jaw and the Bones connecting it with the Skull in Birds, Reptiles, and Fishes." He maintained that the several pieces of the oviparous jaw are represented by the articular and other parts of the mammalian jaw, and that the quadrate and quadrato-jugal bones of ovipara are represented by the glenoid zygomatic parts of the temporal in mammals.

UNIVERSITY MUSEUM, OXFORD.

A very important addition has been made to the collections of Natural History preserved in the new University Museum at Oxford, the whole of the zoological collections, formed with vast care by the late Dr. Burchell, in Southern Africa and the interior of Brazil, having been presented to the University by his surviving sister, as a mark of respect for the honorary degree of D.C.L. conferred on her brother by the University in recognition of his merits as one of the most scientific of modern travellers. The collections of plants formed in these countries by Dr. Burchell have, in like manner, been presented to the Herbarium and Museum at Kew, and constitute one of the most important series of African and Brazilian plants ever collected, every specimen, both of plants and animals, to the extent of many thousands (*e.g.*, 135,000 plants, nearly 20,000 insects, &c.), having been labelled with the utmost precision on the spot, with the date and locality, observations of economy, &c., to so minute an extent that even the hour of capture is noticed in cases of more especial interest. Thus, in a geographical point of view, the collections are invaluable. A very interesting collection of implements and dresses has also been added to the donation to Oxford.—*Athenæum.*

WHITE WHALE.

A WHITE Whale, or white fish, was captured in the Gulf of St. Lawrence a few years ago, and kept on public exhibition in a water-tank for nearly two years. It was 10 ft. long, and weighed almost 700 lbs., and was of an ashy grey colour, nearly uniformly distributed. During his confinement he showed some capacity for education. He was sufficiently well trained to allow himself to be harnessed to a car, in which he drew a young lady around the tank; he learned to recognise his keeper, and would allow himself to be handled by him, and at the proper time would come and put his head out of the water to receive the harness or take food. At times he showed a playful disposition, and amused himself with splashing about in the water; and at other times with tossing stones with his mouth. He often took in his mouth a sturgeon and a small shark which were confined in the same tank, and after playing with them for awhile, allowed them to go unharmed. An anatomical description of this animal, illustrated by plates, has been contributed to the Boston Society of Natural History, by Dr. Jeffreys Wyman, Professor of Anatomy at Howard College, U.S. The stomach contained a collection of stones, nails, pieces of glass, stones of fruits, half-digested fragments of the flesh, and a few vertebræ of fishes; also other substances, which had been, doubtless, swallowed after entering the tank. The heart, when compared with the size of the animal, was remarkable for its volume and capacity. It was injected, and required thirteen pounds of tallow to fill its cavities.—*Illustrated London News.*

INDIAN CETACEANS.

A PAPER has been read to the Zoological Society, by Professor Owen, containing descriptions of New Species of Indian Cetaceans, which had been observed and collected on the eastern coast of the Indian peninsula by Mr. Walter Elliot. Of the seven species described as new, six belonged to the family Delphinidæ; the seventh was referred to the Sperm whales, (Physeteridæ), and proposed to be called *Physeter* (*Euphysetes*) *simus.*

THE CATTLE MURRAIN.

DR. SHETTLE has read to the British Association, "A few Remarks *on the Causes* of the Cattle Murrain." The author considered pulmonary and steppe murrain as undoubtedly blood diseases, and partaking largely of the character of typhus; whilst the two other milder forms of the complaint, carbuncular and vesicular murrain, had their origin in a fungus growth in the parts affected. He had been for five years engaged in experiments to discover the real use of the iron in the blood. During the act of respiration a large amount of chemical action takes place; this, he states, cannot occur without a corresponding development of electricity, and the blood, through the iron it contains, was one of the best attractive agents for electricity known. The abstraction of electricity from the blood causes it to assume a dark, pitchy character, and readily to decompose, whilst its presence prevents decomposition and promotes organization. It therefore follows that if iron does not exist in the blood globules they will not exert a due amount of attraction for the electricity or vital force developed, consequently it must be attracted by the next best conductor, the nerves. In health this is only done to a certain extent, any excess causing disease. In the author's opinion, the cause for the generation and virulence of the disease might be found in the various and severe electrical changes which had lately taken place. Dr. Crisp thought that electricity had nothing whatever to do with the disease. He considered it to be a special poison, like cholera.

NEW PORCUPINE.

MR. SCLATER has given to the Zoological Society a description of New Species of Indian Porcupine, proposed to be called *Hystrix Malabarica*, distinguished from the ordinary Indian species, *H. leucura*, by its orange-coloured spines. Four living examples of this new species had lately been presented to the Society by his Excellency Sir William Denison, Governor of Madras.

THE BAT.

PROFESSOR HUXLEY has read to the Zoological Society a notice of the singular form of the stomach in the Bats of the genus Desmodus, in which the cardiac end of this organ assumes the form of a greatly elongated cœcum, reflected upon itself. This and the peculiarities of the dentition seemed to Professor Huxley to indicate the probable necessity of constituting the genus Desmodus, and its allied form Diphylla, a separate section of the order Cheiroptera, under the name Hæmatophilina.

Mr. William Sowerby, in a letter in the *Annals of Natural History* for October, describes the singular method adopted by the long-eared Bat in capturing its prey. In bats the flying apparatus is extended from the hind legs to the tail, forming a large bag or net termed the "femoral membrane," not unlike two segments of an umbrella, the legs and tail being the ribs. Mr. Sowerby placed a lively male bat in a wire-gauze cage, into which he put some flies. The bat pounced instantly upon its prey, but instead of eating it at once covered it with its body, and, by the aid of its arms, &c., forced it into his bag. He then put his head down under his body, withdrew the fly from his bag, and leisurely devoured it. Mr. Sowerby once saw an unwary bluebottle walk beneath the body of the apparently sleeping bat into the sensitive bag, in which it was immediately imprisoned. White, of Selborne, speaking of a tame bat, alludes to the above described action, which he compares to that of a beast of prey, but says nothing respecting the bag. Mr. Thomas Bell, in his *British Quadrupeds*, says that the interfemoral membrane of bats "is probably intended to act as a sort of rudder, in rapidly changing the course of the animal in the pursuit of its insect food. In a large group of foreign bats, which feed on fruit or other vegetable substances, as well as in some of carnivorous habits, but whose prey is of a less active character, this part is either wholly wanting or much circumscribed in extent and power." May it not be (asks Mr. Sowerby) that they do not require an entomological bag-net?—*Illustrated London News.*

SKELETON OF THE AYE-AYE.

A SKELETON of that rare and singular animal the Aye-aye, or Chiromys, has been added to the Hunterian Museum. It is an inhabitant of the island of Madagascar, where it was first discovered by Sonnerat about the year 1780. The specimen brought home by that traveller, and presented by him to the celebrated French naturalist, Buffon, has remained until within a few years the unique representative in Europe of this remarkable creature. By Cuvier, and many other zoologists, it was considered as a member of the Rodent order, on account of the conformation of its teeth resembling those of the gnawing animals: but De Blainville, and others, laying more stress upon the character of the limbs, placed it among the Lemurine-quadrumana, or monkey-like animals. This view has been completely confirmed by the dissection of a specimen recently sent to Professor Owen by Dr. Sandwith, a fully illustrated account of which will be found in the *Transactions of the Zoological Society* for 1863. A living example is now in the Regent's Park-gardens, but, as it is purely nocturnal in its habits, it is rarely seen by visitors. A stuffed specimen has lately been presented to the University of Cambridge by Mr. A. Newton. Besides those above mentioned, very few examples of this rare animal have as yet been received in Europe. The skeleton just added to the College Museum was discovered in the possession of a dealer in objects of natural history in Paris, by Mr. Flower, the indefatigable conservator, who at once secured it at an expense of £20 for the collection with which he is so deservedly connected.

WOMBATS.

MR. J. E. MURIE has read to the Zoological Society a paper upon the Hairy-nosed Wombat (*Phascolomys lasiorhinus* of Gould), which he showed to be identical with the species previously described by

Professor Owen, under the name *P. latifrons*. Dr. Murie, having examined a series of specimens of this form in the collections of this country, had arrived at the conclusion that there were three good species of Wombats at present known to science. Two of these, *P. wombat* and *P. platyrhinus*, Owen, belonged to the typical genus Phascolomys; the third, *P. latifrons*, Owen, offered such striking distinctions in its osteological character as would necessitate the adoption for it of the generic term Lasiorhinus, proposed for it by Dr. Gray on its external characters.

THE UROTRICHUS.

THE Urotrichus, a singular little animal, apparently a link between the shrew and the mole, is the subject of a notice by Mr. J. K. Lord, which appears in the January number of the *Annals of Natural History*, by which we learn that it is only known at present as a native of Japan, and the Cascade Mountains in North-west America. The colour of the animal is of a bluish-black, and his hair is so arranged that it can be smoothed in either direction, and thus not impede his progress through his tunnels; but his nose is one of the most remarkable in nature, compensating for hands, eyes, and ears. "His snout," says Mr. Lord, "is very much like that of a pig, only that it is lengthened out into a cylindrical tube covered with short thick hairs, and terminating in a naked, fleshy kind of bulb or gland; this gland is pierced by two minute holes, which are the nostrils. Each nostril has a little fold of membrane hanging down over it like a shutter, effectually preventing sand and small particles of dust from getting into his nose while digging. His fore-feet are also very curious, being a species of diggers, each too being armed with a strong scooped nail, like a garden trowel, which enables him to dig with great ease and quickness. The hind feet resemble scrapers, being about two-thirds longer than the fore feet."—*Illustrated London News*.

A BIRD VILLAGE.

Two papers by Dr. John Shortt describe in the *Linnean Society's Journal* a heronry and breeding-place of other water-birds, at Vaden Thaugul, about fifty miles from Madras. These birds come to the spot in flocks in October and November to settle for breeding. Nests are rapidly built; the scene soon becomes exceedingly lively; and the trees are covered with bird-life. As the young are gradually reared the families depart, and by the middle of April the spot is quite deserted. The bird village is protected by the British Government. Dr. Shortt visited the camp in March last, when he caused much dismay to the occupants, of which he gives a list.

THE DODO.

IN the *Mauritius Commercial Gazette*, we read that M. Gaston de Bissy, having caused to be dug from a marsh on his property the alluvium in it to use as manure, after digging two or three feet, the men came in contact with bones of tortoises and deer, the former in vast numbers. Nothing further was found until two men entered the dark-coloured water, about three feet deep, and from the soft mud at the bottom brought up these remains of the Dodo—a broken tarsus, an entire tibia, and the remains of another. The *Commercial Gazette* states that there was subsequently found "every important bone of that remarkable bird, so that an experienced person can well build a Dodo from these remains, the toes being the only part wanting. The skull of this bird was of amazing thickness, and the cerebral cavity very small; the beak of great strength and solidity, as are the condyles of the lower mandible. Some of the cervical vertebræ are more than two inches in diameter, and of very elaborate structure. The sternum, of which the form shows a strong resemblance to that of the pigeon tribe, in some specimens is more than five inches wide and seven long. The keel is a quarter of an inch thick, and about an inch deep in the deepest part, which is at the centre, and the sternum is there three-quarters of an inch in thickness, but it thins off to a sharp edge at the margin. The humerus is less than four inches in length, and the shaft only about three-eighths of an inch in diameter, and the ulna under three inches, and less than a quarter of an inch in thickness. Some femurs are nearly seven inches long and more than an inch in diameter, and tibiæ nine inches long, and the upper condyles two inches in diameter. The tarsometa-tarsi are of a very solid bone, and have been found in greater numbers than any others. They are about the length of those of a good-sized turkey, but more than twice the thickness. The vertebræ are very strong, and show that the spinal cord was fully double the size of that of the turkey. Mr. Clark (who had superintended the search) deposited the first specimens of dodo's bones he obtained in the museum at the Royal College, as well as those of the flamingo, the existence of which in Mauritius was remembered by the parents of persons now living. He has also sent a complete set of the dodo's bones to Professor Owen for the British Museum."

STRUTHIOUS BIRDS OF NEW ZEALAND.

THE Rev. F. Howlett has described the occurrence of the bones of extinct struthious birds in New Zealand: in three different ovens, in Middle Island, where had been discovered osseous remains of the moa, consisting of four femoral bones, as many tibiæ, and several toe-bones.

At a meeting of the Geological Society has been read a paper by Dr. Julius Haast, respecting the ancient climate of New Zealand, with especial relation to the history of the gigantic bird named by Mantell, Dinornis. Dr. Haast expressed his opinion that the extinction of the bird was due to the agency of man at some recent date, since the present Alpine flora of the country furnished a large quantity of nutritious food, quite capable of sustaining the life of so large a creature.

EGG OF THE MOA.

THE *Nelson Examiner* states:—"A Moa's Egg is now being exhibited at Messrs. Bethune and Hunter's offices. It is about ten inches long and five inches in diameter, of a dirty white colour. It was found at the Kaikoros, in the Middle Island, under singular circumstances. A labourer in Mr. Fyffe's employ, who was digging the foundation for a house, came upon the egg, and, unfortunately, with his pick broke some portions of the shell. It was found in the hands of the skeleton of a Maori, who was buried in a sitting posture, with the egg resting in his hands and held opposite to his head. The egg has been placed in a box of rimu, and protected with a sheet of glass on the top. In a drawer beneath, securely covered with glass, are the fragments of the shell, which have been carefully preserved. The injury, as the egg is placed in the box, is not perceptible, and it appears to be perfect." This statement has been corroborated as follows:—

Mr. G. D. Lockhart's ship, *Ravenscraig*, Captain D. B. Inglis, of London, arrived from New Zealand, reports having brought home an egg of the Moa, or Dinornis, alleged to have been discovered under somewhat singular circumstances. While some labourers were marking out a site to build upon in the Wairakie district, a pick struck upon a cave. On opening it, it was found to contain the skeleton of a Maori in a crouching position, holding with both hands the egg, and in such a manner as if death came upon the unfortunate native while in the act of partaking of the contents of the egg. Although the shell is slightly broken, the gigantic proportions of the egg yet remain perfect. It measures about nine inches in length, and seven inches in diameter.

TOOTH-BILLED PIGEON.

AN engraving of a rare bird—the Tooth-billed Pigeon (Didunculus strigerostris, the nearest living ally to the extinct Dodo)—is given in the *Journal of the Asiatic Society of Bengal.* It was taken from a living specimen brought to Sydney by Mr. J. C. Williams, consul, from Upolo, one of the Navigator Islands, where it is known as the manu-mea, and where it was very plentiful till the influx of a great number of cats. The natives also fed upon the birds so long as they could be procured in considerable numbers. The manu-mea is strictly a ground pigeon, traversing the thickly-wooded sides of mountains in flocks from ten to twenty in number, and feeding upon various berries, especially the mountain plantain. The only note observed by Mr. Williams was a low, plaintive cry, resembling that of a chicken. The specimen was about the size of a common pigeon, but, being then young, has probably grown much larger.

THE TRAGOPAN.

Among the birds lately received at the Jardin d'Acclimatisation at Paris, there are some Tragopans—a kind of Chinese pheasant, sent over by M. Dabry, French Consul at Han Keou. These birds are called *Too-Chew-Kee* by the Chinese, a name meaning, "The bird that vomits flakes of silk." They are brought from the mountains of Sze-Chwen, and also from the Hoopay, Fokin, and Kwang-Tong districts, where they are much esteemed by the inhabitants, both for their plumage and the delicacy of their flesh. Viceroys and rich people always keep some in cages as curiosities. The size of the Tragopan does not exceed that of a common hen. Its plumage displays the most varied and brilliant colours. The head is jet black, with a gold-yellow crest; the eyes are large and bordered with blue; the neck is sky-blue; the breast a fiery-red; the back and abdomen speckled white on a red ground. During summer it displays the magnificence of its plumage by puffing itself up and strutting about with the pride of a peacock, every now and then uttering a hoarse caw; then all at once it thrusts out a tongue at least a foot long, of a beautiful blue, speckled with fiery spots about the middle; at the same time two charming little blue horns make their appearance on its head. This curious spectacle lasts about a quarter of an hour, after which the bird withdraws its tongue, lets down its horns, and subsides again into its sober toilet for common wear, uttering an odd sound, as if in mockery of the spectators. This bird, according to Chinese naturalists, is not only one of the wonders of Nature on account of its plumage, but it also possesses the important virtue in the eyes of the Chinese—viz., filial piety; for the young ones take care of their parents when age or illness renders it impossible for them to provide for their own nourishment. This affectionate care has procured this creature the name of *Hiao-Ky*, or "bird of filial piety." It is also called *Py Choo Ky*, or "bird that avoids trees," because it haunts rocks rather than woods. Its flesh is excellent, and the Chinese say it has the property of making a man intelligent. The Tragopan is of the pheasant family, and this is the first time it has been seen in France. There is every reason to hope that it will be acclimatised.

BUTCHER-BIRD.

A Butcher-Bird, or Great Shrike, has been captured alive by some boys in the market-place of Wick, in Caithness. Though included by Pennant, Edwards, and Willoughby, among our English birds, specimens having been taken in the northern counties, the Shrike, the *Lanius cinereus* of Gesner and Aldrovandus, the *Lanius excubitor* of Linnæus, is properly a native of Norway and Sweden, and is but seldom met with even in the most northern parts of Great Britain, including the Orkney and Shetland Islands.

MARINE FAUNA OF THE CHANNEL ISLANDS.

The Rev. A. M. Norman has made to the British Association a verbal Report relating to a portion of the researches of the Committee appointed to investigate the Marine Fauna of the Channel Islands. He reported the discovery of new species of crustacea, and called particular attention to the Artemia solina, the conditions of whose existence, he considered, involved a problem difficult of solution. He had found it in the salt-pans at Guernsey; it existed in the salt-pans of Lymington, and in the salt-pans of various places on the coast of France. It was never found in the open sea; and it was discovered in the greatest abundance in the pans that were most strongly impregnated with brine. The question appeared to be, how the species came to exist in the salt-pans, and how they came to pass from the pans of one place to those of another; for the specimens found in the pans at all the places he had mentioned were identical in character, not differing in the least.

THE TORPEDO.

In a paper addressed to the Academy of Sciences, M. Matteucci examines the nature of the electrical apparatus of the Torpedo, with a view to ascertain the connexion existing between the functions of the nerves and electricity. Happening to be at Via-Reggio, a small sea-port where the torpedo is very frequent, he instituted experiments with a large number of them. When the fish is in a state of rest—that is, when it does not give a shock—the electrical organ may be easily recognised by the aid of a galvanometer sufficiently delicate to denote the muscular current of the frog; the extremities of the instrument should, however, be fixed to two plates of amalgamated zinc dipping into a solution of sulphate of zinc, and communicating with each other by means of flannel cushions or filtering paper. Such an apparatus will experience a deviation of from 14 to 15 degrees over a piece of organ cut out of a small torpedo that has already ceased to give discharges; the deviation itself takes place in the direction of the current. A piece of electrical organ cut out of a torpedo which had ceased to produce any effect on a galvanoscopic frog subjected to dermal irritation, gives a constant current between the dorsal and abdominal faces in the direction of the discharge obtained by pulling or cutting the nerves of that piece. With a delicate galvanometer, a deviation of from 40 to 50 degrees may be obtained in this way. M. Matteucci adds that, in hot weather especially, he has met with torpedoes which, being out of the water, would very rapidly lose their electrical power. By irritating the nerves of the organ, however, or by inflicting a wound on the fourth lobe, the electro-motive power would immediately reappear and last for a certain period. Our author is therefore of opinion that the electricity of torpedoes or other fish enjoying a similar property must be attributed to a set of secondary voltaic piles which are formed in the cells of the electric organs by the action of the nerves. M. Matteucci states that the ray has an organ similar to that of the torpedo; and that, by irritating it considerably, manifest signs of electricity may be obtained from it.

THE ELECTRIC RAY.

M. ROBIN has reported to the Academy of Sciences at Paris details of his investigation into the Electric Apparatus of the Ray fish and its action; the results of which prove that the apparatus performs the same function as that of the Torpedo and the Gymnotus, and other electric fishes. Nothing can be better characterized than the element which composes their discs: nothing can be more regular than their configuration and their juxtaposition of the parts rich in vessels and nerves; and nothing can be more constant than the distribution of nerves and the exclusion of vessels on the face of the disc which is turned towards the positive pole of the apparatus, while the vessels, to the exclusion of the nerves, are placed on the opposite face of the disc by which the current escapes during each discharge. M. Robin refers to the researches of Faraday, Becquerel, and Breschet, relating to this interesting subject.

METAMORPHOSES OF FISHES.

M. AGASSIZ has reported to the Academy of Sciences at Paris his observation of Metamorphoses among Fishes as remarkable as those known to occur among reptiles. Certain very small fishes, which at first resemble gadoïdes or blennioïdes, he has observed to pass gradually into the type of labroïdes or lophioïdes, &c. He thinks that, eventually, the classification of fishes must be remodelled, and based on the correspondence which exists between their embryonic development and the complication of their structure in the adult state.

THE KING PENGUIN.

THE first live King Penguin ever exhibited in this country—the first, we believe, of the larger kind of penguins ever brought alive to Europe—is now to be seen at the Zoological Society's Gardens, in the Regent's Park. The king penguin (Aptenodytes penantis) is remarkable for his exquisitely-coloured skin, in which black and green hues blend with golden yellow, creamy or silvery white, and bluish grey, all most beautifully varied. This skin is often made up as a lady's muff. The bird itself is a queer-shaped mass of living blubber, capable only of voracious feeding, and fit only to be knocked on the head with a stick. Such, at least, is the popular conception of a penguin. But Commander William Fenwick, of her Majesty's ship *Harrier*, has brought one of these birds with him, we believe from the Falkland Islands. It is most likely the first that ever came alive to Europe, and has been presented by him to the Zoological Society. Sitting upright, the penguin rests and sleeps; upright it hatches its one egg, holding it between its legs. The bird under discussion was not caught young and at first refused to feed; but, that difficulty once overcome, it soon got sociable and especially attached to the cabin-boy who attended to it on board ship, and with whom it used to walk the deck for hours. The yellow feathers from the skin of this penguin are much prized by many of the South Sea Islanders, and are used as ornaments and marks of distinction in their feather cloaks. The eye of the penguin is very peculiar. The pupil is upright and oblong, the iris dark, and the lids open, as it were, by a slit like those of the eye of a seal, whose loving, languid expression it shares. Deep orange patches on the lower part of the beak heighten the picturesque effect of the colouring. The tail consists almost only of stiff quills, and helps to support the body when at rest, forming a tripod with the heels of the feet, the toes being generally off the ground, turned somewhat upwards, when the bird is quite comfortable. Mr. Darwin and Dr. Bennett give excellent accounts of this penguin. The former says that its activity on land is by no means small when it tries to get away through the tussocks of grass by the shore, using legs and flippers, looking much like a quadruped, and being easily mistaken for one. The wings have a scaly appearance; the small, broad quills of the feathers only being developed, forming a pattern on the former, and getting larger where the larger feathers would be in other sorts of birds. To a person of excited imagination, a number of these birds would look much like people—soldiers especially—at a distance; and the more so as Dr. Bennett describes penguins congregating in enormous numbers on certain spots in the South Pacific Ocean, where they are arranged, when on shore, with the greatest order, in as compact a manner and as regular ranks as troops; the different classes keeping their respective situations—the young birds one, the moulting birds another, sitting hens a third, and clean birds a fourth. Thousands are coming and going, and should a bird make a mistake and intrude in a wrong quarter, it is immediately ejected from it.—*Illustrated London News*, wherein the bird is cleverly engraved.

THE AUK.

The Great Auk, or the Gare-fowl (Alca impensis), termed by Yarrell, in 1842, "a very rare British bird," and now considered to be extinct, is the subject of an article in the *Natural History Review*, full of interesting details collected from various writers. This singular bird, by the merciless hand of man, has been driven from the shores of Denmark, Scotland, the Orkneys, the Færoes, and St. Kilda; and the eruption of a submarine volcano in Iceland, by laying low one of its chief abodes, has greatly accelerated its destruction. In May, 1834, a great auk was caught near the entrance of Waterford harbour. It was nearly starved, and swam near a boat, into which it was easily taken. It lived some time, being fed with potatoes and milk, and fish. It stood erect, and frequently stroked its head when fed. This bird may possibly still exist in secluded parts of Iceland and Newfoundland. A mummy specimen of this bird, which was found pressed flat, with the flesh converted into adipocere, on an island to the northward of Newfoundland, several feet below the surface, in a deposit of frozen guano, was presented to the British Museum, in 1864, by the Bishop of Newfoundland.

THE WATER SHREW.

Mr. N. L. Austen, in the *Annals of Natural History*, gives some particulars of the habits of the Water Shrew, an animal rarely kept with success in confinement. It closely resembles the field-shrew, but is rather larger, being about five inches long, having the feet and tail fringed with stiff white hairs, of great use for swimming. In the water-shrew the head and back are commonly of jet black, and the sides and underpart pure white. It lives in the vicinity of pools and rivulets, where it forms on the banks long winding burrows, which end in a small chamber furnished with a bed of moss and dry grass. Here from six to ten curious small pink-white creatures, as little as possible resembling their parents, are born about the middle of May. When under water the fur of the water-shrew is covered with multitudes of tiny air-bubbles, that shine like silver. Its food includes insects, worms, young frogs, and small fish, which last it pursues and captures with the dexterity of an otter. Like it, also, it holds the fish firmly between the forepaws, and, commencing at the head, eats it gradually downwards, by a succession of snapping bites. Mr. Austen kept two of these animals for some time in a cage connected with a tank-bath. They lived happily, till one day the door was left open and they escaped. When running about this cage, they often uttered a shrill, sibilant chirp, resembling the note of the grasshopper lark. The ear of the animal is provided with three small valves, which close together when the animal dives, and thus effectually exclude the water; when it ascends, and the pressure of the water is removed, the valves reopen spontaneously.—*Illustrated London News.*

THE WATER-OUSEL.

In a note on the Water-Ousel, Dr. E. Crisp says that he cannot entirely acquit it of occasionally destroying the fry of fish, but knows no reliable evidence of its taking the ova. Mr. Gould states that in five of these birds, shot in November, 1859, no trace of spawn was found in any of them. Their hard gizzards were entirely filled with the larvæ of the water-beetle and other insects.

He thinks that these birds may do great service by destroying these insects and their larvæ, which may attack the ova and fry of fishes.

BERTRAM'S SAND-PIPER.

A BEAUTIFUL specimen of Bertram's Sand-piper was killed within a short distance of Falmouth, on November 9. It appears to have suffered but little from its lengthened migration across the Atlantic, for it was, at the time of its capture, to all appearances, in perfect health and in capital condition. The bird is a faithful representative of that figured in the Supplement to Yarrell's work on *British Birds*, which was killed in Cambridgeshire many years ago, and communicated to the *Illustrated London News* by the Rev. F. Tearle, of Trinity Hall.

VORACITY OF THE CHIASMODON.

DR. CARLES has read to the British Association a Note, illustrated by a specimen received from Dr. Imray, of Dominica, by Sir Leopold M'Clintock. A small fish, with teeth inclined backwards, swallowed a very much larger fish, and whilst helplessly floating was picked up. The swallowed fish was dead, the swallower yet alive. The abdominal integument has been stretched enormously, and is as thin as goldbeater's skin, but quite perfect. The lesser fish is of the genus Chiasmodon. The length of the swallower is 6⅝ in., and of the swallowed fish 10¼ in. Dr. Gunther knew of only two other specimens of the above fish. They were found always at a depth of from 300 to 400 fathoms, and they knew of only five or six species. The most extraordinary characteristic of all these deep-sea fishes is that all of them have the stomach extremely extensible, and in two other cases, for instance, saccopharynx, which was caught in the middle of the Atlantic Ocean, and in the species caught by Johnson, at Madrid, a similar expansion of the stomach has been observed, but it is far inferior to that seen in the specimens present. Another peculiarity in these deep-sea fishes is the looseness with which the single bones are connected—in fact, many of these fish when brought to the surface, fall to pieces. The great pressure of the water under which these fish are continually resting holds the single parts together, and the cellular tissues are far more feeble than in fishes living nearer the surface of the water. Mr. Lowe, when fishing at a depth of 300 or 500 fathoms, had drawn up a piece of jaw and a piece of the head, the rest having gone as the fish approached the surface of the water. The specimen swallowed by this fish is also a rare specimen. He knows of only three other specimens. It is the Scopelus macrolepidotus. Fifty years ago we had no idea that fishes were able to live at more than a hundred fathoms in depth; and it is only by recent discoveries that these fishes have been made known.—*Illustrated London News.*

CULTURE OF OYSTERS.

MR. FRANK BUCKLAND has communicated to the British Association his Report on the Culture of Oysters. The cultivation of the full-grown oyster after it has arrived over the state of "brood" is familiar, but of the young oyster in its earliest stages of development little or nothing is known. It is important, therefore, to turn attention in this direction, especially as the author considers legislation to be actually at fault in the matter. The first part of this Report treated of the cultivation of oysters; the second part was devoted more especially to the information obtained and that required in respect to the actual process and means by which the delicate and thin-shelled young "spat" manages to cling to various substances. Mr. Buckland regarded the chief cause of the frequent death of such large quantities of young spat in the open sea as being the want of sufficient temperature in the water. In comparing the French and English systems of artificial culture he again dwelt on the point, declaring the French system, though so much lauded, to be in reality no better than our own. There could be no doubt that, as a rule, oysters spat much more freely on the west coast of France than they do at the mouth of the Thames, but the reason he considered was obviously that oysters required heat in their young state. Those, therefore, who said, "These things are better done in France: why cannot they be likewise done here?" might as well wonder why the farmers of Essex do not grow grapes as well as the vine-growers of Southern France.

THE OYSTER CROP OF 1865.

EARLY in August Mr. Frank Buckland wrote to the *Times*:—"Just now the oysters at the mouth of the Thames are in full 'black spat'—that is, they are just ready to send forth the young oysters (technically called 'spat') from their shells. The way to ascertain this, without operating with the oyster-knife, is to place oysters newly dredged in the sun; they will shortly 'gape their shells,' and then, by peeping carefully in between the shells one can see in those which contain spat a mass of mud-like material adhering round the beard of the oyster. If the embryo be nearly ready to be emitted from the parent shell it much resembles slate pencil in a state of powder, if it be in a less advanced stage of maturity it is of a white, milk-like colour.

"It has been stated that from one to two million young oysters are produced from a single parent. I have examined several native oysters of the average size and weight, and never found the highest number of spat to be more than 829,655, and the lowest 276,555. Even with these reduced figures, imagine what an enormous number of young ones must be produced from the parent oysters in a well-stocked laying or oyster-bed; and yet the 'fall of *spat' for the last five years* has been bad—in other words, although the young oysters have been born, something has happened to them, and they have died in their infancy.

"I have been lucky enough to see more than once, in my little oyster observatory, the process of 'spatting.' The oyster slowly and cunningly opens its shells and waits awhile. If there is the slightest jar or shake in the water, snap go the shells in an instant, like a steel trap on the leg of a rabbit. All being again quiet, suddenly the parent oyster ejects the spat in a dense cloud, spreading it out in all directions like a jet of steam from a stationary locomotive on a calm day. In a minute or two afterwards out comes another cloud of spat from the oyster, and so on till the performance is concluded.

"From the observations I have made, I am convinced that in the embryonic state young oysters are very susceptible of cold. If the temperature of the sea suddenly drops many degrees, they all close their shells, and fall to the bottom dead just as a frosty night will 'nip up' and cause to fall off from the branches the delicate blossoms of fruit trees. If, on the contrary, the weather continues of a warm and equal temperature both day and night, and if it be at the same time calm, the young oysters will have a chance of taking up their positions on the various substances they love best.

"In calm and warm weather, and particularly in the sunshine, I find the young oysters slowly like to dance up and down, rising up and falling like sparks from a firework; the main body of them, however, remain at the bottom, swarming about like bees round the entrance of a hive, or a colony of wood ants when their nest is disturbed.

"One sees occasionally columns of gnats dancing up and down in the air. I fancy the same conditions which suit the gnats on land suit the young oysters in the sea. Cold and wind disperse the gnats, and they are no more seen; the same with the oysters, though they have many enemies besides.

"It is for this reason that so much will depend upon the weather during the next few weeks whether we shall have a good or bad crop of oysters this year.

"It is not known how long the young oysters after leaving their mother's shell swim about by means of their ciliæ; but it is known that after an unknown period they affix themselves to the 'culch'—*i.e.* empty oyster shells, &c.—and commence to grow. How this process of fixing is done no living man knows. Happy he who finds it out and applies his knowledge to practice.

"In my 'museum of economic culture,' which I have established at the Royal Horticultural-gardens, South Kensington, under the Science and Art Department, can be seen samples of oysters adhering to most of the substances which they choose for themselves, and by applying the observing and then the inductive faculty we are enabled to provide such substances at the bottom of the sea as are agreeable to the oysters, and thus entice them to fix themselves."

Mr. Buckland, we perceive, states that the fisheries depend upon "the natural fall of spat," which is controverted by Mr. Cholmondeley Pennell, who contends that the principle on which they are worked is briefly this: "There are hundreds of oyster-grounds in all parts of the kingdom which will, and do, constantly breed oysters; the speciality of the Thames beds is to fatten them. Oysters bred in Ireland, for instance, with a few exceptions, are rough, coarse-flavoured, and in many instances actually unpalatable from saltness or muddiness, or both. These cheap, rough oysters are brought over and laid down at Whitstable or Herne Bay, and in a few months they become palatable and fat, and ultimately realize a high price at Billingsgate; and if they 'spat' on the ground before being sent to market, the quality of the Thames water is such that in two or three generations at furthest their progeny become, to all intents and purposes, pure natives. Again, brood oysters are procured in large quantities from Wales, Falmouth, and the coasts of Kent and Essex. These latter, when arrived at maturity, are in all respects equal to the produce of either of the great fisheries; and constitute the larger proportion of the exquisite 'native oysters' so familiar at the dinner-tables of London and Paris. The Thames oyster fisheries are, in short, the finest fattening grounds in the world. This is the secret of their extraordinary prosperity, and on this basis primarily they are worked.

"It happens, however, that besides this, there occurs every now and then an unusually heavy fall of spat (there were always a certain quantity) on the Thames beds themselves and their neighbourhood, and this is of course a godsend to the oyster companies, as it is sometimes worth hundreds of thousands of pounds. But it is now seven years, or thereabout, since they had such a golden shower, and, for aught they can tell, it may be seven years more before they have another."

LARGE MOLLUSC.

Léon Vaillant has sent to the Academy of Sciences, at Paris, a paper on the anatomy of *tridacna elongata*, a sort of shell-fish, which is often met with in the Bay of Suez, where it is used for food. This Mollusc has seldom been examined by naturalists, even when preserved in spirits, and though zoologically described by MM. Quoy and Gaimard, the creature had not yet been subjected in a fresh state to anatomical dissection. The only fact which may be of interest to our readers in this paper is, that a *tridacna elongata*, 21 centimetres in length, and the shells or valves of which weighed 2½ lb., could by its muscular strength balance a weight of 10 lb. Now as there are *tridacnæ*, the valves of which weigh as much as 500 lb., it may reasonably be concluded that, in such a case, their muscular strength would balance a weight of 1800 lb.—*Galignani's Messenger.*

FISH-REARING.

THE objection which has been raised to the turning of young fry into the river Thames just as they begin to feed, as likely to become victims of the fish of prey, has been fully removed by the Committee of the Thames Angling Preservation Society, who by the liberal aid of the Board of Thames Conservancy have adapted a pond and watercourse near Sunbury-lock to place the small fry in until they have arrived at a sufficient growth to defend themselves. Already 12,000 Thames and other trout, and upwards of 20,000 salmonidæ, all in a healthy condition, hatched by the Society's apparatus at Hampton, have been placed in the breeding pond. Another pond near the above, at Pecker's Ait, has been granted by the conservators for the purpose of rearing jack, perch, and other fish. These improvements or aids to the fishery of the city waters will be hailed with satisfaction by the Thames anglers, and the erection of fish passes at Teddington and Mouseley, together with the opening of the weirs when the fish are heading up, are of paramount importance to the upper portion of the river, as helping to make all parts of the Thames alike for the purpose of angling. The large quantity of small fry that may now be seen in the river affords the strongest evidence of the prospective favourable results from fish hatching and preservation; and in water like the Thames, which is open to rich and poor alike freely to angle in it, and thus affording a healthy and harmless recreation and procuring wholesome food to the working men of the metropolis, the efforts of the Thames Angling Preservation Society are of a praiseworthy character.—*Times*.

THE DENISON COLLECTION OF SHELLS.

THIS celebrated Collection, dispersed by auction in May last, is thought by some to have been the most important ever brought to sale. A few of the principal lots may be enumerated. Cypræa guttata, a very large and fine example of this exceedingly rare shell, 42*l*.—Cardita crassicostata, a charming shell, 5*l*.—Cypræa princeps, only three others known, 40*l*. Conus Cedo-Nulli, a magnificent example of variety C of Reeve, 22*l*.—Conus Gloria-Maris, a splendid specimen of this extremely rare shell, 42*l*.—Conus Omaicus, a beautiful specimen of this very rare shell, 12*l*.—Conus cervus, a splendid specimen of this rare shell, 19*l*.—Conus Malaccanus, the specimen figured in the Conch. Icon., 10*l*. 10*s*.—Conus Cedo-Nulli (the shell figured 46 E., Conch. Icon.), a dark jet purple shell of surpassing rarity and beauty, to which neither figure nor description can do justice, 18*l*.—Voluta fusiformis, very fine and rare, 6*l*. 15*s*.—Corbis Sowerbyi, remarkably large and fine, 10*l*.—Voluta festiva, specimen figured in Conch. Icon., 16*l*.—Oniscia Dennisoni, 17*l*.—Pholadomya candida, extremely rare, 13*l*.—Voluta papillaris, remarkably fine, 5*l*.—Voluta cymbiola 5*l*. 15*s*.—Voluta festiva, 14*l*.—Oniscia Dennisoni, this and another, specimen are probably all that are at present known, 18*l.*—Carinaria vitrea, remarkably fine, 10*l.* 10*s.*—Typhis Belcheri, four; Cumingii quadratus, with operculum, arcuatus, anceps, four; Clerii and nitens, three, 7*l.*—Necula lanceolata, limatula, and numerous rare nucula, Neæra, and other genera, a rare lot, 10*l.* 10*s.* The total amount of the six days' sale was 2150*l.*

HAMMER-HEADED SHARK.

On July 31, there was captured at Ilfracombe a most rare and interesting visitant to our shores—a very large specimen of the Hammer-headed Shark (*zygœna malleus*)? It was observed floundering among the rocks by the boatmen on the quay-head. With great difficulty and some risk it was secured by ropes, and towed into Ilfracombe harbour. On measurement it was found to be 13 ft. 7 in. in length, 7 ft. 2 in. in girth behind the pectoral fins, 3 ft. 3 in. between the orbits of the eyes, which were nearly covered by crustacean parasites. On opening the animal the remains of two thornbacks and a bass were found, together with a number of intestinal worms of enormous size. There is only one recorded appearance of this remarkable fish on the British coast, at Caistor, near Yarmouth, in the year 1825.

It is figured in Yarrell's *British Fishes*, p. 223, Part XLIX.—*Letter to the Times.*

THE SEA OF MILK.

M. Coste has communicated to the Academy of Sciences at Paris an account of his examination of the marine phenomenon termed "Mer de Lait," or "Sea of Milk," which he observed on September 4, last, in the Atlantic Ocean. The sea appeared like a vast plain covered with snow. On examining a bucketful of the water, he found the whiteness to be due to myriads of small animals, varying from half a centimetre to a centimetre in length, which were in continual motion, ascending and descending, and giving great brilliancy to the water. Some of the animals resembled worms; others had no determinate shape. They were of a jelly-like consistency, disappearing when pressed between the fingers. Treated with alcohol, they died instantly and sank to the bottom of the vase; and nitric acid dissolved them completely. Suriray names these animals Noctiluca miliaris.—*Illustrated London News.*

DEEP-SEA SPONGE.

The Rev. W. R. Hughes has read to the British Association some Notes on the Development of a Deep-sea Sponge, in a marine aquarium. He had placed his specimen in a very ordinary aquarium; and he recorded the fact as an evidence of the great practical value of the aquarium as an instrument for the study of similar phenomena; and to demonstrate that it is possible to retain for a couple of years, in a healthy condition, deep-sea specimens of the order of Halichondria suberea (Johnston) or Hymeniacidon suberea (Bowerbank), whose natural abode, according to Dr. Bowerbank, is in from seven to ten fathoms of water.

THE TAPEWORM—ENTOZOA.

The following contributions have been made to the British Association:—

Dr. Fleming read a Paper "On the Prevalence of Tapeworm in Birmingham," urging the supply of towns with pure water, free especially from sewage contamination. In the discussion which followed, Dr. D. Chrisp said he had heard that, in Germany, the persons most frequently found afflicted with tapeworm were cooks. He suggested that the use of oatmeal in Edinburgh might have something to do with the small proportion of tapeworm cases there, in comparison with Birmingham; but Dr. Cobbold referred it to the meat being there generally well cooked.

Dr. Cobbold exhibited specimens of Entozoa, and, having explained their production and peculiarities, proceeded to say that, although pork had been considered the almost exclusive source of entozoa, it must be borne in mind that the flesh of all warm-blooded animals was liable to harbour those parasites. The human being afforded the exclusive home of at least two species of entozoa; and the worms were taken into the system through the eating of beef and veal, as well as pork.

NEW ANEMONE.

Mr. P. A. Gosse describes, in the *Annals of Natural History*, a new British Sea Anemone, of very great beauty, found by Mr. Alford near the Scilly Isles. It has a high standing column, like the aiptasia, but with the surface warted, and with tentacles, like the richest green velvet, of the same colour to the tips. It possesses a wonderful tenacity of life, having endured eight days' confinement, being delayed in its transmission by post from Mr. Alford to Mr. Gosse. It luxuriates in a small cylindrical vase of sea water; being always ready for dinner, when it devours lumps of raw meat with great appetite. At present this is the only known specimen, which, from the number of its tentacles and the name of its discoverer, Mr. Gosse has termed Ægeon Alfordi.

FROGS AND TOADS.

Mr. F. W. Putnam has reported to the Boston Society of Natural History, U.S., his observations respecting the habits of Frogs and Toads in the neighbourhood of Cambridge, Massachusetts. He states that for several years he has been searching for the eggs of the little piping frog, Hylodes Pickeringii (Holbrook), but had not met with success until the last season. On the 17th of April, after watching the movements of these frogs in the ditch on the museum grounds, he concluded that the eggs were laid among the grass and floating water-plants, and upon carefully examining these plants he discovered a number of eggs. These were not in a mass or in a string, as is the case with the eggs of our other frogs and toads, but were isolated, being attached to the plants some distance apart. The tadpoles were hatched in about twelve days, and were very long, coming from the eggs with a more marked tadpole form than is the case with our other species of frogs and toads with which he was acquainted. The eggs of the wood frog, Rana sylvatica (Le Conte), were found, for the first time, on the 18th of April. They were in a mass, about three inches in diameter, and attached to a spear of grass. The tadpoles were hatched in about six days. The toads, Bufo Americanus (Le Conte), were laying their eggs on the 24th of April, and in about ten days the tadpoles were hatched.—*Illustrated London News.*

NEW SILK-WORMS.

A KIND of Silkworm, first discovered in Montevideo, and hence named Bombyx Platensis, has since been found in many other parts of the South American continent. It feeds upon the leaves of a species of the mimosa, for which the name of Mimosa Platensis has been proposed; and to the growth of which certain French gentlemen well qualified to judge of such matters believe that both Algeria and the south of France are as well suited as the regions to which it is indigenous. Careful endeavours to acclimatise it will be made both in France and in Algeria, and there seems to be little doubt that they will be successful. We should add that the leaves on which the new silk-worm feeds are not the only valuable product yielded by the new mimosa. From its bark, especially in hot seasons, exudes a large quantity of gum, equal in quality to the very best gum arabic; and its seed vessels are so rich in tannin that they will doubtless, when obtainable in quantity, receive numerous important practical applications.

We are also hearing just now of a North American Silkworm. In the new number of *Silliman's Journal* it is stated that, "after numerous experiments, Mr. L. Trouvelot, of Medford, Massachusetts, has succeeded in rearing successfully, and in great numbers, the Atticus Polyphemus, and in preparing from its cocoon an excellent quality of silk, possessing great lustre and strength, and pronounced by competent judges superior to Japanese and all other silks, except the best Chinese. The silk is unwound by a simple process perfected by Mr. Trouvelot, each cocoon yielding about 1500 yards. This insect is very hardy, being found throughout the Northern States and Canada; and, as it feeds upon the leaves of oak, maple, willow, and other common forest trees, may be reared easily in any part of the country. Mr. Trouvelot has gradually increased his stock from year to year, by raising young from the eggs of the *few individuals first captured*, until he has at present seven waggon loads of cocoons, the entire progeny of which he proposes to raise during the coming season. The first public notice of his experiments with this insect was given by Mr. Trouvelot, at a meeting of the Institute of Technology, at Boston, about a year ago, when he exhibited specimens of silk manufactured from it, both natural-coloured and dyed."—*Mechanics' Magazine.*

RESEARCHES ON THE SILKWORM.

A VERY important memoir has been presented by M. Peligot upon some chemical and physiological researches he recently conducted on the Silkworm. The author details several very careful experiments, and draws the following conclusions:—(1) The development of the larva takes place by the transport and assimilation of a portion of the nitrogenous matter contained in the leaf of the mulberry, as the chemical composition, and probably the anatomical structure, are sensibly the same at the commencement and end of the growth, in the embryo larvon and in that which is mature. The phenomena of nutrition are the same during the different phases of development. (2) The quantity of carbonic acid which these animals exhale is very considerable: of 100 parts of carbon which they remove from the leaves, 40 to 50 are converted during respiration into carbonic acid. (3) There appears to be no exhalation or fixation of nitrogen during the development of silkworms. (4) The loss of hydrogen estimated by analysis has a relation to a loss of oxygen such as to lead one to suppose that a notable portion of the alimentary substance disappears during nutrition under the form of water.

M. Pasteur, so eminent for his researches in regard to fermentation and minute forms of animals and plants, has devoted himself to the study of the disease so fatal to silkworms in France. In June last he proceeded to Alais, where he set up a small laboratory, and there examined by the microscope hundreds of the diseased worms, chrysalids, and cocoons. He has recently reported to the Academy of Sciences that certain microscopic black corpuscles of pus are the essential symptom of the disease, and that the gravity of it is in proportion to the number of these bodies: that the remedy must be directed rather to the chrysalis than to the worm, and that a healthy crop of worms can only be procured from the eggs of the parent moths which have no corpuscles whatever on their bodies.

THE SILKWORM DISEASE.

THE Silkworm Disease, which made its appearance in France and Italy in 1857, continued its ravages in 1858, 1859, and 1860, when it appeared to decrease. Silk-growers then hoped that it would disappear altogether on importing fresh seed, and paying more attention to the rearing of the worms. They were, however, disappointed. Its virulence increased in 1863, and 1865 is said to be one of the worst. The Chamber of Commerce of Turin, commiserating the sufferings of the population who occupy themselves with the cultivation of silk, have presented to the Government a report on the silk trade in Italy during the year. It contains ample information on the mode of breeding worms in Italy, on the efforts made to renew and improve the breed, and the means employed to arrest the spread of the malady, which for the last two years has threatened to destroy one of the richest branches of industry in the kingdom. Unfortunately, the results hitherto obtained are not satisfactory, as may be seen by the produce of the last crop. Ten years since there were silk-markets established in at least 100 towns in the north of Italy: at present the number is reduced to one half. The quantity of cocoons formerly offered for sale in these markets amounted to upwards of 650,000 myriagrammes, but it fell in 1864 to 525,000, and in 1865 to 283,000. The sales, of course, decreased in a similar proportion. From 1,600,000*l.* they fell in 1864 to 1,160,000*l.*, and during the year 1865 to 800,000*l.* This sudden diminution within two years was too serious not to attract the attention of all engaged in the trade, and they consequently set about devising means to remedy the evil which threatens them with ruin. One method strongly recommended is a succession of crops during the year. By this plan if one crop fail the next one may succeed, and the breeder thus recover the first loss. An important fact is noticed in the Report. The silkgrowers of Lombardy provided themselves with seed from Japan, and they were more successful than their neighbours, who supplied themselves from Greece. There are two distinct breeds of the silkworm in Japan. One produces white cocoons, and the other green. Italian breeders have found by experience that the produce of the green cocoons is greater than that of the white; but, on the other hand, the silkworms require much more attention in the rearing.

THE SILKWORM OF THE OAK.

DR. WARD calls attention to a Report upon the Silkworm of the Oak, Bombyx (*Yama-Mai*), lately introduced from France into Japan, and which the reporter considers as perfectly adapted to the climate of Normandy, and which Dr. Ward, from two years' residence at Caen, considers may be introduced with success into the south and west of England, which differ very little, if at all, from that of Normandy. The oak-worm, or yama-mai, of Japan, is a monopoly of the Royal Family, and to sell or export the eggs is punishable with death. Hence the complete ignorance which exists respecting this valuable insect. In 1861, M. Duchesne de Bellecourt, the French Consul-General in Japan, sent some of the eggs to the Société d'Acclimatisation, but as nothing was known of the habits of the insect, only one worm survived to make its cocoon. This single specimen, however, was enough to establish its value; and in 1862 a scientific Commission searched for and sent a quantity to France. M. Personnat, of Laval, received a few of the eggs, and after three generations, he had, in May, 1865, 20,000 worms on his oaks at Laval. The following is an abridgment of his Report:—The eggs are easily produced through the winter, if kept dry; and in the spring, when the oaks come into leaf, to hatch the eggs it only requires that they should be placed in a room with a southern aspect. The worms feed upon any kind of oak, grow rapidly, cast their skins four times, and in 60 or 65 days begin their cocoons. After the first change, or even from the egg, they may be exposed to the open air, as they are not affected by the weather; but as there are sharp frosts in England in May and June, a little nursing under cover is advisable till the oak-leaves are strong enough to protect them. The weight of the cocoon is much greater than those of the mulberry worm. An empty one weighs 70 centigrammes (11 grains), while one of the mulberry worm only weighs 33 centigrammes (5½ grains). It takes 450 to 500 full or fresh mulberry cocoons to weigh a kilogramme, while 200 of the oak-worm will make the same weight. One square metre, nearly 40 inches square, of oak underwood will support 15 or 20 cocoons; but taking it at only 10, then a single hectare (2½ acres) will produce 100,000 cocoons, or 500 kilogrammes.

The price of mulberry cocoons is from 5f. to 8f. (4s. 2d. to 6s. 8d.) the kilogramme; although the oak-worm silk is said to be quite equal in value, yet taking it at 4f. (3s. 4d.) the kilogramme only, will give a return of 2000f. (80*l.*) the hectare, or 32*l.* per English acre.

There are thousands of acres of oak brushwood in the south and west of England only used for fagots and hop-poles; according to M. Personnat they can be made to rival the gardens of the Hesperides in their produce without at the same time interfering with the original object of their growth. Hence the cultivation of this new species of silkworm is well worth attention. The above data are taken from the *Annuaire des Cinq Départements de la Normandie*, and contained in a letter from Dr. Ward to the *Times*, dated January 12, 1866.

THE HUMMING-BIRD MOTH.

SPECIMENS of this pretty little insect have been taken in various places during the summer and autumn. Mr. Abbot, of Durdham Park, found one in his garden, and noticed that its movements were like those of a Humming-bird. It extends a proboscis like a bird's beak, and otherwise is more like a minute and beautiful little bird than a moth, save in its wings. It expands its tail like a bird when flying, and feeds on the way; while its humming is that of a great blue-bottle fly, but more musical. Its head, too, and eyes are very bird-like. It feeds with greatest pleasure on the red geranium and larkspur.

Mr. Akerman, writing from Abingdon, mentions the frequent appearance of the Humming-bird Moth in his neighbourhood. The *Rev. Mr.* Acland writes from the same place:—"I can fully bear out Mr. Akerman's account; but, in opposition to his experience, have seen these lovely little creatures feeding more eagerly upon the scarlet geranium flowers than upon any other. Having a row of the plants in pots outside my window, I have often sat for a long time watching the moths and listening to the musical humming of their wings as they hovered over the flowers, thrusting their long trunks into one after the other, and after a short excursion returning and trying the same flowers over and over again. I may add that I noticed the same moths during a visit paid by me to the Scilly Islands in August; and that there, too, they were always busy with the scarlet geranium.

Mr. Charles Pearce writes:—"It is generally supposed that the Humming-bird Moth is peculiarly susceptible of climate, and has only been attracted to this country by the late remarkably hot and dry summer. That it can bear both cold and rain I have discovered, by seeing one morning in my garden near Walton-on-Thames, apparently as strong and lively as in the early summer, although the weather for some days past has been cold and unsettled, and the day before was one of incessant heavy rain."

A Correspondent writes from Frewin Hall, Oxford:—"I can fully bear out the statements of your Correspondents in the *Times* recently as to the frequent appearance of this pretty little insect during the summer. I have watched it repeatedly in my own garden, where it always showed a preference for the flowers of the jessamine, visiting next the scarlet geranium and verbenas. In the specimen caught by me the long spiral tongue measures 1⅛ in. in length, the body being 1¼in. Those who care for its natural history may consult *Westwood on Insects*, vol. ii., p. 364; *Curtis's British Entomology*, part 1, *Lepidoptera; Stephen's Entomology*, p. 747. The last-named work gives a full description of the creature in its larval and pupal condition, by which any one may easily recognise it. Its entomological name is *Macroglossa stellatarum*, being a species of the family *Sphingidæ*, order *Lepidoptera*. I may also mention that another member of the same family,—viz., the *Acherontia atropos*, or Death's-head moth,—has been very plentiful in this neighbourhood.

"In conclusion, it may be interesting to some to note that this year—prolific though it has been in insect life—has been singularly barren in the wasp tribe, few, if any, having been seen, to which fact the sound state of our ripe fruit bears ample testimony."

LIGHT OF FIRE-FLIES.

The Rev. H. Clark has exhibited to the Entomological Society a collection of Beetles made by Lieutenant J. Hobson, in Central India; and read a letter from the *Ceylon Examiner*, respecting a remarkable Lampyris. Again referring to the alleged flashing, or simultaneous exhibition and extinction of their light by numerous fire-flies—the subject of discussion at a previous meeting—Mr. Clark read the following extract from a letter from Mr. A. Fry:—

"I can confirm your observation that the fire-flies of the genus Aspisoma flit at night in great numbers over low-lying, damp fields, chiefly near water; emitting light by short flashes, at intervals of three or four seconds, the majority keeping time with each other as if in obedience to the *bâton* of a leader. I think it is only the fire-flies of that genus who practise it. The numerous fire-flies common in Mexico and North America, belong chiefly to the genera Ellichnia and Photuris, whose habits are different, so far as I have had opportunity to observe their congeners in Brazil." Mr. Evans mentioned that, in consequence of the recent discussion on the luminosity of Fulgora, he had sent a drawing of *F. lanternaria* to his son, Mr. W. T. Evans, of the Commissariat, at present in British Honduras, with a request that he would investigate the subject; he had recently received the following:—"Belize, 17th May, 1865.—I have succeeded in my entomological researches about the lantern-fly. I had one given me, caught here, alive, and I saw it myself giving light. I kept it in a tumbler for about a day, and it sometimes did not give it, but at others it did."

BEE-KEEPING EXPERIENCES.

To the *Times* Beemaster's Report of the Honey Harvest of 1865, he appends these interesting communications:—

A Correspondent from California writes that after a hive there has sent forth three swarms, each swarm sends out other swarms—that is, grand swarms. Out of one swarm a proprietor will often in a few years have 70 hives. Whether this be that in California everything is large, or that bee-flowers last longer in bloom and are more abundant, it is hard to say.

Much has been talked and written about the Ligurian bee. I do not speak from experience, but from reading, and, so far as my information is reliable, I am not disposed to supplant the native by the foreigner. A Correspondent of a Melbourne paper thus states what he saw:—

"We have on more than one occasion called the attention of acclimatizers to the injury they are inflicting on the colony by the importation of noxious pests like the Ligurian bee. A Correspondent, writing to the *Age*, confirms our remarks as to the damage done to the vineyards by the new bee. He gives the following as the experience of a German vigneron, who had 24 hives of these bees:—

"'The bee has destroyed the crop of the vineyard (two and a half acres) and orchard completely during three successive years. His neighbours, also, whose vineyards were three miles distant, complained about them, so that he was obliged to part with them and re-stock with common bees, which he did, without finding any difference in the yield of honey.'"

Baron von Berlepsch, the highest authority on this recent introduction into England, gives the Ligurian bees one very bad character:—"They strive wherever opportunity offers to force their way into colonies of common bees," "and are more disposed to rob." A beekeeper in the West of England thinks the *Apis Ligustica* more productive and profitable than the other species—the native British bee.

There is no evidence of any devastation here by the bee similar to that experienced in Australia. But at present a very high price is asked for a Ligurian queen and colony, which puts the experiment beyond reach of the cottager. I confess I would rather direct attention to the improved treatment and cultivation of our indigenous bee than listen to a few *dilettanti*, who, according to the highest authorities, may inflict upon us swarms of robbers and picturesque brigands from the States of the Church who will flourish only on the expatriation or extirpation of our natives.

I see no objection to experimental hives of the Alpine or Ligurian bees; but I recommend to cottagers to attend to the improved cultivation of the British queen and her loyal and industrious subjects. I do not know, what many of your readers must be acquainted with, the amount of imports of foreign honey and beeswax. But I believe it is much greater than is generally supposed. I should like to learn that we import none and export much. It will be seen in the following extract from *The Times* that Corsica, the birthplace of the Imperial bee, produces an immense quantity of honey and wax:—

"A great portion of the immense quantity of honey consumed in France is supplied from the island of Corsica and from Brittany. Corsica produced so much wax in ancient times that the Romans imposed on it an annual tribute of 100,000 lbs. weight. Subsequently the inhabitants revolted, and they were punished by the tribute being raised to 200,000 lbs. weight annually, which they were able to supply. Wax is to honey in Corsica as 1 to 15, so that the inhabitants must have gathered 3,000,000 kilogrammes of honey. When Corsica became a dependency of the Papal Court it paid its taxes in wax, and the quantity was sufficient to supply the consumption not only of the churches in the city of Rome, but those in the Papal States. Brittany likewise supplies a great quantity of honey, but of inferior quality to that of Corsica. The annual value of the honey and wax produced in that province is estimated at 5,000,000f."

Why should England come behind Corsica? It is no doubt a pity that bees should to any extent contribute to the making of Roman candles and Papal ceremonies; but free trade, like every earthly blessing, must have some drawbacks. London gas, the worst in the world, would more effectually create the "dim religious light," and wax candles in English drawing-rooms would add to the health and improve the complexion of English ladies, and prove a far more worthy use of the produce of English bees.

ANTS CARRYING GRAIN.

Mr. J. J. Lake has sent to the *Athenæum* the following anecdote in illustration of the habits of Ants:—"It is disputed by some whether ants do carry off grain and store it; but the following incident will show that they do so, and to a considerable extent. At the side of my house at Zante there was a threshing floor, or rather the paved space was converted temporarily into one, a pole having been fixed in the centre, to which horses were attached and driven round and round to trample out the corn. A pile of wheat was left here unthreshed for a few days. In the meantime the ants committed depredations upon it, and, on one of their nests being opened, two good-sized tin cans-full of grain were found deposited in it."

Another Correspondent of the *Athenæum* writes: "The question whether food is carried away and stored by ants, recalls an interesting proof of the certainty of this, of which I was witness last year during a visit to Acro-Corinth. The party of which I formed one was composed of four persons, and, having partaken of lunch at the summit of the Acropolis, we remained probably half an hour afterwards surveying the surrounding country. Our lunch had been composed of cold meats, hard-boiled eggs, &c., and several pieces of the eggs had been scattered on the ground. About to descend from the Acropolis, we were much surprised to find a stream of ants, some passing one way, some another, of about one inch in breadth, leading to the place where we had lunched. On following the stream in the direction from which the ants were swarming, for a distance of about twenty feet, we found that it terminated in a hole in the ground, from and into which they were continually passing. Each of the ants travelling towards the hole was laden with some portion of the egg, and the yolk appeared to be the favourite part. Some were toiling along with pieces larger than their own bodies, others with smaller pieces. No ant seemed to notice another; but each one performed its labour, without assistance or interruption, until it arrived at the hole, when, if I am not mistaken, save in one or two instances, where the pieces were large and cumbrous, other ants from the inside assist in conveying them into the hole. We watched them for a considerable time, and the work went on uninterruptedly, and probably continued until the whole of the egg was consumed. That they carried the egg away, and for a great distance, we had abundant proof, and that it must have been conveyed for the purpose of storage there can be little doubt."

Dr. John Shortt has described in the *Linnæan Society's Journal*, the habits of the Mÿrmica kirbii, a species of ant found in Southern India. Its nests, built on trees, about 30ft. above the ground, are constructed of a fine mixture of cowdung and leaves, arranged in such a manner as to be impervious to rain, yet permit free ventilation. This ant is exceedingly ferocious, attacking man or beast when meddled with. Late one evening Dr. Shortt placed two nests on his window-sill: the next morning the place was completely covered with dead or dying ants, a dreadful battle having ensued between the inhabitants of the two nests.

THE EPEÏRA AURELIA SPIDER.

The history and habits of the Epeïra Aurelia Spider are the subject of a paper by Mr. Frederick Pollock, who has recently had the opportunity of studying it at Madeira. We select a few points. The Epeïra haunts the prickly pear. Its cocoon contains between 600 and 1000 bright yellow eggs, which burst at the end of four weeks. At the end of the fifth week, when about the size of a pin's head, they cast off their first skin, and become active. For ten days after they cluster together; but in a fortnight they separate, and each begins to spin a web, at first about the size of a penny piece. Mr. Pollock had some enclosed in a glass-case, but they did not make webs or thrive in captivity. They consume whatever comes into the web, spider or fly. The females have nine changes after leaving the cocoon; and for about two days preceding each change they remain motionless, and seem to eat nothing. After the eighth change the female spider is adult, and takes to making cocoons, which operation lasts for several months. About a week after the fifth cocoon is made she changes her skin for the last time, rests from her egg-laying for about thirty days, makes five more cocoons at intervals of from fifteen to twenty-five days, and dies in a week or so after making her last one. The largest of these female spiders has a body about 13-16ths of an inch in length, while the male's body is only 3-16ths of an inch long. These spiders capture wasps and bees, winding them round, and incasing them like mummies before approaching within reach of their formidable prey. They are never attracted to anything that does not move, and never eat what they have not themselves killed. Their voracity is very great, and is equalled by their power of endurance, since they will live for a week or ten days without food. The duration of their life is generally about eighteen months.—*Illustrated London News.*

NEW SPIDER.

MR. BLACKWELL, in the *Annals of Natural History*, gives a series of descriptions of a number of new Species of Spiders from the east of central Africa.

ON THE VINEGAR EEL.

THIS little animal (*Rhabditis aceti*) has of late been the subject of much interesting speculation. It long since attracted attention —as was unavoidable—so soon as the microscope revealed its existence. Buffon rests upon it, and upon the eel found in paste, one of his principal arguments in favour of his theory regarding molecules which take spontaneously, and according to circumstances, the form and vitality of the animal. It has by some been considered the cause of the impression made by vinegar on the organ of taste; by others it was believed to afford a proof of the existence of spontaneous generation. But the question regarding it has been set at rest by a communication made to the Academy of Sciences at Paris, by M. Davaine.

The argument in favour of Spontaneous Generation, derived from the Vinegar Eel, rests on the supposition that it is not found in the grape, nor in the wine from which the vinegar is derived, nor, indeed, anywhere except in the vinegar. But this supposition is altogether illusory. These eels will live and multiply prodigiously in fruits which are neutral or but slightly acid, such as peaches, plums, apricots, grapes, cherries, gooseberries, apples, pears, melons, &c. They will even thrive and propagate in vegetables, but always in proportion to the quantity of sugar present; hence the beetroot and the onion are highly favourable to their production, the carrot and the tomato exactly the contrary. On the other hand, M. Davaine kept wine vinegar for ten years, in contact with the atmosphere, without any eels making their appearance.

Not only is vinegar not necessarily their dwelling-place, they do not require even any acid liquid, since they will multiply in great numbers in water containing 5 per cent. sugar, and the rapidity of their increase augments with the quantity of sugar, up to 30 per cent.; if so much as 50 per cent is present, they perish.

It might be said that their presence in the solution of sugar is due to the production of acidity; but this is not the case, since they will multiply faster in a neutral solution than in one that is acid. Acidity may even be fatal to them, since they soon die in water acidulated to the same degree as vinegar by the mineral acids, or by oxalic, citric, or even acetic acid; and hence they are found only in the vinegar made from fruits.

Wherever produced, however abundant their food or the contrary, they undergo no modification, either of size or shape.

The origin of the vinegar eel is, therefore, obvious. It has great powers of locomotion, and can go in search of those substances which afford it nutriment, especially the fruits containing sugar, which fall to the ground. Should none of these be at hand, it can wait, since it will live for weeks in a moist soil. Once in the fruit, it is easy to trace these animals to the vinegar, and once in vinegar, they maintain their ground in the casks, &c., used to hold it, and are thus transmitted indefinitely from one quantity of vinegar to another.—*Scientific Review.*

THE ZOOLOGICAL SOCIETY.

By the last Report, the Society appears to be in a very flourishing state. The number of fellows, fellows elect, and annual subscribers of the Society on that day amounted to 1955, showing an increase of 201 members since the last anniversary. During the year 1864 no less than 264 new fellows and annual subscribers had been elected—a greater number than had joined the Society in any one single year for the previous twenty-eight years. Seventeen corresponding members had also been elected since the previous anniversary. There was considerable increase in the income of the Society. The income of the year 1863 had amounted to 20,284*l.* 12s. 11d.—a sum unexampled except in the two Exhibition years; but the income of the past year had exceeded that sum by 1429*l.*, the total receipts for 1864 having amounted to 21,713*l.* 13s. 10d. The number of visitors to the Society's gardens had also largely increased during the year 1864, the entrances having amounted to no less than 507,169, a number which placed the year 1864 as exhibiting a more favourable aspect in this point of view than any of the preceding years, except the two Exhibition years.

The Report proceeded to speak of the Society's gardens in the Regent's Park, and stated in reference to them that the new entrance lodges, aviary, and monkey-house, concerning which full details and explanations had been offered to the Society in their last annual report, had been all completed and brought in perfect order during the course of last year. That as regards the latter building, the new monkey-house, which was only brought into full working order during the latter part of last summer, the council could not refrain from congratulating the society upon the very important amelioration that had been thus effected in what had been heretofore one of the most defective parts of their garden establishment. That this building had not only proved most attractive to the public, but also as regards the health and welfare of the animals to the use of which it was devoted, there could be no question that it had likewise proved an entire success. In striking contrast to the constant mortality that had prevailed in the old monkey-house, the deaths among the Quadrumana during the late long and severe winter had been very few, and the greater number of them had remained in an excellent state of health. That the total cost of the erection of the new monkey-house had been 3382*l.* 18s 3d., and that the further sum of 1459*l.* 7s. 3d. had been spent in fittings and works connected with it. That the most important event connected with the Society's Menagerie that had occurred since the last anniversary had been the successful result of Mr. Thompson's mission to India. Several of the Society's corresponding members in India having announced that they had collections waiting for transmission to the Society (among which were a pair of young rhinoceroses and other valuable animals) the council had determined on sending out to Calcutta to receive and bring back those proffered donations, Mr. James Thompson, the Society's head keeper, who had previously made the same journey with such signal success on the occasion of the introduction of the Himalayan pheasants in 1858. That Mr. Thompson had left Calcutta on his return voyage in the *Hydaspes* on the 5th of April, and had arrived in the Thames on the 28th of July, 1864, bringing with him a very fine series of animals, among which might be specified two rhinoceroses, one rhinoceros hornbill, two concave hornbills, three green-necked peafowl, three lineated pheasants, two rufous-tailed pheasants, and other valuable animals. That the total cost of Mr. Thompson's expedition had amounted to 808*l.*, while the lowest estimate that could be put upon the value of the collection thus acquired amounted to 1516*l.*

The Report then gave a list of the animals exhibited for the first time during the year 1864, which comprised eight mammals, twenty-three birds, two reptiles, and two fishes. Among these particular notice was directed to the orange-quilled porcupine (Hystrix Malabarica), a new and very interesting addition to this group (for which the Society were indebted to their corresponding member, his Excellency Sir William Denison, Governor of Madras), and to the Didunculus Strigirostris, or tooth-billed pigeon of the Samoan Islands in the Pacific; perhaps the rarest specimen ever exhibited alive in the Society's menagerie, as it had been supposed, until recently, to be quite extinct. For the latter the Society were indebted to their indefatigable correspondent, Dr. George Bennett, of Sydney, who had made so many valuable donations to the menagerie.

The Report then gave a list of animals which had bred in the gardens of the Zoological Society between the 1st of January, 1864, and the 1st of January, 1865, among which were twenty-two species of mammals, twenty species of birds, one reptile, and three fishes, and an alphabetically arranged list of donors and of their several donations to the menagerie during the year 1864. In concluding their

Report the council stated that they felt themselves entitled to offer to the members of the Society at large their warmest congratulations upon the present state of every branch of the Society's affairs. It might be now safely stated, from the experience of the past two years and the prosperous commencement of the present, that the yearly income of the Society might be reckoned under ordinary circumstances to be likely to reach the amount of 20,000*l*. Allowing 17,000*l*. for the ordinary expenses of the present large establishment, a surplus of 3000*l* remained, which might be devoted to extraordinary works without trenching on the Society's reserve fund.

BOTANY.

TRACHEAN VESSELS OF PLANTS.

IN the *Annals of Natural History* have appeared some notes by M. T. Lestilgoudois maintaining the existence of liquid and solid matters in the Trachean Vessels of Plants. Among other instances, he refers to the case of an old vine-stem, on the surfaces of which, when cut to pieces, were found filaments of gummy matter five or six millimetres in length, which had issued from the large vessels. Hence it appears that, even at an advanced age, the trachean vessels may contain not only gaseous bodies, but substances which sometimes acquire a great density.

THE COCOA-NUT.

THE author of *Our Tropical Possessions in Malayan India* remarks that a Cocoa-nut Plantation has altogether a singular appearance. "The trees at maturity attain a height of forty feet, unbroken by a leaf or branch, and rarely inclining more than two or three degrees from the perpendicular; the tops have a spread of about twenty-five feet in diameter, and, as the trees are seldom planted further apart than thirty feet, their foliage forms nearly an unbroken canopy, shading the ground below. The nuts grow in clusters between the roots of the leaves or branches at the top, in all conditions of ripeness. If not picked when ripe they drop, and even with careful picking many nuts are lost by dropping and being broken on the ground. Indeed, in a large plantation, the noise of the falling nuts and the dead old branches strangely breaks the silence that reigns around."

GERMINATION AND TEMPERATURE.

M. DE CANDOLLE has published in the *Bibliothèque Universelle* of Geneva a memoir on Germination under various degrees of Constant Temperature, in which, after giving minute details of his experiments, he arrives at the following, among other conclusions:—That there exist seeds which will germinate at the freezing point, that there is a minimum and maximum for each species; and that there is an analogy between seeds and eggs, and between germination and combustion.

THE DE CANDOLLE PRIZE.

The Physical and Natural History Society of Geneva will this year (1866) award De Candolle's botanical prize of five hundred francs for the best essay upon a genus or family of plants. Memoirs must be sent in not later than the 1st July, 1866. The ordinary members of the Society will not be allowed to compete. The Society reserves the right of printing in its memoirs the successful essay.

We understand that a grand Congress of European botanists is soon to be held in London, under the presidency of the veteran De Candolle; and that the Lord Mayor is to give a special dinner upon the occasion.

CLIMBING PLANTS.

The *Journal of the Linnean Society* contains Mr. Darwin's paper, or rather treatise (in 118 pages), on the movements and habits of Climbing Plants. He considers, in order, spirally-twining plants, leaf climbers, tendril bearers, and hook and root climbers. In conclusion, he says:—"It has often been vaguely asserted that plants are distinguished from animals from not having the power of movement. It should rather be said that plants acquire and display this power only when it is of some advantage to them; but this is of comparatively rare occurrence, as they are affixed to the ground, and food is brought to them by the wind and rain. We see how high in the scale of organization a plant may rise when we look at one of the more perfect tendril bearers. It first places its tendrils ready for action, as a polypus places its tentacula. If the tendril be displaced, it is acted on by the force of gravity, and rights itself. It is acted on by the light, and bends towards or from it, or disregards it, whichever may be most advantageous. During several days the tendril or internodes, or both, spontaneously revolve with a steady motion: the tendril strikes some object, and quickly curls round and firmly grasps it; in the course of some hours it contracts into a spire, dragging up the stem, and forming an excellent spring. All movements now cease. By growth the tissues soon become wonderfully strong and durable. The tendril has done its work, and done it in an admirable manner."—*Illustrated London News.*

VEGETABLE FLANNEL.

We find in the *Athenæum* the following note on the Manufacture of Vegetable Flannel:—Since about 1860 there are two establishments near Breslau, in one of which pine leaves are converted into wool, while in the other, for invalids, the waters used in the manufacture of pine wool are employed as curative agents. The process for converting the pine needles into wool was discovered by Mr. Pannewitz. In the hospitals, penitentiaries, and barracks of Vienna and Breslau, blankets made from that material are now *exclusively used.* One of their chief advantages is that no kind of vermin will lodge in them. The material is also used as stuffing, closely resembles horsehair, and is only one-third its cost. When spun and woven, the thread resembles that of hemp, and is made into jackets, spencers, drawers, and stockings, flannel and twill for shirts, coverlets, body and chest warmers, and knitting-yarn. They keep the body warm without heating, and are very durable. The factories are lighted with gas made from the refuse of the above manufactures.

GALLS ON WILLOW-TREES.

THE following note is from the *Athenæum*:—

"Bottesford Manor, Brigg, March 13, 1865.

"In Saturday's *Athenæum*, p. 352, it is recorded, that at the Meeting of the Entomological Society, held on March 6, 'Mr. Bond exhibited specimens of a Gall found on a Willow Tree near Cambridge; the attack of the insect .... caused a premature terminal development of leaves in whorls, so as to resemble a flower-head.' Galls of this kind are of very frequent occurrence on willows in this neighbourhood, and, I believe, throughout the whole of Lincolnshire. They are so common here, that I have always supposed that they must be familiarly known to naturalists. They first show themselves in the latter summer and early autumn, but are not easily discovered until the tree sheds its leaves. When that happens, the gall-leaves become prominent objects. Their form is singularly like that of a small rose, and the likeness is increased by the colour, which, in December and January, is a light brown, very often nearly approaching red. As time goes on the brown becomes deeper, and when the green leaves shoot forth in spring, the galls drop off. The likeness to a rose is often so complete, that an uninstructed person might easily be led to the absurd conclusion that he had seen roses growing on willows. That this opinion was current at one time, is proved by the following entry in the chronicle of John Capgrave, 1338: 'In that same zere welowes bore roses, red and frech; and that was in Januarie.' p. 207. This is another proof to be added to those accumulating daily, that the strange histories to be found in the records of past ages, are not, for the most part, deliberate fables, but truths ill understood, or facts seen out of their proper perspective. There is a story told by an Irish writer, of a certain willow-tree, which, having received the blessing of S. Coënginus, straightway began to bear apples. (*Lau. Beyerlinck, Theat. Vitæ Humanæ*, t. 1. p. 921a) It is highly probable that the foundation of this legend must be sought in a similar direction.

"Yours, &c.,

"EDWARD PEACOCK."

DEODAR FORESTS.

A PAPER has been read to the British Association, by Dr. Cleghorn, "On the Deodar Forests of the Western Himalaya," which he explored in 1862 and 1863, with a view of obtaining correct information respecting the timber resources available for the Punjaub Railway. He exhibited a sketch map showing approximately the position and extent of the deodar tracts, so far as ascertained, between the Jumna and Indus rivers. He dwelt on the applicability of the wood of the *Cedrus deodara* for railway purposes, for which it has been found very valuable. An officer is now employed upon each of the great rivers of the Punjaub for carrying out, upon sound principles, the conservancy and management of these important forests. The quantity of deodar timber brought down the Chenáb alone in one year has amounted to 12,000 tons, and an increase of timber upon the Indus and Kabul rivers was predicted. The characteristic vegetation of the Deodar Forests was shown in a series of photographs taken by Lieutenant-Colonel C. Hutchinson, R.E.

GIGANTIC TREES OF CALIFORNIA.

THE reproachful regret expressed a few years ago by botanists at the destruction of the Gigantic Trees of California, will be alleviated by information recently received at the Royal Gardens, Kew, from Professor Brewer, of the Californian State Geological Survey. He announces, in a letter to Sir William Hooker, the discovery "of the big trees in great abundance on the western flanks of the Sierra Nevada, in about latitude 36° or 37°;" and he describes them as "very abundant along a belt at 5000-7000 feet altitude, for a distance of more than twenty-five miles, sometimes in groves, at others scattered through the forests in great numbers." One of the largest trees seen by Professor Brewer measured 106 feet in circumference at four feet above the ground, and was 276 feet in height. "You can have no idea," he adds, "of the grandeur they impart to the scenery, where at times a hundred trees are in sight at once, over fifteen feet in diameter, their rich foliage contrasting so finely with their cinnamon-coloured bark." It is satisfactory to learn that there is no danger now of speedy extinction of the species, for "immense numbers" of seedlings have been seen growing. Professor Brewer remarks that he has "no doubt of the true generic relations," and that "no one who is familiar with both species *in situ* would separate them generically from the *Sequoia sempervirens;*" and he is of opinion that "the names *Wellingtonia* and *Washingtonia* would not be insisted on with such zeal were it not for seed-dealers and plant-collectors, who name species more for profit than from any honest conviction that they are new species."—*Athenæum.*

GAMBOGE-TREE OF SIAM.

MR. DANIEL HANBURY has contributed to the Linnæan Society a paper on the species of Garcinia, which affords Gamboge, in Siam We learn that, above two centuries ago, one of the Dutch voyagers, returning from India, first brought to the notice of his countrymen a gum-like substance, of an orange colour, to which various important medicinal properties were ascribed. In 1677 Herman announced that this drug was derived from two trees, since ascertained to belong to the order *Guttiferæ*, and of which one is known as the *Garcinia gambogia*, the other being, in all probability, the *Garcinia morella*. Desirous of settling the question as to the origin of gamboge, Mr. Hanbury procured from Messrs. Almeida, of Singapore, a jar of specimens from trees on their plantations. These gentlemen state that they have twenty-eight of these trees, varying from 35 ft. to 50 ft. in height; the largest with a circumference of about 3 ft. They grow on the slope of a low hillock with very little attention, and are asserted to be "the real gamboge-tree." Mr. Hanbury gives the botanical details of the specimens, and proposes to name them "Garcinia morella, variety pedicellata."

VALUABLE PALMS.

A CORRESPONDENCE has taken place between Sir Henry Barkly, Governor of the Mauritius, and Mr. George Bentham, the President of the Linnæan Society, relating to the preservation of the Valuable Palm named "Coco de Mer," in the Seychelles Isles, from total destruction, by clearing land for cultivating the manioc. Directions have been consequently given for planting the germinating nuts, &c. We are glad to learn that on one estate these palms may still be seen in all stages of growth, from the sharp, sword-shaped spathe just rising from the ground, to palms 120 feet high, which have long since arrived at maturity, and whose age it is impossible even to guess.

M. De Vry, in the *Journal de Pharmacie*, advocates the cultivation of the palm-tree (Arenga saccharifera) as the new source for the supply of a sugar, resembling cane-sugar, which, he states, the Javanese obtain in great abundance, in a very rough primitive manner. As soon as the tree begins to blossom they cut away the stem which bears the flower, and collect the juice, which flows in bamboo tubes, which have been previously smoked to prevent the fermentation in consequence of the heat of the climate, and a small quantity of nitrogenous matter in the juice. This juice, after being heated in iron basins over fire, is left to thicken by evaporation, till a small drop becomes solid, when it is cooled by being poured upon a cold surface, and becomes crystallised in the form of prismatic lozenges. This palm-tree does not require the rich soil necessary for the cultivation of the sugar-cane and beetroot. The tree does not produce sugar until the eleventh or twelfth year; but afterwards furnishes it for many years, thus constituting a continued source of industry. We are glad to learn that this tree has been introduced by the British into Ceylon, where the natives prepare a sugar they term "jaggery."

WOOD OF THE AILANTHUS.

M. GUÉRIN-MÉNEVILLE has transmitted to the Academy of Sciences at Paris, a note on the valuable qualities of the Wood of the Ailanthus, a species of oak, the leaves of which furnish the food of a new Chinese silkworm. He states that M. Raoulx has tested this wood in comparison with oak and elm, and asserts that the ailanthus is the best in regard to tenacity and flexibility, and very little inferior to oak in density, and possesses nearly twice its tenacity. It is very hard, takes a good polish, and yet is easily worked. This tree is being rapidly planted in France, as an ornament to gardens, parks, and forests. (See *ante*, p. 205.)

TRANSFORMATION.

M. Trécul, in a recent contribution to the Academy of Sciences at Paris, describes a Transformation which, if correct, will be equally interesting to the chemist and the botanist. While studying the Lactuca altissima, he separated from the bark, by maceration, some beautiful green, needle-like crystals of globular and hemispherical forms, contained in the cellular laminæ. On further examination he witnessed the gradual conversion of grains of chlorophyl into crystals. In the same communication he reports certain experiments for which he claims the result, "that organic matter contained in certain cellules may, during putrefaction, be transformed into living bodies of a very different nature from the generating species."—*Illustrated London News.*

SAND FOOD OF SONORA.

The Ammobroma Sonoræ (Sand-food of the Sonora) is an extraordinary root-parasitic plant of the region at the head of the Gulf of California. In a note in the *American Journal of Science*, by Dr. Asa Gray, we learn that this plant, growing in a forlorn sandy desert, almost covered by the sand in which it lives, was found by its discoverer, the late Colonel A. B. Gray, to form a considerable part of the sustenance of the Papigos Indians of the district, and is said to be very luscious when first gathered and cooked, resembling in taste the sweet potato, only far more delicate.

RANUNCULUS.

Mr. W. H. Hiern has read to the British Association a paper upon "The Ranunculus Radiano of H. Revel, as a British Plant," first discovered at Silverdale, in Yorkshire, in June, 1864, although it had been said by Professor Babington that the plant was not to be found in England. Mr. Hiern showed that this plant possessed the floating leaves and other peculiarities of the true plant, and he claimed for it a new name in the British flora.

INFLUENCE OF FROST UPON POTATOES.

M. Vogel has reported to the Academy of Sciences at Munich the results of his researches on the Influence of Frost upon Potatoes. A potato which has been hardened by frost when thawed becomes flaccid, and gives out a brownish liquor, which putrefies after two or three days. Whether this modification is mechanical or chemical has not yet been determined. Girardin considers it to be *mechanical, and that* the frozen potato contains quite as much starch as the unfrozen. Payen seems to have an opposite opinion, since he asserts that hardly a fourth of the quantity of starch obtained from unfrozen potatoes can be obtained from frozen; but he admits that their softened state when thawed prevents their being easily rasped. His experiments have been confirmed by M. Vogel, who has also proved by a chemical process, in which the starch was transformed into glucose by boiling and sulphuric acid, that there is no difference as to their quantity of starch between frozen and unfrozen potatoes. The liquid which flows from frozen potatoes when thawed takes up a feeble blue colour by the action of iodine. It contains, consequently, only traces of starch; but it is rich in vegetable albumen, which coagulates firmly by boiling, and gives a much more abundant precipitate than the liquid extracted from fresh potatoes. Frozen potatoes lose their nitrogen when heated in water unless they are put into boiling water while still frozen; in that case the albumen coagulates and is not dissolved. When peeled potatoes are put into cold water and gradually heated till they boil, an albuminous scum is formed, more or less. This fact is of some importance, when we consider that the potato is already very poor in plastic alimentary substances. Since frozen potatoes, then, do not lose their starch, and unfrozen ones do so quickly when once germination begins, it would certainly be advantageous to freeze those intended for the starch manufacture. This is done on a large scale on the mountains of Peru.—*Illustrated London News.*

VEGETABLE ORIGIN OF DIAMONDS.

PROFESSOR GOEPPERT'S long-expected prize essay "On the Vegetable Nature of Diamonds," has been published, illustrated by coloured plates. Experiments show that diamonds cannot be produced by Plutonic agency, as they become black when subjected to a high degree of temperature. That they are, on the contrary, of Neptunian origin, and were at one time in a soft condition, is proved not only by the impressions of grains of sand and crystals on the surface of some of them, but also by the enclosure of certain foreign bodies such as other crystals, germinating fungi, and even vegetable structure of a higher organization. If Professor Goeppert's conclusions be accepted, confirming and extending as they do the views held by Newton, Brewster, and Liebig, diamonds seem to be the final product of the chemical decomposition of vegetable substances.

PROPERTIES OF COFFEE.

IN the *Popular Science Review* we have a note "On Coffee," by Baron Liebig, in which, after describing its properties and the various methods of preparing the beverage, he recommends that *three*-fourths of the coffee to be employed in preparing it should be *boiled* and the other fourth infused, the results being mixed. By this means both strength and flavour are ensured. To preserve the flavour of ground coffee the Baron recommends that the powder should be wetted with a syrup of sugar and then covered with powdered sugar. The volatile parts of the coffee are thus prevented from escaping.

KEW GARDENS.

THE most important work commenced in the year has been the revision of the Arboretum. The pleasure-grounds are devoted to the cultivation of a complete named and classified collection of all the trees and shrubs that will stand our climate, and about half the collection has been examined. Many valuable contributions were received for the Museum, the Herbarium, and the Library. Most flourishing accounts of the chinchona plantations continue to arrive from India; in the Neilgherries the plants have been propagated at the rate of 30,000 to 40,000 monthly. In Ceylon there were in September 190,000 plants, the tallest six feet high, and it was expected to issue 20,000 monthly. The cork oaks sent out at the request of the Government of South Australia have arrived in excellent condition, and are thriving; similar cases of live cork oaks have been sent to Victoria, Queensland, and Sydney.

VEGETABLE PARASITES.

MR. JABEZ HOGG, M.R.C.S., has read to the Microscopical Society an interesting paper on the identity of the Parasitic Fungi infesting the Human Skin, in which he satisfactorily shows that—

1st. There exists but one essential organism—a fungus whose spores find a soil common alike to the surface and the more secluded parts of the human or animal body.

2nd. That variations in skin diseases associated with parasitic growth are due to differences in the constitution of the person affected; to the moisture, exudation, soil, and temperature under which the development of the fungus takes place. Consequently it is neither correct nor desirable to separate and classify them as "*parasitic diseases of the skin.*"

3rd. That parasitic growths vary but little in any case, and then only in degree, not in kind, some soils appearing to be better suited than others for their development—that furnished by the eruptive or secreting surface being in every way the most congenial; while diversity of form, in all cases, arises from growth taking place either upon a sickly plant, a saccharine solution, or an animal tissue.

4th. That fungi generally excite chemical decomposition in the soils on which they feed, and it is the exclusive province of a certain class, when spread on the surface of an albuminoid, saccharine or alcoholic, or slightly acid liquid, to develope and grow, and during growth to give rise to either the alcoholic, acetic, or putrefactive fermentation.—*Transactions of the Microscopical Society.*

Geology and Mineralogy.

GEOLOGICAL PROGRESS.

At the late meeting of the British Association, the President of the Section of Geology (Sir R. I. Murchison), in his Inaugural Address, characterised the advances made in Geological Science in the 16 years which have elapsed since the last meeting in Birmingham. "The lowest sedimentary rocks, which, with most geologists, (said Sir Roderick), I considered to be azoic, or void of life, simply because at that time nothing organic had been discovered in them, have, through the labours and discoveries of Sir William Logan and his associates in Canada, been found to contain a Zoophyte, which they termed *Eozoon Canadense.* But the rocks containing this fossil were named Laurentian by Logan long before that fossil was detected in them, and simply because they clearly underlie all the rocks of Cambrian and Silurian age. On the same principle of infraposition, it was my good fortune to be able, in 1855, to point out the existence of these same ancient rocks on a large scale in the north-west Highlands of Scotland; and though I at first termed them Fundamental Gneiss, as soon as I heard of Logan's discovery in North America I adopted his name of Laurentian. In our islands, however, nothing organic has been discovered as yet in these our British fundamental rocks, though they are truly of Laurentian age. For although it was supposed for a moment that the rocks of the Connemara district in the west of Ireland were also of that high antiquity, because it was said that they contained an Eozoon, I assert, from my own examination, as well as from information obtained during a recent visit by Professor Harkness, that the quartzose, gneissose, and calcareo-serpentinous strata of the Bins of Connemara, in which the supposed Eozoon was said to exist, are simply metamorphosed Lower Silurian strata. Professor Harkness will explain this point to you, and will further, I believe, endeavour to convince you that there is no organic structure whatever in the serpentinous rock of Connemara. But, whatever may be the decision of microscopists, I must, as a geologist, declare that, inasmuch as zoophytes of a low order (Foraminifera) unquestionably occur in Laurentian rocks, so it was by no means improbable that the same group of low animals, having, as far as we can detect, no antagonistic contemporaries, and having been, therefore, free from any 'struggle for existence,' might have continued to be the inhabitants of sea-shores and cliffs during the long succeeding epoch. The mere presence of an Eozoon is therefore no proof whatever that the rock in which it occurred is of the 'Fundamental' or 'Laurentian' age, that point being only capable of settlement by a clear infraposition of the rocks to well-known and clearly-defined Lower *Palæozoic* deposits, in the lowest of which, or the Cambrian of the

Geological Survey, another form of low Zoophyte, and a few worm-tracks have, as yet, alone been detected. In a word, this discovery of a Foraminifer in the very lowest known deposit, instead of interfering with, sustains the truth of that doctrine which all my experience as a geologist has confirmed, that the lowest animals alone occur in the earliest zone of life, and this beginning was followed through long periods by creations of higher and higher animals successively.

"Thus, through the whole of the vastly long Lower Silurian period, so rich in all the lower classes of marine animals, whether Mollusks, Crustaceans, or Zoophytes, no one has yet detected a vertebrated creature. Fishes first begin to appear in the latest Silurian deposit, from which time to the present day they have never ceased to prevail; and new forms of vertebrata, adapted to each succeeding period, have followed each other. Every geologist knows how, in the overlying Secondary and Tertiary formations, higher and higher grades of animals successively appear, and how the relics of man or his works have been detected in the youngest only of the Tertiary deposits, though certainly at a period long anterior to all history.

"We now well know that human beings co-existed with quadrupeds which are extinct; and we also know that the physical configuration of the surface has undergone considerable changes since such primeval men lived. This subject, opened out in France by M. Boucher de Perthes, followed by some of his distinguished countrymen, has in our country received much illustration at the hands of Prestwich, Lyell, Falconer, Lubbock, Evans, and others, and is now a well-established doctrine. But the great feature at the other end of the geological series, to which I revert, is the uncontradicted fact, which has been passed over by many writers, or misrepresented by others, that there were enormously long periods, following that of the primeval zoophytic deposits, during which the seas, though abounding in all other orders of animals, were not tenanted by fishes.

"As this is a fact which the researches, during thirty years, of many geologists, amidst the Lower Silurian rocks in all parts of the world, have been unable to invalidate, so it teaches us, in our appeal to the works of Nature, that there was a beginning as well as a progress of creation, and that those writers, however eminent, who have announced that fishes, mollusks, and other invertebrata appeared together, have asserted that which is positively at variance with the results of the researches of this century. I adhere to my long-cherished opinion as to the great intensity of power employed in the production of dislocations of the crust of the earth; and though I cannot subscribe to the doctrine that the ordinary action of deep seas remote from coasts can adequately explain the denudation of the old surface, even by invoking any amount of time, I recognise with pleasure the ability displayed by my able associates, Ramsay, Jukes, and Geikie, in sustaining views which are to a great extent opposed to my own in this great department of theoretical geology. Admiring the Huttonian theory, as derived from reasoning upon my native mountainous country Scotland, and fully admitting that on adequate inclines ice and water must, during long periods, have produced great denudation of the rocks, I maintain that such reasoning is quite inadequate to explain the manifest proofs of convulsive agency which abound all over the crust of the earth, and even are to be seen in many of the mines in the very tract in which we are assembled.

"Thus, to bring such things to the mind's eye of persons who are acquainted with this neighbourhood, I do not apprehend that those who have examined the tract of Coalbrook Dale will contend that the deep gorge in which the Severn there flows has been eaten out by the agency of that river, the more so when the deep fissure is at once accounted for when we see the abrupt severance that has taken place between the rocks which occupy its opposite sides. In that part of Shropshire, the Severn has not worn away the rocks during the historic era, nor has it produced a deeper channel; whilst in its lower parts it has only deposited silt and mud, and increased the extent of land on its banks. Then, if we turn to the district in which we were last assembled, the valley at Bath is known to be the seat of one of those disturbances to which my eminent friend Sir Charles Lyell candidly applied the term 'convulsion;' the hot waters of that city having ever since flowed out of a deep-seated fissure, clearly marked by the strata on the one side of the valley having been upheaved to a height very different from that which they once occupied in connexion with those of the other side. When, indeed, we look to the lazy-flowing, mud-collecting Avon, which at Bath passes along that line of valley, how clearly do we see that it never scooped out its channel; still more, when we follow it to Bristol, and observe it passing through the deep gorge of mountain limestone at Clifton, every one must then be convinced that it never could have produced such an excavation. In fact, we know that, from the earliest periods of history, it has only accumulated mud, and has never worn away any portion of the hard rock. From such data, I conclude that we cannot apply to flat regions, in which water has no abrading power, the same influence which it exerts in mountainous countries; whilst we are also compelled to admit that the convulsive dislocations of former periods produced many of those gorges in which our present streams flow. To pass, indeed, from the environs of Bath and Bristol, and even from the less distant Coalbrook Dale, you have only to contemplate the tract which lies between Birmingham and Dudley, and endeavour to satisfy the mind as to the processes by which it has been planed down before the surface was covered by the Northern Drift; for the great dislocations which this tract has undergone, as proved by many subterraneous workings, must have left a highly irregular surface, which was so levelled by some very active causes as to obliterate the superficial irregularities corresponding with the interior disturbances.

"In short, what was this great power of denudation which took place in a tract where there are no mountains whence powerful streams descended, and in which there are no traces of fluviatile action? Must we not in candour admit that such denudation is as difficult to account for as it is to explain by what possible gradual agency the vast interior of the valley of elevation of the Weald of Sussex and Kent, and that of the smaller valley of Woolhope in Herefordshire, have been so absolutely and entirely denuded of every fragment of the enormous masses of débris which must have encumbered these cavities, as derived from the rocks which once covered them? Placing no stint whatever on the time which geologists must invoke to satisfy their minds as to the countless ages which elapsed during the accumulations of sediment, I reject as an assumption which is at variance with the numberless proofs of intense disturbance, that the mechanical disruptions of former periods, and the overthrow of entire formations, as seen in the Alps and many mountain chains, can be accounted for by any length of existing causes."

HISTORY OF GLACIERS.

Professor De La Rive, in opening the forty-ninth session of the Société Helvétique des Sciences Naturelles, at Geneva, mentioned that fifty years previously, at the time of the foundation of the society, the question of Glaciers in Geology was first started. The occasion was this: M. de Charpentier, a name held in honour among Swiss geologists, returning from a visit to the glaciers of the valley of Bagnes, sought a night's lodging in the chalet of an intelligent chamois-hunter, named Perraudin. In the conversation that followed, the features of the country, and principally the glaciers, were spoken of. "The glaciers of our mountains," said the hunter, who knew them well, "had formerly a much greater extent than in our day. All this valley was occupied by a vast glacier prolonged even to Martigny, as is proved by the blocks of rock found in the neighbourhood of that town, and which are too big to have been carried there by water." This hypothesis appeared so improbable to De Charpentier, that he then paid no attention to it; and from this may be inferred from the reception he gave at first to Venetz's argument, that a glacier had formerly occupied not only all the Valais, but all the space comprised between the Alps and the Jura. If Perraudin's hypothesis had seemed to him extraordinary and unlikely, that of Venetz would appear wild and extravagant. And yet, after long and conscientious study, De Charpentier admitted the new theory, and saw that in no other way could he explain the mass of facts observed in the Swiss valley; facts of which science, up to that date, had been able to give but a very imperfect account. He communicated a memoir to the society, in 1834, embodying the results of his observations. As part of the history of one of the most important questions in geology, these facts appear worth recording.

GLACIAL PHENOMENA.

The following papers have been read to the British Association:—

Mr. W. Williams gave an account of his researches into the ancient Glacier of the north and east of Llangollen, more particularly in the neighbourhood of the Hope Mountain, which he considered to have been overswept by an immense glacier which had risen even above its summit.

Professor Phillips read a paper on "Glacial Striation," in which he showed how, by a study of the relative grinding of the face of the icy weight under different conditions, that if such pressure could be communicated, it would not be effective in excavating the lake; for a satisfactory explanation of the full effect of ice in valleys and lakes it would be necessary always to treat each case on a special problem, by no means purely geological, but including important and quite practical mechanical determinations.

ATMOSPHERIC EROSION *versus* GLACIALISM.

The *Geological Magazine* for April reviews a report of the survey of Southern India (Trichinopoly), and says, "The tendency of the granatoid rocks to *weather* into tors and isolated bosses, which, in a glacier region, might be considered as the work of ice, is worthy of attention, as showing how nature often employs different agents to bring about apparently similar results. These huge masses are *common* in many parts, towering amidst the surrounding jungle, or seated like perched blocks, on bosses of rock rising above the ground." In the tropics then, granite may be quietly "*weathered*" into tors; but not so in our climes! Here, "*similar* results" must be caused by "*different* agents," and we cannot dispense with that most monotonous invention of modern geology, "the Glacial Epoch." The tropics seem "too hot to hold it."—George Greenwood, Colonel; *Athenæum.*

SLICKENSIDES.

Slickensides is the term commonly applied by geologists to those surfaces which they suppose to have been striated and smoothed by friction caused by the movement of one mass of rock upon another. In a paper, by the Rev. Maxwell Close, on the Striated Surfaces in the Granite near Dublin, read to the Dublin Geological Society, that gentleman criticises the theories on the subject, and doubts in many cases, as in the galena slickensides, whether the phenomenon is to be ascribed to movement at all. At all events, he adduces enough evidence to lead to much discrimination in the use of the term. With regard to granites, he concludes with the following remarks:—"The striated coatings are later than the joints which carry them; they were formed after the consolidation of the granite, but also they were formed before certain other joints which cut through them, or before the granite had attained its final structural condition—that is to say, after the cooling of the granite had begun and before it was completed. Perhaps, then, we may have in thermo-electric currents the polarizing force we seek. We know that light is able to influence crystallization, as also the action of a powerful magnet. It seems easier to explain by thermo-electric agency than by the more widely-acting currents of terrestrial magnetism the variations in direction of the striations which we have noticed, and also the fact that near the boundary of the granite (where the cooling of the intruded mass must have been comparatively rapid and irregular) the slickenside phenomena are either absent or confused. The magnetic currents might, however, affect in some degree the thermo-electric ones, and therefore the general tendency of the direction of the crystallization.—*Illustrated London News.*

GEOLOGY OF CANADA.

Professor A. C. Ramsay has delivered, at the Royal Institution, a paper, in which he considered the geological history of the oldest known rocks—the Upper and Lower Laurentian, and the Huronian, in Canada—and the remarkable discovery in them of the earliest known fossil, the Eozoön. For our knowledge of the character of these rocks we are indebted to the laborious investigations of Sir William Logan, the director of the Geological Survey of Canada. They have been divided into two unconformable groups—the Upper and Lower Laurentian; and in both divisions zones of limestone occur. In these limestone bands specimens of organic origin were discovered, consisting of layers of calcareous spar and a magnesian silicate. When slices of these specimens were examined microscopically by Drs. Dawson and Carpenter, they were found to consist of the remains of an organism which had grown in large sessile patches, increasing at the surface by the addition of successive layers of irregular chambers, bounded by walls of variable thickness, containing bundles of fine branching tubuli. Dr. Dawson named the animal Eozoön Canadense, and concluded it to be a foraminifer, allied to Carpenteria by its habits of growth, but of more complex structure. It had attained enormous size, and by the aggregation of individuals, assumed the appearance of a coral reef. The depth of the strata containing them has been computed to be about 23,000 ft., and the superficial extent more than 200,000 square miles in Canada alone. Full details of the subject appear in the *Journal of the Geological Society.* Professor Ramsay considered in detail the physical, chemical, and mechanical questions involved in the subject, concluding with remarks upon the almost inconceivable lapse of time involved in the history of these remains, and the continually increasing evidence of the extreme antiquity of the commencement of life upon the surface of the earth.—*Ibid.*

INLAND SEA-BEACH IN THE ISLAND OF CERIGO.

MR. J. J. LAKE has communicated to the *Athenæum* the following suggestive observations:—

The village of Metata is situated about 12 miles inland from Cerigo, the capital of Cerigo, one of the Ionian Islands. On approaching Metata from the south, the road descends into a deep ravine, and crossing a bridge ascends the face of a nearly perpendicular cliff. This cliff is composed of imperfect sandstone, full of scallop-shells. At the head of this ravine is a deep rent in the limestone rocks, through which a small stream descends. This rent will be referred to again. At the top of the sandstone cliff the village is attained. Passing through it a plain is reached above, composed of the same sandstone as the cliff on the ascent, and also full of scallop-shells. Pushing on for about half-an-hour from Metata, a most singular spot is gained. Imagine the sea to have retired from some bay it had washed for ages,—such was the scene presented. On the right there was a gradual ascent by water-worn terraces, undisturbed since the day the sea retired, except here and there, where attempts had been made to raise a crop of corn in the barren sand. There was a great quantity of sand on the rocks at this part abounding with imperfect fossils, which were soon displaced on advancing further. The old shore went in and out, not pursuing a straight course.

As I proceeded I came upon a fragment of a scallop that must have been 10 in. at least in length when perfect. Gradually working round into what appeared to have been a small bay, the loose sand was found to be swarming with fossil echinidæ, scallop and large oyster-shells; also the following: internal cast of a Cyclas (?), such as *Cyrena corobrina*, in length 4¼ in., breadth 3¼ in., thick 2¼ in.; judging by the impression on this cast, the seats of the adductor muscles were raised,—internal cast of a Venus (?), but considerably enlarged at the lower point of the lunule—length 4¼ in., breadth 3 in., thick 2 in.,—internal cast of a Conus, 2¼ in.,—internal cast of a Cyclostoma (imperfect), 2¼ in. diameter. The shells of these casts had entirely disappeared, and they, as well as the echinidæ and scallop-shells, bore the appearance of having been at one period inclosed in sandstone, which had disappeared and left them deposited on the sandy beach. These fossils were found most abundant in corners and places where apparently they were least exposed to the force of the ancient sea. Near this spot I picked up a handle of a small jar or urn. The natives, who know well the difference between ancient and modern pottery, pronounced it to be ancient. It lay on the sand, and was not merely affected by exposure on the upper surface, but was partially decayed all over; and small pebbles that had been in the clay when the vessel was manufactured were projecting from it. At the furthest part we reached there appeared to have been a hollow or bay, with a reef of grey limestone stretching diagonally into it. This reef was curiously waterworn. At the extremity of the main piece the water had drilled a hole through it, and afterwards worn the portion between the hole and the end into a sort of pedestal. At the upper extremity there was the appearance as of a rocking-stone, which, on near approach, proved to be part of an upper stratum that had been rounded by the action of water above and hollowed out considerably below, but still resting firmly on its base. The reef had at one time extended further, but a considerable part had been broken or worn away nearly to the general level of the existing surface. From this place the shore extended in a circular direction for two or three miles, descending gradually from the higher parts, in a sort of funnel shape, to a point already alluded to, the deep rent in the limestone rocks at the head of the ravine on the opposite side to the village of Metata, and through which rent, without doubt, the waters from the beach above had made their escape. The height of this beach above the present level of the sea is not less than 800 or 1000 yards.

DESERTS AND OASES OF AFRICA.

AN interesting account of the Peculiarities of the Deserts and Oases of Africa, was given by Professor Desor, at the annual meeting of the Helvetic Society, and is printed in the *Bibliothèque Universelle de Genève.* He divides both deserts and oases into classes:—1. Deserts of the plateaux. In these the surface of the soil is covered with a crust of gypsum placed together in fragments. This soil is not favourable to vegetation; but when, in some places, the crust is broken into fissures, plants thrust themselves through—especially a species of stipa, named "drin," a favourite nutriment of camels. In winter, also during the rainy season, some small green plants furnish very precious food to the flocks of the Arab nomades. In these deserts, besides gypsum, are found quartz, flints, and pieces of rolled chalcedony, of which the origin is unknown. 2. The "deserts of erosion." When we descend from the plateaux just mentioned, no more gypsum is seen, but also no more vegetation, no more "drin;" the soil is too much impregnated with salt. The lakes are also entirely salt. These great depressions are due to the eroding action of torrents, the water of which has been concentrated into the lakes. 3. The "deserts of moving sand" are entirely arid, having only here and there a tuft of "drin." They are composed of hills or "downs" of sand nearly uniform, the contour of which is not exempt from a certain kind of beauty. Nothing in the nature of these sands is contrary to vegetation; water alone is wanting to give them a verdant appearance. In the same way M. Desor describes three kinds of oases. 1. The "oases of the plateaux" are formed by springs of water inclosed in reservoirs produced by the fissile nature of the calcareous rocks which surmount them. Channels are formed round these springs, and date-palms and leguminous plants are cultivated. 2. The oases of the deserts of erosion are formed by artesian wells, imperfectly formed by the Arabs. 3. The oases of the moving sands, where artesian wells cannot be made, are formed by actually removing the sands, until the covering of a spring is obtained, at a depth sometimes between 25 ft. and 30 ft. Gardens are thus formed by the industrious Arabs after constant and painful labour.—*Illustrated London News.*

GEOLOGY OF THE RHENISH PROVINCES.

M. Vanderdecken and Professor Römer have described to the British Association the Geology of the Rhenish Provinces, elaborately illustrated by a large geological map, to which Mr. Jukes attaches great value, because it illustrates so well the Devonian rocks of the Rhine district. He fully believes that in the British Islands the true key to these deposits would be found in the district in south Ireland, whereof the geographical survey is now being made out. Mr. Warrington Smyth observed the map showed that in Rhenish Prussia the coal measures have been reached by penetrating the newer rocks. This is important to the mining interests of Britain, as the corresponding deposits cover up large tracts of carboniferous rocks in our own country; and thus another inducement is offered to search for coal beneath these overlying red rocks.

LAURENTIAN ROCKS OF BRITAIN.

SIR RODERICK I. MURCHISON has contributed to the *Geological Magazine* a paper on the Laurentian Rocks of Britain, Bavaria, and Bohemia, in which he reminds geologists that these same rocks were by him originally termed "fundamental gneiss," and were described as completely severed from all palæozoic rocks. Now, however, he states that the term "azoic" (without life) must be excluded, since the discovery of the Eozoön Canadense, "one of the lowest forms of animals in the lowest known sedimentary rock." He rejoices in this, and also in the intelligence that Mr. W. E. Sanford has found the Eozoön in the green serpentinous limestone of the crystalline rocks of the Bins of Connemara, N.W. Ireland.

DRIFTS AND ANCIENT RIVER-BEDS OF SILURIA.

THE Rev. W. S. Symonds has read to the British Association a paper detailing the observations he had made during the last two years respecting the Drifts and Ancient River-beds of Siluria. He referred to a number of facts in reference to the transportation of rocks from one place to another, which, he said, could only be explained by a theory that the transportation of such rocks was owing to the action of land-ice and snow, rather than to sea-wandering icebergs, during the period when England was submerged. To land-ice agency he attributed the transportation of the rock fragments studding the slopes of the hills in the South-Welsh coal-fields, and the other districts in Siluria. He found resting in carboniferous sandstone or mountain lime-stone, for instance, angular masses of millstone grit, and other rocks, which were evidently derived from local centres and had a local distribution. He illustrated his theory by reference to the Malvern hills, St. David's, &c. Sir Roderick Murchison said Mr. Symonds had established the great facts upon which he insisted, that there was most distinct evidence of great terrestrial glacial action, purely terrestrial; and that there were evidences of fluviatile action over a period even anterior to the glacial drift.

LOWER SILURIAN AND UPPER CAMBRIAN STRATA.

MR. J. W. SALTER has made to the British Association some remarkable statements with respect to the faults and dislocations of the Lower Silurian and Upper Cambrian Strata, occurring in the neighbourhood of Dolgelly. It appears that the richest gold-bearing strata of these ancient rocks—as Sir Roderick Murchison and others have shown—are at, or were the junction of, the

Lower Silurian and the Cambrian rocks of Sedgwick. The geological surveyors, probably not having time to explain the paradoxes found by them, left them untouched and unnoticed in the geological maps. Mr. Readwin pointed this out to Mr. Salter, and employed him to survey the place: hence the above valuable facts.

PALŒOZOIC FLORAS.

PRINCIPAL DAWSON, in a paper on the Successive Palœozoic Floras in Eastern North America, states that in America the first evidence of terrestrial vegetation is found at exactly the same horizon in the great strata forming the crust of the earth as in Europe. Beneath that the vegetation is marine. The learned author also established in his paper that the great coal formation was very widely spread over America as well as over Europe. Sir R. Murchison, speaking with reference to the paper, observed that the great oil springs proceeded from rocks of the Devonian age—particularly in Canada; and this was very remarkable, inasmuch as in that age vegetation was by no means so abundant as in the carboniferous period. It was added that the greatest flow of Petroleum ever heard of in all history came from rocks which showed a very small proportion either of vegetable or animal matter. He quite agreed with the generalization as to the universal spread, all over Europe and America, of the great coal formation. If he (the president) was not misinformed, coal had recently been found in Brazil. He was not aware that hitherto the existence of the old true coal had been determined with such accuracy anywhere south of the equator. The universal diffusion of coal showed that the same conditions must have prevailed over the whole of our planet during the formation of the coal-fields.—*Proceedings of the British Association.*

GEOLOGY OF SCOTLAND.

FROM the dissolution of the glaciers till the present day Scotland has risen by fits and starts, and the last rise is marked by a raised beach, which can be followed round the British Isles. It is the shelf on which most of the large towns in the country are built. In this, the lowest of the raised beaches, are found the remains of human art—canoes, weapons, and bones, and here geology gives place to ethnology and to history, and to the arguments of scientific men. The facts stated by Mr. Archibald Geikie in his able work on *The Scenery of Scotland Viewed in Connection with its Physical Geology*, are beyond all dispute. The sea was over the land, for sea-shells are buried in the upper boulder clay and have been dug up in dozens of places up to great heights. Blocks of foreign rock are poised on hills far above the beds of shells, on the shoulder of Wyvis, on the back-bone of Scotland, up to 3000 feet above the sea-level at least. The land was smothered in ice, for the moraines of glaciers and the ruts of the "iceberg caves of winter," as Hugh Miller called them, are everywhere conspicuous. Glens have certainly been carved out of continuous tracks of layers of sandstone, carved and sawn down to the fundamental gneiss on which the layers of sandstone were first laid down, and long after the gneiss had been crumpled, up-heaved, altered, and denuded. But the facts being admitted, the learned disagree on the meaning of the record. Mr. Geikie's history is entirely at variance with that which would follow from the Polar glacier, which, according to Professor Agassiz, covered the whole northern hemisphere, Mr. Geikie agrees with Professor Ramsay, who thinks that glaciers dug out numerous rock basins, in which lakes are now held. Their commanding officer, Sir Roderick Murchison, does not believe that lake basins were so produced. Others again believe that currents like those which now flow down the coast of Greenland and Labrador may have altered climates, so as to promote the growth of glaciers on land and bergs and flows at sea, and thus currents may have accelerated the rate of denudation for a time. Others hold that every rock basin is a mark of subsidence, and every glen a fissure. In short, modern geologists have got upon new ground, and find much to be learnt and unlearnt. In search of causes for changes of climate which certainly have taken place in certain places, astronomers are pressed, and set to calculate the amount of solar heat that the earth would gain or lose if its orbit became more or less elliptical. To this possible cause of the glacial periods Mr. Geikie refers; but in the meantime another school of philosophers have calculated the rate of secular cooling of the sun itself, and to them and to their calculations geologists and astronomers must attend when they place a value on geological time.—*Review of Mr. Geikie's Work, in the Times.*

LAST GEOLOGICAL CHANGES IN SCOTLAND.

MR. T. F. JAMIESON has read to the Geological Society a paper, in which the history of these Changes was divided into three periods—the pre-glacial, the glacial, and the post-glacial. Our knowledge of the first period is obscure, through the absence of the later tertiary strata; but Mr. Jamieson considers it to be represented by thick masses of sand and gravel, and that there were indications of the mammoth having inhabited Scotland during the period. The glacial period he divided into three successive portions—the period of land ice, during which the rocky surface was worn and scratched and the boulder earth or glacier mud formed; the period of depression, when the glacier marine beds were formed; and the period of emergence of the land, to which belong the valley-gravels and moraines, and during which the final retreat of the glaciers took place. During the post-glacial period Mr. Jamieson believes that the formation of the submarine forest beds took place, and that this was followed by a second period of depression, to which succeeded the elevation of the land to its present position. In this second period of depression Mr. Jamieson discovers the first traces of man in Scotland. He refers the shell-mounds with chipped flints to the same epoch as the blown sand and beds of peat—the most recent period, during which the land was raised to its present level.—*Illustrated London News.*

PARALLEL ROADS OF GLENROY.

THERE has been read to the Geological Society a paper by the Rev. R. Boog Watson, on the Origin of the Remarkable "Parallel Roads" of Glenroy, in Scotland, in which he investigates the "ice-dam" and the "marine" theories. He acknowledges that the former has strong points, but refers to phenomena for which it would not account, remarking that, although the "marine" theory could not be considered absolutely perfect, yet there is evidence that the sea has been on the spot, and is able to perform the work required of it.

COALBROOKDALE.

THE Rev. W. Purton has read to the British Association a paper "On the Geology of Coalbrookdale." The point most worthy of notice in this coal-field is the estuarine, or fluviatile character of many of its strata, as evidenced by their organic remains, while others seem clearly of marine origin; from this it has been inferred that the coal measures of this field were deposited in an estuary in which flowed a large river, subject to periodical floods. From an examination of the drift deposits Mr. Maur has proved, what had before been conjectured only, that the Severn valley was, in a portion of the great glacial epoch, a marine strait.

CHARNWOOD FOREST.

A NOTE has been communicated to the *Geological Magazine* for November, by Mr. D. Mackintosh, on Charnwood Forest, where, in the midst of a comparatively tame and cultivated plain of new red sandstone, near the centre of England, rises up a part of the under crust of the earth so as to present the appearance of an island, leading the imagination back to those remote ages when its porphyritic peaks and syenitic knolls were surrounded by the sea.

DATE OF THE ENGLISH CHANNEL.

A PAPER has been read to the Geological Society by Mr. Prestwich, "On the Raised Beach of Sangatte, with reference to the date of the English Channel, and the presence of loess (brick-earth) in the cliff section," in which he adverted to his discovering fragments of chert in the shingle and associated sands (which he inferred were derived from the lower cretaceous strata), fragments from the oolitic series of the Boulonnais, and two pebbles of red granite, probably from the Cotentin. These facts seem to him to add probability to the existence of a channel open to the westward, and extending between England and France, anterior to the low-level, and possibly to the high-level, valley-gravel period. Above the raised beach he found a mass of chalk-rubble and flint-rubble with beds of loam, from 20 ft. to 80 ft. thick, containing land shells.

VALLEY OF THE MEDWAY.

MESSRS. C. Le Neve Foster and Wm. Topley have read to the Geological Society a paper "On the Superficial Deposits of the Valley of the Medway, and the Denudation of the Weald." A detailed account was given of the "pipes" at Maidstone, where loess (brick-earth), containing land and fresh-water shells and mammalian remains, has been let down into deep cavities in the Kentish rag, probably by the gradual dissolving away of the limestone by the action of rain-water containing carbonic acid. The authors endeavoured to prove that the gravel and brick earth occurring at a great height above the level of the Mersey are old alluvia of the river; and they think that, if so large a denudation has been effected by atmospheric influences, there will be little difficulty in supposing the present inequalities of surface in the Weald to have been produced by these agents upon a comparatively plane surface of marine denudation. They also consider that the escarpments of the chalk and lower greensand which surround the Weald are not sea-cliffs but are due to the difference of waste of the hard and soft formations under atmospheric denudation.—*Illustrated London News.*

THE DRYING UP OF THE THAMES.

IN the last Session of Parliament a Bill promoted by a Cheltenham Waterworks Company was resisted and eventually rejected, on the ground that if it was carried, the water of the Thames in its upper portion would be exhausted to such an extent as seriously to interfere with the supply of the metropolis. That the danger was not altogether imaginary, is shown by some evidence given before the Select Committee on the Thames Navigation, more particularly by that of the Rev. J. C. Clutterbuck, of Long Wittenham, near Abingdon. This gentleman, who told the Committee that from his "love of the question of water," he had been led to examine it very closely, said he could state from his own knowledge and what he had seen that there is a danger of the water in the Upper Thames falling off

"The peculiar geological condition of that country," said the rev. gentleman, "is this—you find the oolites there, and there is an interspersing of the beds of stone and rock and gravel with clays. Wherever there is a junction there is a spring, and wherever there is this weeping the springs there are necessarily land drainage; the land drainage leads away this water at once, so that these parts of the strata are left entirely dry, and instead of weeping out gradually, as they used to do before the land drainage was in vogue, and so supplying the water to the Thames throughout the summer, it all comes away at once. I have myself seen at Cirencester the river running bank high, perfectly clear—as clear as crystal—merely from the drainage water which comes off in such an immense quantity; whereas in the same place where the water was four or five feet deep, running in an immense volume, as at the Thames head and elsewhere, you will find at the end of the summer the river perfectly dry. I should say that it is a very important question, not only with reference to the Thames navigation, but also with reference to the water supply of London. I believe that the time will come, and that we may live to see it, when London will be distressed for want of a supply of water from the Thames. I believe that it is an important question to the London water companies, and I think that the time will come when it will be absolutely necessary to construct reservoirs in the upper part of the Thames, just in the same way as reservoirs are constructed to supply the Oxford canal. The Oxford Canal is so well supplied with water from these reservoirs, that occasionally they are able to sell water to the Grand Junction Canal. The upper part of the Thames is extremely well fitted for these reservoirs, and I believe that the time will come, and that not long hence, when these reservoirs will be absolutely necessary, whether for the mills, the navigation, or the supply of water."

Proceeding to speak more particularly of the Cheltenham scheme, Mr. Clutterbuck said:—"I will give you an idea of what a pump can do. In the Upper Thames there is a place called the Thameshead, from whence the water used to flow, I have no doubt, in abundance. From the peculiar physical position of the valley, the water used to flow out in a peculiar way. Subterranean water generally lies on an incline, and whenever there is a dip in this line—that is to say, when the country dips below the angle at which the water rises in the soil—there will be a spring, and that is no doubt the origin of what is called the Thames-head, which lies close by the Tedbury-road Station. There is a pump, and that pump is working in a cylinder of nine feet stroke, and 33 inches diameter, which, without exaggeration, raises at every stroke 250 gallons of water, and there are eight strokes a minute, that is, about 3,000,000 gallons a day. Now, there was a scheme for supplying Cheltenham, and they were to take about 1,500,000 gallons, that would be just half as much as this engine pumps up. I went down the bed of that stream and I found that there was not a drop of water till you got down to a place called Ewen, and then you begin to find the springs. Then I went to the first mill on the stream, and found the disconsolate miller scratching his head, and not quite clear whether within two or three days he could *grind one sack* of corn for a man who had brought it. In the next mill there was an agricultural engine to help them to grind, as there was not sufficient water to grind with. The miller told me that they would be up to their ankles in water one day, and the steam pump should be put on, and in two days they would be able to walk across to the opposite meadow without getting wet. Now, if the Cheltenham Waterworks had taken those springs at South Cerney, they would have done just the same thing by the Churn as that engine does for the original Thames, for that was the original Thames in the time of the Saxons, and no doubt there was a beautiful stream of water gushing out in one head, which made it notorious. If Parliament had allowed that scheme of Cheltenham to be carried out, then they would have played the same trick with the Churn as they had done with the Thames, and then somebody else would come and they would take another stream."—*Pall Mall Gazette.*

THAMES WATER.

In the Evidence published, which was taken before the Commons' Select Committee of last Session, on the Thames river, it was mentioned that Cricklade, Lechlade, Oxford, Abingdon, Wallingford, Goring, Streatley, Pangbourne, Reading, Wargrave, Henley, Marlow, the Wycombe stream, the Ray mills (near Maidenhead), the Taplow gasworks, and Windsor, with most of the mansions and houses on the banks of the Thames, discharge their sewage and refuse into that river above the water-works at Hampton Wick and Thames Ditton, which supply the metropolis. The pound locks, however, at various points of the river—30 between Oxford and Staines—turning the river into a series of ponds, stop the sewage to a certain extent. In all of them a deposit is found, which has to be taken out, and is thrown upon the land; otherwise the pounds would in many instances be completely blocked, and the locks would not work. Windsor Castle is supplied from Romney pound. But if people follow the example of fish in regard to purity of water, manufactories should be most feared. The refuse from these is poison to the fish, says Mr. Frank Buckland; but pure sewage, clean dirt, as he calls it, he considers not likely to stop salmon from coming up the river.

COAL FORMATION OF NOVA SCOTIA AND NEW BRUNSWICK.

Dr. J. W. Dawson has read to the Geological Society a paper on the conditions of Coal Deposit, more especially as illustrated by the coal formation of Nova Scotia and New Brunswick. Dr. Dawson contended, as on previous occasions, that the occurrence of stigmaria under nearly every bed of coal proves beyond question that the material of the coal was accumulating by growth, *in situ*, while the character of the intervening strata proves the abundant *transport* of mud and sand by water; in other words, the conditions implied are such as prevail in the swampy deltas of great rivers. He also stated, that the coal consists mainly of the flattened bark of sigillaroid and other trees, mixed with ferns and other herbaceous remains; and that cannel coal and earthy bitumen are of the nature of the fine vegetable mud which accumulates in the ponds and shallow lakes of modern swamps.

FORMATION OF COAL.

A PAPER has been read to the British Association, by Mr. W. M. Williams, "On Some Vegetable Deposits in the Archensée—North Tyrol," which assumed a local importance, owing to its bearing upon the formation of coal. The author maintained that the vegetable deposit in question represented the manner in which many of the older deposits of coal were formed. Sir Charles Lyell objected to the formation of coal being accounted for on the drift supposition, and alluded to the deposits now taking place in the valley of the Mississippi, urging that, as a rule, the material forming our present coal seams must have grown and become consolidated nearly in the places where they are at present found. Professor Dawkins regarded the instance under notice as an exceptional case. In North America there is abundant evidence that the trunks of Sigillaria, &c., have grown in the position which they now occupy. The vegetable remains which formerly grew on the soil must have been submerged and afterwards covered with mud. The purity of cannel coal may be accounted for from the fact that it was probably formed in subaerial districts. Mr. Brinney did not agree in the theory of the subaerial origin of coal. Bright coal generally contains the remains of fishes. In Lancashire there are large trees which have their rootlets well preserved. He did not believe that any coal originated in fresh water. The shells of so-called fresh-water organic remains are all marine. Mr. Williams, in reply, stated that cannel coal yields, on distillation, products similar to those obtained from peat.

SOUTH STAFFORDSHIRE COAL-FIELD.

THERE has been read to the British Association a paper on "The Extent and Duration of the South Staffordshire Coal Field," by Mr. H. Johnson. Both the extension and duration of this coal-field are questions open to a very great difference of opinion; and it is to the confines of the present coal-field that any hopes for fresh supplies can be looked for. On all sides of the coal-field explorations are being successfully carried on, with perhaps the exception of the eastern boundary on the Birmingham side; but the great depth at which the thick coal has been last worked in the neighbourhood of West Bromwich (about 400 yards) has probably retarded explorations. The result of operations going on in other portions of the field is looked forward to with great interest, as affording a warrant for an attempt to reach the coal through the Permians at Smethwick and Harborne. During the last ten years, a great number of new winnings have been made in the Cannock Chase district, at Aldridge, Himley, and other places; but the most important recent trial sinkings are those on the south end of the coal-field, in the neighbourhood of Hales Owen, Congreaves, Cradley Park, and Wassel Grove. In the event of those at Hales Owen and Wassel Grove discovering the thick coal—both looking promising, and now sunk about half way—more than 4000 acres of the thick seam may be considered proved, and this assurance will no doubt give a fresh impetus to additional search further south. A scheme for proving the continuity of the coal-field underneath the Permian on the down-throw side of the Great Western boundary-fault at Essington is now in course of formation.

It is proposed to form a fund, by subscription, from all the adjoining landowners likely to be benefited. It is proposed to drive from the existing workings on the upthrow side, at a depth of about 200 yards, across the fault into the Permian district, and then to bore up or down to discover the position of the coal measures underneath. There is, however, a more comprehensive scheme for exploring the whole Permian districts lying between the South Staffordshire coal-field and the Warwickshire and Shropshire coal-fields. To attempt to estimate the probable duration of the coal-field whilst these important additions are being added, would be impossible; but it may be observed, that such additions are not keeping pace with the enormous consumption and consequent rapid destruction of the parent portion of the coal-field. In a valuable paper, by Mr. Matthews, in 1860, he estimated the then duration of all parts of the coal-field at an average of about forty years. There can be no doubt but that in one-half that number of years a very large portion of the earlier-developed part of the coal-field will be totally and for ever exhausted.

Sir Roderick Murchison characterised this paper as an accurate and well-condensed view of what coal might be expected to be found surrounding the redstone which immediately surrounds the existing coal-field of South Staffordshire.

CANNEL COAL IN NEW SOUTH WALES.

THE *Journal of Gas Lighting* says:—"Advices have been received, by the last overland mail, of the discovery, about 80 miles from Sydney, near a line of railway now in course of construction, of a workable seam of cannel coal, which surpasses the hitherto unrivalled Boghead in richness. Its yield per ton is reported to be 17,500 cubic feet of gas of thirty-one-candle illuminating power, and ·745 specific gravity. The discovery must exercise great influence on gas-lighting in Australia, the East Indies, China, California, and South America, by enabling the gas-works of those countries to use their inferior local coals, and bring up the quality of their gas to a satisfactory illuminating power by the addition of *a small* quantity of Australian cannel."

EXTRACTION OF GOLD.

A NEW process for Extracting Gold from Auriferous Ores, and particularly applicable to pyrites and other ores containing gold in small quantities, is described by Messrs. Jackson and Ott in the *Journal of the Franklin Institute*, published at Philadelphia. Their process mainly consists in improvements in Plattner's method of extracting gold by means of chlorine, introduced at Reichenstein, Silesia, where immense quantities of auriferous residues have accumulated for centuries. Messrs. Jackson and Ott submit the ore to the action of hypochlorous acid (a gas containing equal parts of oxygen and chlorine) instead of chlorine, and thereby, as they assert, obviate the formation of injurious agents by means of the oxydizing action of the oxygen, and obtain the advantage of the chlorine acting in the nascent state.

GOLD IN NOVA SCOTIA.

MR. HAMILTON, the Commissioner of Mines for Nova Scotia, gives an account in the *Times* of the gold regions of that colony. He says:—"What is geologically known as the Lower Silurian Formation, in which are found most of the gold deposits of Nova Scotia now being worked, comprises a band of from ten to forty miles in width, extending along the whole Atlantic coast of the mainland of the province, a distance of 300 miles in length. Throughout the whole of this tract, from Yarmouth to Cape Canso, with the exception of certain isolated spots where granitic rocks prevail, gold is found. The proportion which, throughout this area, the veins and beds of quartz bear to the rocks which inclose them, is something enormous. Wherever these quartz veins have been tested to any extent they have been found auriferous, although varying much in richness. If, as I firmly believe, all of these quartz deposits will prove remunerative if operated upon judiciously, there is mining work for ages in this coast band alone. But further inland there are certain ridges of hills of a more recent geological formation, believed to be Devonian or upper silurian. These ridges may be described as extending through the whole length of the province, from St. Mary's Bay to Cape North. Gold is found at numerous points along and in the vicinity of these hills, and is probably obtainable throughout their whole extent; although, owing to their comparative inaccessibility and to their being for the most part densely wooded, explorations in that part of the country have as yet been very limited." He contends that the working of the mines pays well, and might be made to pay a great deal better. He could point out lodes, the quartz from which has yielded at the rate of 100 oz. of gold to the ton; others that have yielded 20 oz., 10 oz., 5 oz. to the ton. He could name not a few mines that are producing at the rate of 1000 per cent. per annum upon the capital invested in them. But these are the prizes, and he prefers to state the general results. He appeals to the official statistics of the colony, and observes:—"I may be wrong, but I think if like averages are made, based upon equally complete returns of gold-mining results in any other country where such operations are carried on, it will be found that those results are less satisfactory than they are in Nova Scotia."

GOLD-MINING IN WALES.

ABOUT two years ago a number of Companies were started with the view of working the auriferous quartz deposits discovered in several localities in North Wales. The temporary success of the Vigra and Clogau mine was the great inducement to enter into speculations. Among the Companies formed were the Cambrian, East Cambrian, Welsh Gold Mining, Castell Carn, Dochan, Dolfrwynog, East Clogau, St. David. Quartz containing a certain percentage of gold has been discovered at all the mines, but the cost of reduction has been far above the yield of pure metal; hence the unprofitable character of the speculations, and until the mechanical appliances for extracting the gold from the quartz are more perfect and less costly than at present, gold-mining cannot be successfully carried on in Wales.

Mr. Readwin has recorded some particulars of the gold mine at Trawsfynydd, about eight miles north of Dolgelly, upon a farm known as Gwynfynydd. Geologically, the mine is situated at the junction of the Upper Cambrian and the Lower Cambrian grits, penetrated occasionally by bands of greenstone. Mr. Readwin believes that gold-mining in Wales is destined to rise in commercial estimation. Half a ton of gold—worth, say 50,000*l.*—has been extracted already from about 7259 tons of quartz. The cost of procuring it could not have been 25,000*l.* Mr. Readwin has exhibited a bar of gold weighing 104 ounces, which had been extracted during the week at Castell Carn Dochan mine, from 158 tons of quartz.

During 1864 gold was obtained from five mines in Merionethshire; 2336 tons of auriferous quartz were crushed and treated by the amalgamating processes. From this the adventurers obtained 2887oz. of gold, the value of which was 9991*l.* By an improvement in the process of amalgamation, the discovery of Mr. William Crookes, F.R.S., it is expected that the production of British gold will be considerably increased during the current year.

A MOUNTAIN OF SILVER.

SILVER Peak is believed to be as pre-eminent over all silver mountains as the iron mountain of Missouri is superior to all other iron deposits. Silver Peak is situated east of San Francisco, on the eastern side of the Sierra Nevada, and nearly one degree south of the city of Austin. It is some two miles from Castle Mount, an old extinct crater about 5000 feet above ocean level. Near Silver Peak is an extensive deposit of salt, and not far distant a hill of pure sulphur. The whole country has a naked appearance, being quite destitute of vegetation, and bristles with mountains scattered over a plain of great extent. The dreaded "Valley of Death," upon the plains of which, along the "old Spanish trail," travellers have suffered so much, lies but a short distance to the south-east of the crater of Silver Peak. Little Salt Lake, in Southern Utah, lies directly east of Silver Peak. At first the searchers after deposits of the precious metals confined their searches to the Pacific side of the Sierra Nevada, but discoveries in New Mexico, Arizona, and Virginia city induced a thorough examination of the east side of the Sierra Nevada. This resulted in great success, the most brilliant of which is found in the neighbourhood of Austin, on the line of the great overland mail, where a city has sprung up within three years, which Senator Nye says contains a population of 10,000. From along this line of exploration the miners are rapidly extending their operations, both north and south. Recently (within six months) they came upon this immense deposit near Castle Mount. Twelve exceedingly rich lodes, or "ledges," as the miners call them, were discovered on that single mountain. This discovery in an unexpected region is believed to be the most valuable yet developed. The specimens—a great number of which have been brought to New York by Colonel Catherwood—are certainly very remarkable, and merit the attention of the whole financial community. If there is no mistake—and with the specimens actually before us we do not see how there can be—a new deposit, superior even to the Comstock lode, which has furnished so many millions of silver, is about to pour into our market its limitless supply of this precious metal.—*New York Journal of Commerce.*

HEMATITE DEPOSITS IN PEMBROKESHIRE.

DEPOSITS of Hematite Iron Ore have been discovered in a bed of mountain limestone at Penally and Jameston, Pembrokeshire. The mountain limestone is found in a ridge of the old red sandstone, which is accounted for by the disturbed geological character of the county. The ore resembles the hematite deposits of West Cumberland, in which district it is found in pockets that appear to be isolated from each other, but in some instances they are connected by fine mineral veins, so that the experienced miner, having exhausted one pocket, can follow one of these threads till he reaches another. The ore has been discovered near the Pembroke and Tenby Railway, and there will be shortly direct communication with the iron-making districts of South Wales. Samples of the ore have been analyzed by the Dowlais Company, and they yielded 50 per cent. of iron, which is about 10 per cent. below the yield of the Cumberland ores.

GEOLOGIC ORIGIN OF THE SOUTH STAFFORDSHIRE IRON ORES.

DR. T. L. PHIPSON has published the results of an analysis he has recently made of a fossil which occurs among the Iron Ores of the South Staffordshire coal measures, and, after showing that this fossil has the same composition as the ores which constitute its matrix, he remarks: "We could not have greater proof that these vast deposits of iron ore, to which England owes so much of her commercial and industrial prosperity, must be looked upon by the geologist as fresh-water formations; deposited, doubtless, in the first instance, as hydrated peroxide of iron, like the bog-ore now forming in the Swedish lakes, which swarms with minute organisms, and afterwards reduced to the state of carbonate of protoxide by the constant presence of organic matter in a state of decomposition." A much "greater proof" of the soundness of the theory that the South Staffordshire iron ores were deposited from fresh-water is afforded by the fact, which Dr. Phipson seems to state only incidentally, and not at all as the basis of his argument, that the fossil in question is a mollusca of the genus *Unio*, "all the mollusca of which genus are fresh-water mollusca." He represents the fossil as containing, per cent., 74·55 carbonate of iron, 6·20 carbonate of lime, 3·20 carbonate of magnesia, 1·0 carbonate of manganese, 0·20 phosphoric acid, 13·50 silicate of alumina, and 1·20 water.—*Scientific Review.*

COPPER MINES IN NEW SOUTH WALES.

COPPER mining is very extensive in the Western districts, and rich veins of Copper have been traced from the Canoblas mountain range, that divides the Lachlan watershed from that of the Macquarie, to Carcoor on the south, and to Ophir on the north, or over an extent of country 50 miles in length. The principal copper mine as yet at work is that of Cadiangalong, on the southern watershed of the Canoblas, and about 16 miles from Orange. It employs when in full work 250 hands. The smelting works at Cadiangalong are very complete, and work up about 200 tons of ore per month, returning on an average about 30 tons of pure copper. The Carangara copper-mine is about 18 miles distant from Cadiangalong in a northerly direction. The mines have been opened for some years, and smelting works were erected on them. But the mistake was made of putting up blast furnaces, and the Company found they could not get a sufficient per centage of copper to pay. The ores are gossan ores to the ten-fathom level, when the sulphurets commence. In the Southern district a copper-mine has been opened at Curawong, 22 miles south from Goulburn, and about 7 north of Collector. It is as yet only in its infancy, but a valuable vein of black ore has been struck at a depth of 7 fathoms. There are also numerous veins of gossan ores traceable on the surface.—*Mechanics' Magazine.*

PETROLEUM.

In a paper read at the Franklin Institute, Philadelphia, by Mr. Albert Leeds, on the Geography and Geology of Petroleum, he combats the opinion that the flow from the oil-wells will eventually cease; and gives a statement of his reasons, based upon facts, for the statement that henceforth petroleum deserves to be ranked with coal and iron as a solid mining interest. He refers to the evidence we possess respecting the character of bituminous deposits all over the globe.

Mr. B. H. Paul suggests, in a letter to the *Times*, that "beneath the tarry pools of Zante, from which Herodotus described the dipping out of the mineral oil with myrtle boughs, there is a rich source of petroleum to be developed the same as in America, where, upon the site of the oil-wells from which such enormous wealth has been derived, the Indians formerly collected petroleum for medical purposes, as it gathered in scanty films upon stagnant water, by spreading their blankets upon the surface, little dreaming of the rich resources to be reached by boring." Large petroleum wells exist in Austria, and it is expected that the American improvements in the process of extraction will cause a great increase of the present quantity. Till now the most abundant wells have given about 15,000 cwt. yearly; the majority of them are in Galicia, and run parallel with the Carpathians.

PETROLEUM IN YORKSHIRE.

It has been found that the shales of unctuous clay overlying the iron-stone deposits of the Yorkshire moors, in the North Riding, can be made to produce a mineral oil, similar to Petroleum, at a cost of 6d. per gallon. From the fact that these shales crop out to the surface in almost all the valleys, the discovery is expected to impart a wonderful degree of activity to those hills, unpeopled since the days when Roman legions held them in military occupation. It is evident that during the Roman occupation both the iron and coal deposits were wrought, the refuse from the workings being met with occasionally below the heather.

PETROLEUM IN FLINTSHIRE.

The discovery of Petroleum in Flintshire has led to an examination of and report upon the district where oil has been struck. The Report appears in *Ryland's Iron Trade Circular*. The writer made his way to Padeswood, a small station about two miles from Mold, in Flintshire, and landed at once in the very heart of the Mineral Oil Region. He states that it appeared as if he had fallen asleep in the train at Chester, and woke up among the "Oil Wells" at Enniskillen, Canada West, or Pennsylvania. "There was the identical mud, about the same quantity of smell slightly diminished in strength, the same run of land—the same rough

GEOLOGIC ORIGIN OF THE SOUTH STAFFORDSHIRE IRON ORES.

Dr. T. L. Phipson has published the results of an analysis he has recently made of a fossil which occurs among the Iron Ores of the South Staffordshire coal measures, and, after showing that this fossil has the same composition as the ores which constitute its matrix, he remarks: "We could not have greater proof that these vast deposits of iron ore, to which England owes so much of her commercial and industrial prosperity, must be looked upon by the geologist as fresh-water formations; deposited, doubtless, in the first instance, as hydrated peroxide of iron, like the bog-ore now forming in the Swedish lakes, which swarms with minute organisms, and afterwards reduced to the state of carbonate of protoxide by the constant presence of organic matter in a state of decomposition." A much "greater proof" of the soundness of the theory that the South Staffordshire iron ores were deposited from fresh-water is afforded by the fact, which Dr. Phipson seems to state only incidentally, and not at all as the basis of his argument, that the fossil in question is a mollusca of the genus *Unio*, "all the mollusca of which genus are fresh-water mollusca." He represents the fossil as containing, per cent., 74·55 carbonate of iron, 6·20 carbonate of lime, 3·20 carbonate of magnesia, 1·0 carbonate of manganese, 0·20 phosphoric acid, 13·60 silicate of alumina, and 1·20 water.—*Scientific Review.*

COPPER MINES IN NEW SOUTH WALES.

Copper mining is very extensive in the Western districts, and rich veins of Copper have been traced from the Canoblas mountain range, that divides the Lachlan watershed from that of the Macquarie, to Carcoor on the south, and to Ophir on the north, or over an extent of country 50 miles in length. The principal copper mine as yet at work is that of Cadiangalong, on the southern watershed of the Canoblas, and about 16 miles from Orange. It employs when in full work 250 hands. The smelting works at Cadiangalong are very complete, and work up about 200 tons of ore per month, returning on an average about 30 tons of pure copper. The Carangara copper-mine is about 18 miles distant from Cadiangalong in a northerly direction. The mines have been opened for some years, and smelting works were erected on them. But the mistake was made of putting up blast furnaces, and the Company found they could not get a sufficient per centage of copper to pay. The ores are gossan ores to the ten-fathom level, when the sulphurets commence. In the Southern district a copper-mine has been opened at Curawong, 22 miles south from Goulburn, and about 7 north of Collector. It is as yet only in its infancy, but a valuable vein of black ore has been struck at a depth of 7 fathoms. There are also numerous veins of gossan ores traceable on the surface.—*Mechanics' Magazine.*

PETROLEUM.

In a paper read at the Franklin Institute, Philadelphia, by Mr. Albert Leeds, on the Geography and Geology of Petroleum, he combats the opinion that the flow from the oil-wells will eventually cease; and gives a statement of his reasons, based upon facts, for the statement that henceforth petroleum deserves to be ranked with coal and iron as a solid mining interest. He refers to the evidence we possess respecting the character of bituminous deposits all over the globe.

Mr. B. H. Paul suggests, in a letter to the *Times*, that "beneath the tarry pools of Zante, from which Herodotus described the dipping out of the mineral oil with myrtle boughs, there is a rich source of petroleum to be developed the same as in America, where, upon the site of the oil-wells from which such enormous wealth has been derived, the Indians formerly collected petroleum for medical purposes, as it gathered in scanty films upon stagnant water, by spreading their blankets upon the surface, little dreaming of the rich resources to be reached by boring." Large petroleum wells exist in Austria, and it is expected that the American improvements in the process of extraction will cause a great increase of the present quantity. Till now the most abundant wells have given about 15,000 cwt. yearly; the majority of them are in Galicia, and run parallel with the Carpathians.

PETROLEUM IN YORKSHIRE.

It has been found that the shales of unctuous clay overlying the iron-stone deposits of the Yorkshire moors, in the North Riding, can be made to produce a mineral oil, similar to Petroleum, at a cost of 6d. per gallon. From the fact that these shales crop out to the surface in almost all the valleys, the discovery is expected to impart a wonderful degree of activity to those hills, unpeopled since the days when Roman legions held them in military occupation. It is evident that during the Roman occupation both the iron and coal deposits were wrought, the refuse from workings being met with occasionally below the heather.

PETROLEUM IN FLINTSHIRE.

The discovery of Petroleum in Flintshire has le[illegible] tion of and report upon the district where oil [illegible] The Report appears in *Ryland's Iron Trade* [illegible] writer made his way to Padeswood, a small stati[illegible] from Mold in Flintshire, and landed at once i[illegible] the Mineral Oil Region. He states that it ap[illegible] fallen asleep in the train at Chester, and woke [illegible] Wells" at Enniskillen, Canada West, or Pen[illegible] was the identical smell, about the same quanti[illegible] *diminished in strength*, the same run of he[illegible] people, the same sort of fires and furnaces, cauldrons, retorts, kettles, stewpans for oil, and distilleries—the same heaps of lime, and the same carboys of sulphuric acid—everything the same but the primeval forest, for the trees are all fast disappearing. Here were the 'Oil Wells,' in fact, with all their wealth of production, *minus* their uncertainty in production, and the never-failing crop of open cheating and miscellaneous roguery that springs up from the fattening soil all around them. The stuff they make here is actually petroleum. It has the green colour, the smell, and gives out, to the same treatment, the same products, saving that it is less rich in turpentine, or that the turpentine it contains has less volatile spirit. The taste is the same, and the effect of tasting it exactly similar. There it was, in Flintshire, running out of the receiver from the retort, unmistakeably crude petroleum; and this, in the writer's opinion, settles the question for geologists as to its character and the method of its original production in nature.

The Report continues:—"That they make a capital profit on this spot by its manufacture there is tolerable evidence about us. I do not speak so much of the Companies' works, that are belching out fire, and blowing, and steaming, and smoking away, but in the numerous single furnaces and distilleries that are dotted all over the three or four miles in view. Like the oil wells, at first it is a gold-diggings to the 'small man'—and you can trace its effects in the well-lined pockets, the well-filled shops, the general air of comfort, and the plenty-to-eat-and-drinkishness visible everywhere. The little men have been quietly making the money. Anyone that can buy a ton or two of coal, or get it from hand to mouth—no hard thing where coals are more plentiful than blackberries—can set to work and turn it into oil by sticking up a few bricks and a retort with a pipe. That gives the tar or petroleum. Another boiling does the "run over," that extracts from it the lubricating oil, which fetches 9*l.* or 10*l.* per ton. Now there are three kinds of cannel coal (first, the Curly Cannel, at 29s.; second, the Smooth, at 11s.; third the Shale, at 9s.);—and there are certain mysteries in working these together, about which I am likely to know more in a few days. One ton of the best cannel coal will produce 80 gallons of crude oil, worth 1s. 9d. to 2s. per gallon, and 5 cwt. of refuse, which may or may not be used to light the furnace for another two batches. Each batch consists of half a ton, and occupies twenty-four hours in the crude distillation. In this condition the oil goes to the refiner, whose agent travels about to buy of the small men, and pick up bargains from the needy.

"The oil is made up in barrels of 36 gallons, about 7½ of which go to a ton (at least they did so in Petrolia, but there we allowed for leakage), and a ton of rough oil—the first running off, not from the retort, but from this first distillation—sells for refinery purposes at about 10*l.* 10s. The barrels, which cost from 6s. to 7s. each—for they must be good—are charged to the purchaser. In these barrels lies the way—for some future inventive genius—to fortune. The Yankees and Canadians have tried all sorts of 'dodges;' but after all there is nothing like an oaken stave and an iron hoop. Iron, in casks, spoils the oil, and in soft wood it will perspire itself right through. Some folks speak of enamelled iron for the purpose, but this is yet open to experiment, besides being a severe question of price. The 'Companies' of course refine their own oil, and herein lies—from but a small additional outlay—a large source of extra profit, as I shall proceed to demonstrate. The 80 gallons of crude oil—after redistillation by two processes, and certain washings and rewashings, alternately with caustic soda and sulphuric acid (there are of course certain other pretended manipulations)—come out as follows:—40 gallons boiling oil, 30 gallons heavy oil (lubricating), 8 gallons grease and pitch, 2 gallons refuse; total, 80 gallons. The value is improved 40 per cent.; the labour costs about 5 per cent.

"According to the demand of the trade, or the season, or the skill of the operator, the 30 gallons of lubricating oil are made to produce railway grease, paraffin (by a freezing process), and what is known as 'turpentine substitute.' The railway grease sells at 15s. to 20s. per cwt.; the paraffin (for candles) at 4½d. per pound; and the turpentine substitute for from 2s. to 3s. per gallon wholesale. I will not tell you here what more skilful hands would do with much of this; but some will be able to judge how gold is running to waste, or, rather, the candle being burnt at both ends, in such a process of manufacture. Be this as it may, the place all around, for miles, is boiling over with coal-oil. The cannel—once so despised—that judges and juries and wise men were seven years trying to settle whether it was coal or not—is abundant everywhere just in this vicinity—and I rather think farther towards Shropshire—at any rate, I saw it in the Vale of Llangollen."

PETROLEUM IN CANADA.

In addition to her other natural advantages, Canada is now found possessed of great breadths of oleiferous strata; in other words, of springs and wells of Petroleum; and it is remarkable that these springs occur in geological formations lower than any yet discovered of similar nature. A spring exists in an island of Lake Huron; at Pakenham, Canada West, the rock is full of orthoceratites and all the cavities of these fossils, some of which are of large dimensions, are full of the oil. In like manner the cells of Heliophyllum and Favosites, found in large beds opposite Buffalo on the Niagara river, are full of oil. And Point Gaspé, at the mouth of the St Lawrence, uncommonly well situate as regards the European market, and abundance of wood for fuel and the making of barrels, has recently attracted attention as a promising oil-field. Describing this region in his Geological Report, Sir W. Logan says it "is traversed by a greenstone dyke, in which are numerous horizontal and vertical joints, and abounding in large and small druses (*i.e.* hollows). These cavities are filled with petroleum, which, in some instances, has hardened to the consistence of pitch. The peculiar odour of this substance, which has given the name of Tar Point to the locality, may be perceived at a distance of 50 yards." But it is believed that, as in Canada West, the source of the oil lies deeper in the fossiliferous limestone, which is about 2000 feet in thickness. The surface of the country is described as mountainous, intersected by deep valleys, longitudinal and transverse. Hitherto, however, the only part of Canada which can claim to be an oil region, in the full sense of the term, is the peninsula formed by Lakes Erie and Huron and the river St. Clair. There is the Canadian Petrolia. The river Thames flows through the peninsula more or less along the course of what geologists call an anticlinal axis, and wells sunk in various places near the river have yielded large quantities of oil.

According to a recently-published Report, the central and most important point is at Oil Springs. in Enniskillen township. Oil has been obtained there in "immense quantities." The town of Oil Springs, a very rapid growth, contains about 1000 inhabitants, several hotels, two churches and a school-house, besides good stores and refineries. Petrolia is situate six miles to the north of it. Unlike the hilly oil-bearing districts of Pennsylvania and West Virginia, this Canadian oil region "is a perfect level, hollowed out to a depth of 20 to 30 feet by the largest streams, but without the slightest apparent undulation. A vast forest of large trees, oak, elm, beech, walnut, ash, hickory, and basswood covers the soil everywhere." The surface stratum is clay, probably of the drift period, and from 30 to 80 feet in thickness. In some places wells sunk in this clay have yielded largely. The carboniferous limestone, well known to Canadian geologists, underlies the clay throughout the whole region. Among particulars of the wells we find that "lot 18," when first struck, yielded 2000 barrels a day from each of its two wells. After the wells were "tubed" the supply diminished to 400 or 500 barrels a day for a year, and then ceased. The well in "lot 17" presents a curious phenomenon of accumulation; it yields 60 barrels a week, but nearly the whole of this quantity in the last three days of the week. It is found on commencing to pump on Monday, after the Sunday's rest, that the supply consists almost entirely of water; "but the proportion of oil daily increases, until on Saturday it sometimes reaches 40 barrels, with comparatively little water." The Bruce Well is the most famous. It was sunk to a depth of 237 feet in the rock before the oil vein was struck; the pump was set going and worked for a short time in the usual manner, when suddenly the oil and gas burst forth, blew out the pump, and the well spouted oil like a fountain to a height of 7 or 8 feet for 40 hours. In the words of the Report, "its supposed yield was 7000 barrels a day, and the ground is said to have been covered a foot deep with oil. Indeed, the trees and stumps for some acres around bear marks of the oil upon them with a regularity that nothing else could have produced." While this and other wells were flowing, great quantities of oil ran into the creek and were lost. At times it was set on fire, flowed blazing down the stream, and charred the trees along the bank. The diggers distinguish the oil as "lubricating oil" and "rock oil." The former is said to be worth twelve dollars a barrel in gold. The rock oil is heavy, containing little or no benzine, and has a peculiar and offensive odour, which "seems to be due in part to a volatile sulphur compound." Some of the wells, we are informed, discharge sulphuretted hydrogen, and the same gas is given off during distillation. Add to this, that it is in contemplation to extract and manufacture paraffin on a large scale in the neighbourhood of Oil Springs, and it will be seen that the prospects of Canada as regards her veins and deep hidden lakes of petroleum are very encouraging. In six months of 1862 the yield was 57,550 barrels.—*Athenæum*, Nov. 18, 1865.

OLEAGINOUS MINERAL.

The discovery in New South Wales of Mineral Shale, producing kerosene oil, is likely to prove of importance. The oil can be extracted cheaply. In addition to the oil, there is a demand for the mineral itself. It is found to be very valuable for the production of gas. Some of it has been experimented on at the Sydney gas-works, and some at Melbourne. The principal deposit at present discovered is near Hartley, in the valley of the Lett, and within a few miles of the line traced for the Great Western Railway. It is very similar in character to the Boghead mineral of Scotland, but of a superior quality, and the seam is a very fine one. It has yet to be ascertained how far it extends, and at what points it may be conveniently accessible; but several parties are examining the country, and its mineral resources will soon be better known. It is curious to note how possible wealth may long remain neglected. The existence of the petroleum mineral at Hartley has been known for years, fragments of it lying on the surface of the ground; but its identity with the Boghead coal had never been shown, and but for the great American discoveries it might possibly have remained long neglected.—*Sydney Herald.*

THE AMERICAN OIL WELLS.

The Oil Regions of Pennsylvania have now assumed such importance as to induce the managers of the *Times* journal to dispatch thither a "Special Correspondent" to describe this new field of enterprise. He tells us:—In the gold districts the prizes are few—so few, indeed, as to make the average earnings at "new rushes" lower than the average earnings of Australian labourers, and no one ever yet heard of a digger clearing his 200,000*l.*, 300,000*l.*, or even 500,000*l.* from successful mining. Yet such instances, though not common, are still far from rare in the oil districts of Pennsylvania. The Egbert Farm, the Sherman, Maple Shade, Colwell, Ferrall, Jersey, Keystone, and Coquette wells have each their history of gigantic loss or profit to those who once owned this poor "half-scratched" land, as the thin farms are called in Pennsylvania. In some cases the owners have resolutely held on to their property, and with an outlay of $2000 have realized $2,000,000 in a few months. Others have parted with the right of working wells for as little as $400, and a 30th share in the yield of such cheaply acquired property has since been sold for $30,000. In some cases the yield has been so sudden and prodigious as to spout up with a roar like escaping steam for more than fifty feet into the air, and there being no means of meeting this great efflux of the valuable liquid, it has at last, after vain efforts to stop its rush, or to collect it in ponds, been allowed to flow wastefully away for days, and even weeks, till the supply has ceased as suddenly as it began. Under the depression of price produced by such a tremendous increase in the supply of oil, the value of the oil itself has been as low as half the value of the barrel which contained it; in some cases so low as not to pay the trouble of collecting it, even though flowing on the ground in streams.

We believe that the price of crude petroleum has at one time ruled as low as a dollar the barrel in Oil City, and even then the demand was checked from a fear that there could be no market for it. How far such a supposition was warranted may be guessed from the fact that though petroleum has been but four years an article of commerce, it has already assumed the second place among the exports from the States, and now ranks next to breadstuffs. The pure oil is coming into general use from its cheapness as an illuminator. The secret of extracting its gas with greater ease and at less expense than coal-gas has been discovered and is being put in practice in America. The solid residuum from the refining process which eliminates the gas gives paraffin candles. As a lubricator for wheels and machinery generally the heavier qualities are in demand. Paint-oils and varnish are obtained from it, and the benzine is used as a substitute for turpentine. Some of the most beautiful and durable colours now worn are obtained from the waste petroleum after refining, and after the separation of the naphtha it has been found a valuable substitute for pit oil in tanning, and produces a better and stronger quality of leather. Pennsylvania, however, is far from being the only part of the world where oil wells have been discovered, or where they are believed on good authority to exist. The Crimea, it is stated by Americans who have examined it to ascertain the truth of the reports of its oil-bearing qualities, is likely to yield immense quantities on the skirts of its semi-mountainous interior. Canada, too, possesses oil wells, but in one most important particular differing from those of Pennsylvania. The former seldom yield oil for long; the latter, whether the flow ceases and they have to be pumped, or the pumping is useless and they have to be forced by air pressure, still always yield oil. The short supply of the Canadian oil wells as compared with those in the States may possibly be explained by the geological fact of a deficiency, except at Picton, in Nova Scotia, in the coal formation, to which, whether rightly or wrongly, the presence of petroleum is mainly attributed.

To discover oil in Western Pennsylvania, the *modus operandi* when once the site is determined on, is nearly the same in all cases. Over the spot chosen a timber framework is erected about 10 ft. square by 40 ft. high, and strongly bolted together. A grooved wheel or pulley hangs at the top, and a windlass and crank are at the base. A few feet from the derrick a small steam-engine is stationed and covered with a rough board shanty. A pitman-rod connects the crank of the engine with one end of a large wooden "engine bob," as it is called in some of our mining districts, placed midway between the engine and derrick, the beam being pivoted on its centre about 12 ft. from the ground. A rope, attached to the end of the beam nearest the derrick, passes over the pulley already mentioned and terminates over the intended hole. A cast-iron pipe, from 4½ in. to 5 in. in diameter, is driven into the surface ground, length following length until the rock is reached. The earth having been removed from the interior of the pipe, the actual process of boring or drilling is commenced. Two huge links of iron, called "jars," are attached to the end of the rope. A long and heavy iron pipe is fixed to the lower link, and in the end of this is screwed the drill, or punch, a chisel-shaped piece of hardened steel about 3 in. in diameter and 2 ft. to 3 ft. long. When all is ready, the drill and its heavy attachments are lowered into the tube, and the engine is set in motion. With every elevation of the end of the beam the drill strikes the rock, the heavy links of the "jars" sliding into each other, and preventing a jerking strain on the rope. The rock as it is pounded mixes with the water constantly dropping into the hole, and after a short time the drill is hoisted out and the "sand-pump" dropped into the hole. This is a copper tube about 5 ft. long, and smaller than the drill, having a valve in the lower end opening inwards, which, when the tube is dropped into the hole, the slimy fluid enters and is hoisted out. As the drill is chisel-shaped, the hole made by it would not be round, so a contrivance is resorted to in order to secure that end, which is accomplished in part by the borer, who sits on a seat above the hole, holding a handle fixed to the rope, and giving the latter a half twist at every blow. When the drilling is accomplished, another tool, called a "reamer," is inserted, which makes the hole round and moderately smooth. When the hole gets down to the point where the first reliable indications of oil are reached, the contents of the sand-pumps are carefully examined. The principal features of the geological formation of the Pennsylvania oil region are three strata of sandstone, with intervening strata of soapstone and shale. Indications of oil are found in the first and second sandstone, but the principal deposit is found in the third layer, at depths varying from 300 ft. to 800 ft. Should no oil be found in the third sandstone, the attempt is abandoned.

The well having been bored to the required depth, it is tubed by an iron pipe with a valve at the lower end being run down the whole depth of the hole, the necessary length being obtained by screwing the joints together. As soon as tubed, and sometimes before, the oil and gas, should it be a "flowing well," rush out with great force and considerable noise. A pipe is connected with the upper part of the tube, and the oil is conducted into an immense vat, holding from 500 to 1200 barrels. The gas escapes into the air. If the oil should not flow, a pump-box, with a sucker-rod of wood, is inserted in the tube and connected with the "beam" of the engine. In many instances oil, gas, and water, are all pumped up together, and are separated by a simple contrivance. The mingled fluids and gas are pumped into a small barrel. The oil and water fall to the bottom of the barrel, and run off by a pipe near the bottom into the large vat, where another separation takes place, the greater specific gravity of the water causing it to sink to the bottom. The gas escapes by a small pipe at the top of the barrel, and is conducted into the furnace of the engine, where it burns with a fierce and steady flame, frequently dispensing with the use of other fuel.

Petrolia is already a famous region. Corry, the central exchange of petroleum, is a fine, rough city, of about 10,000 inhabitants, with nearly twenty banks, and two newspapers. Yet all this has been done within four years, and the site of a city which now transacts business to the amount of 3,000,000*l.* sterling annually, and where the land sells almost as dear as in Cheapside, could all have been bought four years ago for less than 5000*l.* But Corry is only one sample out of many. Its position as the arbiter and ruler of prices between the oil regions and New York and Europe gives it, of course, great importance, though in reality the city is not larger than many others of Petrolia which are much younger. Kouseville, Plummer, Titusville, Franklin, are all the juniors of Corry by a couple of years, yet some of these are almost as important as Corry itself and nearly as large.

In a recent discussion at the United Service Institution, the Duke of Somerset expressed a confident hope that the time was not far distant when Her Majesty's ships would be able to use petroleum as fuel instead of steam coal. Such a change means nothing less than that a steam-frigate, which now carries ten days' steam coal, costing say 1000*l.*, would then be able from its portability to carry 20 days' fuel in petroleum, costing 500*l.*

FLINTS OF PRESSIGNY.

MR. J. EVANS has read to the British Association a paper "On the Worked Flints of Pressigny le Grand." Pressigny le Grand is a small town situated on the river Claise, about thirty miles to the south of Tours. The peculiar worked flints which the author had found there in January last, in company with the late Mr. Christy and Messrs. Brouillet and Lartet, were discovered in a soil of red loam, probably of miocene age, and from their resemblance to pounds of butter, have received from the peasants the name of *livres de-beurre.* Their form has been given by striking a succession of flakes from the sides of a mass of flint until a boat-like contour has been obtained. Looking at a number of them arranged together, the eye is struck by their great similarity of form; and the regular and neat manner in which their edges are chipped would at first sight lead to a presumption that they were intended for implements, such as ploughshares, or some kind of large and heavy axes. Those persons, however, who have paid most attention to the subject have come to the conclusion that they are not implements at all, but rather the *nuclei* or cores from which long flakes or knives have been removed, and which have then been thrown away as having served their purpose. The supposition of Messrs. Robert and Élie de Beaumont, that they are the refuse arising from the manufacture upon the spot of flints for fire-arms, was believed to be untenable, on account of their utter dissimilarity to the cores known to be the work of flint manufactories. It seems more feasible that there must have been in prehistoric times a settlement on the spot of men who manufactured long knives from these flints, and afterwards bartered them away, than that they were worked by various tribes who visited the spot as one abounding in the raw material for their cutlery.

Next was read to the Association a paper by Professor Steenstrup and Sir J. Lubbock, Bart. The authors related that the discovery of these flints was due to Dr. Leveillé, who had been induced, by the interest which the general subject had excited, to search for flint weapons in his neighbourhood. In one case they were found in abundance on one side of a little valley, while on the other side not one was to be seen. The "*livres-de-beurre*" and their chippings, on digging for the purpose of ascertaining, were found to extend not more than eighteen inches below the surface; and underneath them numerous fragments of charcoal were discovered. The authors took pains to set at rest all doubts regarding their being the refuse of a gun-flint manufactory. Gun-flints were first adapted to the muskets used by the French army, in the year 1700, and they proved the much greater antiquity of the flint implements by finding several on excavating under the roots of an oak-tree, ascertained to be at least 400 or 500 years old. With regard to the age of the flints the authors thought that there were not, as yet, any sufficient grounds for referring them to the age of the extinct mammalia; neither do they belong to the latest part of the stone.

The opinion that the great flint deposit of Pressigny (says *Galignani's Messenger*) is a place where gun-flints used to be made—an opinion, it must be recollected, confirmed by the President of the Academy of Sciences at Paris—has found an adversary in the Marquis de Vibraye, who has read a paper to the Academy on the subject. He first quotes the testimony of a landed proprietor at La Claisière, M. de Chartres, aged 82, whose father died at the age of 104, and who has stated that no tradition whatever attributes the *nuclei* (rounded flint stones—nodules) which, by the way, cover his own fields, to the existence of any gun-flint manufactory; adding, moreover, that that quality of flint would not be fit for the purpose. M. Eugene Robert had asserted that the surface of the flint implements at Pressigny was not covered with that whitish opaline coating called cacholong. This M. de Vibraye denies, and quotes specimens existing in the museums, and in which this coating exists. M. Robert had also affirmed that the flints of Pressigny did not offer the slightest trace of friction or grinding for the purpose of giving them a useful shape. To this M. de Vibraye replies that observers have hitherto had their attention specially drawn to the large blocks, and paid no attention to the vast number of splinters lying about, and most of which, he allows, bear no trace whatever of workmanship, though there are a certain number which have most undoubtedly been *purposely fashioned* into long sharp knives, the edges of which are ground with the greatest care. There are scrapers artistically rounded off, at both ends sometimes, and hammers of a round form, bearing numerous marks of their having been used. Certain places seem to have been finishing workshops, where the hatchets and other tools were properly polished. As a proof of this, M. de Vibraye mentions a number of blocks of sandstone or quartzite, with deep grooves in them, into which the implements evidently were inserted to give them the last finish.

FOSSIL ELEPHANT OF MALTA.

In the *Geological Magazine* for November Dr. Leith Adams gives some details of the first discovery of the Fossil Elephant of Malta, in one of the numerous fissures, a simple vent with several funnel-shaped expansions, filled with red earth and stones. In 1857 a portion of a tooth and several bones were found by Dr. Speteri Agius; but a dispute between the proprietor and lessee of the quarry stopped the excavation. Close examination led to the determination that these bones belonged to a proboscidian, and similar bones having been discovered in other places, Dr. Falconer named their owner "Elephas Melitensis." On the 14th of June last Dr. Adams obtained permission to investigate the Gandia fissure, where these bones were first discovered. After clearing away much rubbish and a mass of earth, he found a great quantity of teeth and bones of this elephant intermixed with bones of large and small birds, and jaws, teeth, and bones of the Myoxis Melitensis. The state of disorder in which these remains were found precluded the idea that the elephants had fallen into the fissure, and proved that their remains, and those of other animals, had been swept in by the agency of water. Dr. Adams is strongly of opinion that large bodies of water at one time flowed over a great portion of the south-east of Malta.

MALTA BONE-CAVES.

The Report of Dr. Leith Adams on the Malta Bone Caves, read in the Geological Section of the British Association on the 12th of September, has had the result of determining the committee in voting an additional 30*l.* to defray the expense of further excavations. The particulars of the explorations already made are these:—Dr. Adams discovered a cave in 1863 on the south-west coast, which he named the Mnaidra Cave, after the so-called Phœnician ruins close by. He worked at it divers times during the following year until the British Association sent a grant enabling him to clear out 54 feet of the cave, which was filled with red earth and stalactite. Here he found 60 to 80 teeth, and numerous fragments of bones, of at least two species of elephant, one a perfect pigmy, the other of larger size, but scarcely equal to the smallest Asiatic elephant; besides vast quantities of a gigantic rat, land tortoise, and swan—the last of colossal dimensions. It has been named

Cygnus falconerii, after the distinguished palæontologist, Dr. Falconer, whose recent death caused an immense loss to science. We understand that Dr. Adams intends to continue his interesting researches during the winter months.—*Malta Times.*

CAVES OF GIBRALTAR.

LIEUTENANT C. WARREN has communicated to the Geological Society a note in which he describes the principal features of St. Michael's Cave, stating that it is a portion of a transverse cleft through the rock, and probably opened to view at no very remote historical period. The cave at Poco Roco he considers to be a portion of the fissure which extends from Bell-lane in the town to the village of Catalan Bay, the noise of blasting having been heard through the apparently solid rock.

A communication on the fossil contents of the Genista Cave at Windmill Hill, Gibraltar, written by Professor George Busk, and the late Dr. Hugh Falconer, has been read to the Geological Society. The authors state that the Genista cave is one of many inland caverns with which the rock of Gibraltar abounds. It has been traced downwards to a depth of 200 ft.; but the external aperture has not yet been discovered; it was stated to be full of the remains of quadrupeds and birds, some of the former being now wholly extinct, others extinct in Europe. A list of the species to which these remains were referable was then given, and it was inferred that there had been a connexion by land, either circuitous or direct, between Europe and Africa at no very remote period.

THE BONE-CAVE AT RYHOPE COLLIERY.

A GREAT additional quantity of human and other animal remains has been discovered in this cave. Among the bones are two adult human skulls, male and female, the lower jaw-bone of a child of five or six years old, and a number of other bones almost enough to construct another skeleton. The dimensions of the two adult skulls are as follows:—Circumference of both, 21$\frac{5}{8}$ in.; longest diameter, 7$\frac{5}{8}$ in. and 7$\frac{1}{8}$ in.; across the posterior lobe, 6 in. and 5$\frac{5}{8}$ in.; and across the anterior, 5 in. and 4$\frac{3}{4}$. There are also more bones of badgers, foxes, cats, rabbits, &c. Including what has been carried off by the workmen and visitors, there must have been several bushels dug up in all. Several bits of charred wood have been found, and also a chip of wood, clean cut with a very sharp axe, indicating the date of the human remains within a few centuries. In a little recess near the roof of the cave was discovered a number of small bones of different kinds, evidently placed there by hand, just such a depository as a girl playing at housekeeping might be supposed to make. Some of the ox-bones appear to have been broken with a hammer, and one of them bears the mark of having been sawn through. The most probable conjecture now is that these relics are those of a family of thieves or robbers, or of refugees from invasion or persecution, and that they had met their death suddenly and unexpectedly—perhaps by suffocation, like the Macdonalds of the Isle of Eigg, at the hands of the chief of Macleod, or the Arabs in the cave of Dahra, at those of General Lamoricière. There would be plenty of brushwood near for such a purpose.

FOSSILS OF THE NILE AND GANGES VALLEYS.

DR. HUGH FALCONER has read to the Geological Society a paper in which he brings together the few instances on record of the occurrence of Mammalian Fossil Remains in the valley of the Nile, and institutes a comparison between the alluvial deposits of the Nile and those which he had observed in the upper valley of the Ganges. According to certain statements, fossil human bones have been met with in both these sub-tropical valleys. Dr. Falconer considers the facts at some length, and reverts to an opinion expressed by Sir Proby Cautley and himself many years ago—namely, that the Colossochelys Atlas may have lived to an early epoch of the human period and become extinct since; and concludes with some general observations on the vexed question of the antiquity of the human race suggested by more recent discoveries.

VOLCANO OF CHILLAN.

WE learn by a letter from M. Pissis, of Santiago (dated March 30), to M. Elie de Beaumont, read at a recent meeting of the Academy of Sciences at Paris, that the Volcano of Chillan is again in eruption, which is a rare occurrence among the volcanoes of the Andes. This eruption began at the end of November last, on a new point, about 200 metres below the summit of the great cone, a little to the south of the last crater. The new cone about the end of January had already attained a height of more than fifty metres. The lava had escaped by two slopes at the summit, and reached the vast glacier which surrounds the massive volcano. The great cone, which was covered with snow at the time of the eruption, appeared to be denuded; but M. Pissis was informed that the snow had not melted, but was overlaid by a thickness of several decimetres. The alternation of glaciers with layers of scoriæ is frequently seen in the Andes.

ERUPTION OF ETNA.

M. FOUQUÉ has communicated to the Academy of Sciences at Paris, an account of his ascent of Mount Etna. He states that the Eruption of February, 1865, has not materially changed the configuration of the great crater. Towards the north three-fourths of its cavity are nearly filled up with the lava of preceding eruptions. It is only towards the south that he found fissures from which were issuing torrents of suffocating fumes composed of steam charged with sulphuric and hydrochloric acid, the latter predominating. There was no trace of liquid lava. The "fumerolles" have generally a temperature varying from 80° to 100° centigrade; but in the lower crater he found a fissure containing a "fumerolle" with a temperature of 203°.

Since the eruption of Etna, numerous details have been reported to the Academy of Sciences at Paris by eminent savans, who have studied the phenomena on the spot. Recently M. Fougué has forwarded a chart of the present condition of the mountain, with remarks. By a letter from Professor Silvestri we learn that the flow of lava has now entirely ceased, and that he has at length detected the presence of carbonic acid in several places. The following is his analysis of the gas rising from some of the "fumerolles"—sulph-hydric acid, 0·45; carbonic acid, 5·00; oxygen, 17·27; nitrogen, 77·28. On July 18, at ten o'clock, a terrible earthquake occurred at Fondo di Macchia, Bondinella, and other places, by which 200 houses were thrown down, sixty-four persons killed, and eighty-four wounded. The shock was not felt at Catania.—*Illustrated London News.*

At a recent meeting of the Academy of Sciences at Paris, M. Charles Ste. Claire Deville read a letter from M. Fougué, who had been charged with the mission of collecting observations of the phenomena attending the new eruption of Mount Etna. M. Fougué states that the most elevated of the new craters is at the altitude of 1700 metres above the level of the sea. Immediately after the eruption (on the night of January 30-1 last) the principal stream of lava descended the mountain, and in two days it attained a distance of six kilometres. On Feb. 6 this stream of lava stopped its course, and several secondary streams spread themselves in other directions. M. Fougué counted seven new craters, all of which are situated on the same line, which seems to be the radius of a circle of which the culminating point of the mountain is the centre. He especially remarked the absence of sulphur and its compounds in the lava, which appeared to be contradictory to the opinion of M. Charles Ste. Claire Deville, who, however, explained this anomaly by stating that Etna was really sulphurous, but that the presence of sulphur could not be affirmed till after the lava was completely cooled.

A well-executed engraving of the recent eruption, from a sketch taken by a correspondent on the spot, has appeared in the *Illustrated London News.*

BURNING WELL AT BROSELEY.

MR. JOHN RANDALL has given, in the *Geological Magazine* for May, some particulars respecting the Burning Well at Broseley, in Shropshire, mentioned in old topographical works. He states that it has ceased to exist for nearly a century. "It was fed by a spring; and petroleum and naphtha also found their way from rents in the rock into the well with the water, and were occasionally ignited. Springs of petroleum, on a much larger scale than the Broseley one, are met with in the neighbourhood, and the yield of each of these was formerly much greater than the present. Many hogsheads from one of these were exported some years ago under the name of 'Betton's British Oil.' The rocks were tapped by driving a level through one of the sandstone rocks of the coal measures; but these are now drained, and very little is found to flow from them. This is also the case with a spring in Tar-Batch Dingle, about a mile and a half lower down the Severn. The tar spring is still to be seen, but the quantity given out is smaller, we apprehend, than when it first gave its name to the dingle." Mr. Randall considers this oil to be derived from resinous trees of the carboniferous period. It had been probably pressed out from the accumulated masses of vegetable matter which formed the coal seams, and had been absorbed by the sandbeds above them. It would naturally find its way out when tapped by shafts, or levels, or water-courses.

STEAM VOLCANOES AND EARTHQUAKES.

MR. PEACOCK has read to the British Association a paper "On Steam Volcanoes and Earthquakes," including seventy evidences of the presence of steam and its constituents in every species of natural disturbance of the earth's crust. The conclusion he arrived at was that steam certainly operates *quantum valeat* in producing earthquakes, volcanoes, and other similar disturbances. The President said he had not the least doubt that steam escaped from the earth when it got vent, and that when it did not get vent it caused undulation.

EARTHQUAKE AT SEA.

CAPTAIN LAWSON, of the bark *Viking*, of Sunderland, reports that on the 18th of July, 1865, at 2 p.m., while in latitude 36° 18′ north, and long. 2° 32′ west, he experienced a severe shock, as though the ship had taken a shoal of rocks, and so severe was it that the vessel was shaken with great violence, and everything on board was similarly affected. This lasted about five minutes, when the shock subsided, and the vessel resumed her course, nothing the worse for the severe shaking she had undergone. The weather at the time was beautifully fine, and the water remarkably clear. Captain Joseph Horan, of the bark *William Shillito*, of Sunderland, who exchanged signals with Captain Lawson shortly afterwards, reports having experienced a similar shock at the same time. This may, perhaps, be the effect of the earthquake which occurred on the morning of the third day, and which totally destroyed the village of Fondo di Macchia, near Catuia.—*Northern Daily Express.*

EARTHQUAKE NEAR FLORENCE.

We extract a few particulars relative to the Earthquake at Florence on Dec. 12, from a letter from M. de Tchihatchef, read at a meeting of the Academy of Sciences at Paris. After heavy rains and violent south winds during a great part of November, at the end of the month the wind changed to the south-west. A succession of fine days with clear sky ensued till December 11, when the south wind returned, but the sky still remained serene. On the 12th, at nine o'clock in the morning, a struggle between the winds from the south, south-west, and north-west began. At three o'clock p.m. the sky became cloudy; and at 4h. 49m. 32s. came an undulatory shock which lasted nearly ten seconds; at 5h. 58m. a slighter shock followed; and a third, at 6h. 50m., was scarcely felt. Immediately after this the sky darkened, the barometer fell, and at eight o'clock rain began, which lasted several days. According to observations collected by Professor Donati, the centre of the commotion appears to have been at Fierenzuola, about twenty-eight miles north of Florence. At that place the phenomenon was manifested with much more intensity than at Florence, which seems to have been the term of its activity; while in the villages of Mugello and Scarparia, and other places round Fierenzuola, no less than thirteen shocks were observed on December 11, between five o'clock in the evening and midnight.

EARTHQUAKE IN STYRIA.

At ten minutes to six on the evening of the 13th of July, a severe shock of Earthquake visited the town of Pollau, in Styria, and its environs. The shock was felt in a north-westerly direction, and was accompanied by very strong undulatory motion, which continued for about three seconds. Another shock was experienced the next morning at a quarter to ten o'clock, but was weaker than that of the previous night. Shocks were likewise felt on the same day at about the same time in Hartberg and Fehring. Three shocks occurred on the 13th, at two minutes past six in the evening, at Fürstenfeld, having a north-easterly direction. By the last of these, which followed each other in rapid succession, the walls of several buildings were cracked.—*Reuter's Express.*

EARTHQUAKE AT COMRIE.

On the evening of May 7, between eight and nine o'clock, the village of Comrie and its neighbourhood were visited by a severe shock of Earthquake. Articles of furniture, such as crockery, were dashed against each other. The shock, as usual, apparently came from the south-west, and proceeded to the north-east, and was accompanied by a noise resembling a heavy peal of thunder or the discharge of cannon. The day throughout was fair and one of the most beautiful of the season; and the shock taking place on a Sunday night, when all was quiet, alarmed the villagers to a great extent, and they rushed in great numbers to the street, though accustomed to such visitations. At an early hour yesterday morning rain fell in torrents, and before daylight several slight shocks of earthquake again occurred. The shock of May 7 was the most severe since that of the 23rd of October, 1849, and was felt at Ochtertyre, Crieff, and other places east from Comrie.—*Scotsman.*

EXPLORATION OF KENT'S CAVERN.

There has been presented to the British Association, the first Report of the Committee for the Exploration of Kent's Cavern, by Messrs. Lydell, Vivian, and Pengelly. In descending order, according to the above exploration, the cave was found to contain —first, large masses of limestone; secondly, a layer of mould a few inches to a foot in thickness; thirdly, a concretionary mass, composed of angular fragments of limestone; fourthly, reddish cave loam, with fragments of limestone, and totally unstratified. The following objects have been obtained from the upper part of the deposit:—Marine and land shells, hazel-nuts, remains of existing animals, earthenware, bronze, and other human remains, native copper, charred wood. Lower down are found the bones and remains of the historical period. In the red cave clay the remains of extinct animals are found. The bones are covered with teeth marks, showing that they have been gnawed by some of the carnivorous animals. Bones of the cave-bear, rhinoceros, horse, elephant, hyena, &c. Flint implements are also found, particularly near the bottom. Many of these (of which upwards of thirty have been found) are very perfect. The reading of the Report was greeted with enthusiastic applause. Sir Charles Lyell referred to the negative evidence afforded in the upper part of the deposits, not a single fragment of a human bone being found. It has been objected that the flint implements of Abbeville, if genuine, would be accompanied by human bones. This argument would lead us to doubt whether man existed even in the Roman period. Professor Phillips observed that very important considerations arise in determining how the bones and other remains have been conveyed into caverns. He believed that the contemporaneity of man and the cave animals will be established.

Without intending at present to enter on the consideration of all the bearings of the entire evidence produced, the Committee express their conviction that it is totally impossible to doubt either the human origin of the implements or their inosculation in undisturbed soil with the remains of the mammoth, cave-bear, and their extinct contemporaries.

BRIMHAM ROCKS.

Mr. D. Mackintosh has remarked the striking evidence of marine denudation manifested in the fantastic shapes of the Brimham

Rocks, in the West Riding of Yorkshire. He says that ordinary observers are very liable to err in attributing to man what is chiefly or solely due to nature, since many of the cromlechs, and most of the rock-basins and rocking-stones referred to human workmanship, exhibit the clearest traces of the undermining action of water. The traces of atmospheric action are comparatively trifling. Judging from the general character of these rocks, Mr. Mackintosh sees no reason to suppose that any great fractures have occurred among them since they were undermined by the sea, probably towards the close of the second glacial or ice-floe period. (See Professor Phillips, "On some effects of the Atmosphere in wasting the surfaces of Buildings and Rocks," *Proceedings of Geological Society*, April 27, 1831.)

THE EARLIEST KNOWN FOSSIL.

In a letter to the President of the Royal Society, Dr. Carpenter comments on the Structure and Affinities of the Eozoön Canadense, the oldest type of organic life yet known to the geologist. The skeletons of this rhizopod seem to have greatly extended themselves over the surface of submarine rocks, their base frequently reaching a diameter of 12 in., and their thickness being usually from 4 to 6 in. These masses exhibit a more or less regular alternation of calcareous and siliceous layers. Dr. Carpenter determined, by the microscope, the minute structure of this organism, which, he says, in its living state might be likened to an extensive range of buildings, made up of successive tiers of chambers, the chambers of each tier generally communicating very freely with each other. The walls of these chambers are everywhere formed of a vitreous, pellucid shell substance, minutely perforated with little parallel tubes, which are so penetrated by siliceous infiltration that when the calcareous shell has been removed by acid the internal cast of their cavities remains in the form of very delicate needles, parallel to each other, on the solid mould of the cavity of the chamber, over which they form a very delicate layer. Dr. Carpenter, while agreeing with Mr. Dawson in referring the Eozoön to the group of foraminifera, considers that its immediate affinity is rather with the Nummuline than the Rotaline series.—*Illustrated London News.*

In the *Annals of Natural History* for November, we have a note by Dr. Carpenter, in which he defends the zoological character of the earliest known fossil, the Eozoön Canadense, against the aspersions of Professor King. Dr. Samuel Haughton, who lately investigated the structure of the leg of the ostrich, gives the result of his examination of the muscular anatomy of the leg of the crocodile, in which the interlacing of the tendons is remarkably complex. The crocodile, resting on mud, progresses chiefly by using his hind feet as paddles, and in this use of them the great caudal extensor of the thigh is the most important muscle employed; and the simultaneity of the action of the leg appears to be fully secured by the above-mentioned interlacing of the tendons.

FOSSIL ORGANIC REMAINS.*

PROFESSOR ROMER has described a Fossil Spider, discovered in the coal measures of Prussia, on the surface of a piece of shale. It shows not only the feet with all their segments, and the two palps, but even the coriaceous integument of the body and the hairs attached to the feet. The interest of the discovery of this spider lies in the fact that hitherto spiders have not been found in any rocks older than the triassic, and that now the existence of them in the palæozoic period is proved. A fossil spider, discovered some years ago in Coalbrookdale, very much resembled the above.

Professor Owen has described in the *Geological Magazine* for April, portions of a jaw of a large extinct fish, probably a cycloid, which he names Stereodus Melitensis, from its having been obtained from the middle beds of the Maltese miocene.

There have been read to the Geological Society, notes by Messrs. W. Boyd Dawkins, E. Wood, and G. E. Roberts, on some Mammalian Remains found by Mr. Wood, near Richmond, Yorkshire, on a terrace of blue clay, mixed with limestone débris, about 130 feet above the north bank of the river Swale, during excavations for a sewer. The deposit was stated to be a heap of kitchen refuse, and the great majority of the bones, except the solid and marrowless, are broken; and not one of the skulls is perfect. The remains include the polar bear, dog, sow, deer, sheep, bos longifrons, and the horn-cores of a third form of he-goat. M. Lartet has informed Mr. Dawkins that these horn-cores belonged to some of the diversified forms that are the result of hybridity, and stated that they resemble some found in a bone-cave in the Pyrenees.

To the Geological Section of the British Association, Mr. C. J. Woodward has read a paper on "a Deposit, near Lilleshall, Salop, containing recent Marine Shells." Mr. Gwyn Jeffreys, having examined the fossils, stated that they were of Arctic type. The discovery of these beds was important, as extending our knowledge of the remains of the drift period. The Rev. H. Housman has read a paper on "Fossil Footprints in the New Red Sandstone at Brewood, near Wolverhampton," in a quarry in the Forest, unusually rich in fossil footprints, principally of the rare Saurian, Rhynchosaurus, and of the Labyrinthodon. Footprints of the smaller Saurian, hitherto not met with in England, were also found there.

M. A. Sismonda has reported to the Academy of Sciences at Paris, that he has discovered in gneiss, a very ancient rock, impressions of a species of plant very analogous to the equisetum, so abundant in the coal measures. He sees in this vegetable plant a peremptory proof of the metamorphic origin of the fundamental gneiss of the Alps, and a new element for the still-pending discussion as to the geological age of the vegetable impressions

* The majority of these notices are condensed from the ably compiled "Scientific News" of the *Illustrated London News*.

which are contained in the anthraciferous strata of the Western Alps.

In the *Geological Magazine* for January, Mr. Etheridge, the editor, announces the discovery of several new Labyrinthodont reptiles in the coal-beds at Jarrow Colliery, Kilkenny. Professor Huxley has determined five new genera when examining some collections chiefly formed by the labours of Mr. Brownrig and Dr. E. P. Wright. Numerous remains of the wingless bird, Dodo ineptus, have been recently obtained from a morass in the island of Mauritius, by Mr. George Clark, of Mahébourg, of that island; and a very complete series of these bones is in the hands of Professor Owen. Mr. Woodward gives an account of a new crustacean found in the lias of Lyme Regis, Dorsetshire, by Mr. J. W. Marder.

The vast wealden formation at the back of the Isle of Wight, between Black Gang and Brooke, has long been celebrated for the great variety and wealth of its fossil remains. Numerous bones of reptiles have been found in this formation near Brooke, principally belonging to that enormous lizard, the iguanodon, which, with the megalosaurus, hylæosaurus, and other extinct monsters, passed their lives on the banks of this great wealden river. The Rev. W. Fox, of Brixton, near Brooke, well known among palæontologists for his labours in this branch of geology, has discovered in these beds a new reptile of the Dinosaurian family. The only parts of the skeleton wanting are the head and neck. The animal was above 6 feet long from the shoulder to the rump, and was furnished with a massive tail 5 feet long. The legs were about 4 feet in length, terminating in a broad, short foot. One of the most remarkable features of this strange reptile is the manner in which it was clothed with bony armour, plates of bone from half an inch to 4 inches in diameter, and about half an inch thick, covered its body with the exception of its back, which was protected by a great bony shield. Another remarkable characteristic of this animal was a very curious process of spine-like bones, which ran along the sides of the body and tail, some of which are 15 inches long, and weigh 7 pounds. The remains of this extinct monster have been examined by Professor Owen, as well as the wealden formation from which they were extracted; and we understand that, with reference to the extraordinary nature of the spine-like bones to which we have alluded, Professor Owen is of opinion that the most appropriate name for this new Saurian would be Polacanthus.

M. Alphonse Milne-Edwards has communicated to the Philomathic Society of Paris a description of the remains of the birds of the quaternary period, found in company with the bones of mammals; they comprise owls, jays, and partridges, and various species which are now seen rarely in France, but are still met with in Hungary and Germany, and abound in Sweden, Norway, Russia, and Northern Asia.

Specimens of a petrified tree have been found in the Golden

Horn claim, near Geelong, at a depth of 258 ft. The specimen exhibited is a log taken from a fossil tree about 4 feet in diameter. Pieces examined by the microscope, glisten like a galaxy of diamonds. In the same claim, at a depth of 200 feet, several frogs, embedded in bluestone, have been disinterred of a green and yellow colour, without any signs of mouth or respiratory organs.—*Australian paper*.

From the *Geological Magazine* for September, we learn by a note that casts of an extinct gigantic Armadillo, 8ft. long, found in the pampas of Buenos Ayres, have been received by the British Museum.

Among the recent communications to the Academy of Sciences at Paris is one from M. Bianconi, in regard to the fossil remains of the great bird, epiornis, found in Madagascar. Marco Polo describes the roc, a gigantic bird which he compares to an eagle. Hitherto his account has been reckoned fabulous, as the epiornis was considered to be a brevipennis, or short-winged bird. The anatomical examinations of M. Bianconi have led him to justify the statements of the old Venetian, since he detects great similarity in the structure of the epiornis and that of the condor and the vulture.

M. Milne-Edwards, in the name of M. Lartet, has laid before the Academy of Sciences at Paris a piece of fossil ivory, found by M. Lartet and Dr. Falconer, in the ossiferous strata of Perigord, on which is rudely engraved a representation of the extinct long-haired elephant, or mammoth. M. Lartet expresses his conviction that this sketch is the work of a human contemporary of the Elephas primigenius, and other great herbivorous and carnivorous animals, which geologists consider to have lived during the early part of the quaternary period. M. Lartet has also reported his discovery in the caverns near the Dordogne, formerly human habitations, of the remains of a new species of marmot; and likewise of the musk-ox, now existing in the Arctic regions of North America.

Professor Owen has given, in the *Geological Magazine* for January, an illustrated description of the remains of a new reptile, found in the coal-beds of Llantrissent, Glamorganshire. From the characteristic density and thickness of the walls of almost all the long bones hitherto observed of this air-breathing vertebrate, the Professor has named it "anthrakerpeton crassosteum." He concludes, from the evidence before him, that it belonged to that low, probably primitive, air-breathing type which, with some developmental conditions of the bones like those in some fishes, showed forms of the skeleton more resembling those in Saurian reptiles than are attained by any of the more speculised Batrachian air-breathers of our own times. This Magazine also contains some interesting remarks on the present state of geological research, with special reference to the Eozoön Canadense, the earliest created being hitherto known in palæontology.

Astronomical and Meteorological Phenomena.

ASTRONOMERS' ERRORS.

M. LE VERRIER has reported to the Academy of Sciences at Paris the observations of M. Wolf on the "Personal Errors" to which Astronomers are liable, due to physiological causes. M. Wolf, having found his own "personal error" to be 0.30 sec., has reduced it to 0.11 sec., which he cannot avoid. After having convinced himself that the error could not proceed from the comparison which he is compelled to make between the sensation produced on the ear by the pendulum which beats seconds and the visual impression produced by the passage of the star, he concludes that the error is due to the duration of the impression made by the luminous ray on the retina—a duration which varies in each observer. M. Le Verrier at the same time stated that, when he himself was observing the small planet Amphitrite alternately with his colleague, M. Marié-Davy, a difference was found which could be attributed only to the difference of impressibility of the retina of the two observers, especially in regard to colour.

SOLAR ECLIPSE.

IN a letter addressed to the Academy of Sciences, Father Secchi, of Rome, gives a description of certain observations made by Father Cappelletti at La Conception, Chili, during the total eclipse which was visible there on the 15th of April, 1865. La Conception lies in 36 deg. 43 min. S. lat., and 73 deg. 8 min. W. long. Father Cappelletti was unable to obtain photographs of the protuberances on account of the state of the weather, but he could observe the eclipse during the complete obscuration, which lasted 2 min. 20 sec. The first thing he saw during that short period was an immense mountain of fire, in the shape of a horn, at 57 deg. N.W. from the zenith. Nearly opposite there was another, which was smaller. Both were rose-coloured, but the second was the paler of the two, and 2 min. in height; while the first was 2 min. 40 sec. After the lapse of 38 secs. a series of coloured flames appeared, so that the Sun seemed to be on fire, and gave one the idea of a train of powder igniting successively and with great rapidity. The extent of these rose-coloured flames was 90 deg. along the limb. It bore some analogy to a chaplet of beads, but some of the latter were oblong, two ended in a point, and others were undulated. Above these protuberances there was a solitary rose-coloured point. There were no protuberances on the eastern side. At the moment the Sun disappeared, 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 great protuberance. Its western side coincided with the direction 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 deg. with the second protuberance; it was less luminous than the other, and its borders were rounded off. The third pencil was at equal distances between the other two. The Government Commissioners only saw two of these pencils, but at Rio Janeiro they saw five of them. The darkness might be compared to that of an hour after sunset, owing to the weather being slightly foggy. The country around had assumed an ugly greenish tint. An arc, presenting the colours of the rainbow, appeared at a distance of 30 deg. from the sun, and disappeared as soon as the eclipse ceased to be total. It was in the form of a crescent; its ends resting, so to say, on a line tangent to the inferior limb of the moon. The inhabitants of La Conception clearly saw the delineation of the shadow in the fog, and were much frightened at it. Several stars of the first and second magnitude became visible. Nothing particular occurred 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 returned as soon as the light reappeared. Father Cappelletti remarked that, at the first appearance of light, the sun's limb was undulated, looking like the ocean at Cape Horn with its immense waves. The protuberances disappeared; but the arc remained visible for 38 seconds longer. During the totality the moon was surrounded with a ring of silvery light, after which came the crown of rays. Her border was rather indented, and this caused, also, the irregularities of the sun's crescent when it reappeared.—*Galignani.*

THE SOLAR PHOTOSPHERE AND SUN SPOTS.

At the Royal Astronomical Society, Mr. Isaac Fletcher, of Tarnbank, Cumberland, has critically examined the Photosphere. On each day he found the entire photosphere, when not occupied by faculæ, covered with minute white granules, to which he thinks Mr. Stone's appellation "rice-grains" well applies. Mr. Frederick Brodie (at Uckfield, Sussex), after examining the same phenomena, compares them to a "coarse, shing'y beach." He exhibited, at the same time, drawings in which their various forms are well represented. On one occasion he witnessed the extreme mobility of the photosphere. In the course of four hours the umbra was divided by an unusually wide bridge of luminous matter, which appeared to move at the rate of 1400 miles an hour. In June last he observed a fine group of spots, the configuration of whose penumbra resembled some of the great Alpine glaciers. The discussion concluded with some remarks by Mr. Norman Lockyer and by the president, Mr. Warren De la Rue, on the importance of *waiting* for the accumulation of more facts before attempting to arrive at any conclusion.

SPOT ON THE SUN.

A VERY remarkable Solar Spot made its appearance on the south-western limb of the sun on the 7th of October last, and was distinctly visible to the unassisted eye for many consecutive days; on Nov. 3, it could be seen again on the south-western limb, having been brought round again to view through the sun's rotation. It is inferred to be the same identical spot,—not so much from its magnitude and form, as from the period of time at which it was expected and from its position, though somewhat nearer the heliacal equator. It was seen through an equatorial of 9 ft. focal length and of 6 in. aperture.

NEW COMET.

ON the 18th of January last a New and Large Comet, near the constellations Grus and Toucan, was discovered in the southern hemisphere by M. Soloman at the Cape, and by Professor Moesta at Santiago, in Chili. From the Cape, Sir Thomas M'Lean reports that the head of the comet was not well defined, due, probably, to the agitation of the air. The splendour he describes as being inferior to that of Donati's comet. Sir Thomas considers that no danger need be apprehended from its proximity to the earth. Professor Moesta, in the *Astronomische Nachrichten*, No. 1519, gives more details of daily observations. On January 24th the nucleus was more defined; on January 25th the head seemed to have become smaller, and on January 30th the nucleus was surrounded by a fine nebula. By calculations he was enabled to ascertain that the new comet is not the one which appeared in 1843. Mr. Ellery, director of the Observatory at Melbourne, reports that the orbit of this comet bears no striking resemblance to that of any other computed comet. A slight similarity is shown to the comet of 1677 observed by Hevelius, Flamsteed, and others, but not sufficient to justify an assumption of identity. Its path in space is inclined eighty-seven degrees to the ecliptic; and the comet appears to have made a pretty close approach to the sun on January 14th, and hence to have gained in brilliancy and in the development of the tail. Its distance from the sun's surface at six p.m., Greenwich time, on January 14th, was about 2,300,000 miles.

We have received a communication from Mr. John Tebbutt, jun., of Windsor, New South Wales, containing additional information respecting the large comet which appeared in the southern hemisphere early in the year, and which could not be observed in Europe. It was seen in some parts of the colony on January 17th, but was not detected at Windsor till the 22nd, when it appeared as a faint patch of light. It was not visible again till the 30th, the sky being continually overcast. Mr. Tebbutt says that then "the nucleus was very brilliant in the telescope, and its tail, which extended over an arc of twelve degrees, was somewhat curved, being convex on the western side. According to my calculations the comet was at this time distant 63,000,000 of miles from the sun, and 114,000,000 from the earth, the length of the visible portion of its tail being 35,000,000 of miles. It arrived in perihelion at eight o'clock on the evening of the 14th January, mean time at Greenwich, being then only 2,500,000 of miles from the sun's centre. It was at no time within 90,000,000 of miles of the earth, consequently its imposing aspect was probably due to its previous near approach to the sun." It was at first supposed to be a return of the great comet of 1843, in accordance with the so-called prediction of Sir John Herschel, in his "Outlines of Astronomy;" but Mr. Tebbutt considers it to be a totally different body, although its perihelion distance is, like that, very small. He states that "the longitude of the ascending node is 253 deg., and that of its perihelion 141 deg., the inclination of its orbit 87½ deg., and its motion retrograde. This comet moves nearly in the same plane as the *fifth* comet of 1826, having the same perihelion distance, but its perihelion nearly in the opposite quarter of the heavens. A comet was observed about B.C. 371, and Pingré has assigned the limiting values of its elements from an account given of it by Aristotle. That comet may possibly be identical with our late visitor, but observations made more than two thousand years ago are too rough for the settlement of this question. On the 18th of March the comet had increased its distance from the sun and earth to 162,000,000 and 188,000,000 of miles respectively. It was last seen by me on the 28th of the same month, but was so faint as to defy accurate observation."—*Illustrated London News.*

PASSAGE OF THE EARTH THROUGH THE TAIL OF A COMET.

EARLY in the month of June, 1861, M. Liais, the celebrated astronomer, wrote from Rio Janeiro to the Academy of Sciences of Paris, to the effect that the observations which he had made of the great Comet of that year, which had not as yet become visible in Europe, had convinced him that there was a great likelihood that the earth would come in contact with one of the tails of that body. M. Liais attended the sitting of the Academy, and submitted elaborate calculations proving beyond question that on the 19th of June, 1861, the earth really did pass through one of the comet's tails. The moment of contact was twelve minutes past six a.m., Rio Janeiro time: and, according to the calculation of its dimensions made by M. Liais, the earth must have been *wholly immersed in the tail* for about *four hours!* This immersion in the tail of a comet had no perceptible influence upon the weather—a very remarkable fact, adding one more to the many reasons there were already for supposing that cometary matter is some millions of times rarer than our atmosphere. Not the least curious consideration suggested by the phenomenon is that it was one which *perhaps* had never occurred before—for, according to Arago, the chances *against* the contact of the earth with a comet are more than two hundred and fifty millions to one.

THE PLANET MARS.

PROFESSOR JOHN PHILLIPS, of Oxford, has communicated to the Royal Society further observations on the Planet Mars, and on the physical aspect of the Sun, with illustrative plates. In the first paper he reports that he has perceived no appreciable change in Mars in the main outlines of land and sea since his close scrutiny in 1862. A smaller extent of snow was visible at the further pole. The ruddy tint observed in the surfaces of broad tracts of land he regards as characteristic of some peculiarity in them, possibly due to some special substance, or to atmospheric influences. With the second paper the Professor gives diagrams, showing the appearance of the sun's disc, the bright and shady parts of the surface, and other interesting phenomena. He suggests, as a good way of observing the solar spots, the projecting the sun's image on a smooth porcelain screen, or on very smooth white paper, whereby every imaginable degree of relative darkness appears in the spots, and the faculæ come out bright and distinct. The spots seem so dark in the nuclei as to suggest the hypothesis that the parts of the sun to which they belong really emit heat rays invisible to our sight.

FALL OF TWO AËROLITES.

ON the 7th September last a well-authenticated case of the Fall of Two Aërolites within half a mile of each other took place at Muddoor, in India. It was in the daytime, and three loud reports, like the explosion of shells in the air, were heard by many persons. Three natives, immediately after the reports, saw the fall of the stones, which raised a great quantity of dust. They were at first frightened, but called others to their assistance, and dug out the stones. Their depositions were afterwards taken. The first of them, named Kenda, was very much frightened: "he did not go close to it, because he thought some calamity had fallen there from the heavens." The second, Channay Gowda, "did not go close to the spot, thinking that some devil or evil had come down from the heavens." The third, Mallay Gowda, did not go to see it, "because he thought that some calamity or *Mary* (meaning his deity of evils) had come down on the land to ruin the community." A large number of persons, including the police, were brought by these natives to the spots, and the two stones on being dug out in a broken state were found to be identical in appearance. Ali, the resident almidar, took down the statements in writing, and sent the whole at once to Mr. L. B. Bowring, Commissioner for the province of Mysore.

BRILLIANT METEOR.

MR. WARREN DE LA RUE, while driving on November 21, in the evening, from the Southall station of the Great Western Railway towards Cranford, Middlesex, at about five minutes past 6, his attention was arrested by a Brilliant Meteor passing with a slow velocity from east to west vertically over his position, which he ascertained to be 51 deg. 29 min. 40 sec. north latitude, and 1 min. 24 sec. west longitude. When first seen, it was about 40 deg. above the eastern horizon, and disappeared in about ten seconds, without bursting, about 25 deg. above the horizon due west. It presented the appearance of a fireball from a Roman candle, shining with a brilliant bluish light, and it was accompanied by a tail from 2½ to 3 deg. in length of a reddish colour. No noise accompanied or followed its appearance. The sky was hazy, so that the stars were obscured in the path of the meteor, yet it appeared fully three times as bright as Venus at her brightest, and the throwing of the matter forming the tail could be distinguished. The meteor's course was to the south of and lower than the constellation Cassiopeia, a few stars of which were visible. The time given is only an estimation.

SHOOTING-STARS.

AN article on the altitudes of Shooting-stars observed, on the night of Nov. 13-14, 1863, at Washington and other places in the United States, computed by Mr. H. A. Newton, whose name is now associated with that of Mr. A. H. Herschel in these investigations, appears in the *American Journal of Science*. It is remarkable that the region in which the November meteors appear and disappear is 15 or 20 miles higher than the corresponding region. for the August meteors. Mr. Newton considers that if the decrease of density of the atmosphere at this elevation follows the same law as near the earth's surface, the air in the latter region is 40 or 50 times as dense as in the former. The most plausible explanation of the fact is that the two groups of bodies differ in their chemical and mechanical constitution; the November group being more inflammable than that of August.

NOVEMBER SHOWER OF METEORS.

MR. AIRY, the Astronomer Royal, has received from Mr. Glaisher, Superintendent of the Magnetical and Meteorological Department of the Royal Observatory, Greenwich, the following account of the Meteors observed on the 12th of November, under a system of observation organised by Mr. Glaisher :—

"The calculated time of recurrence of the November meteoric shower was the hour beginning at midnight of the 12th of November, and ending at 1 h. a.m. on the 13th. From 6 p.m. on the 12th a watch was kept up at the Royal Observatory, Greenwich, and till 8 h. the sky was cloudless, during which time only two meteors were observed. From the hour of 8 till midnight the sky was covered with cloud; at this time the clouds began to break, and by 20 minutes to 1 h. a.m. the sky was free from clouds. At this time six observers, viz., Messrs. Nash, Harding, F. Trapand, E. Jones, Wright, and Lieutenant Rikatcheff, I.R.N., were on the look-out at different parts of the sky. At 0h. 12m. a meteor was recorded; and by 1h. the position, path, &c., of 29 were registered; in the next hour the particulars of 90 were noted; between the hours of 2 and 3, 66 additional meteors were recorded, 49 in the next hour, and 43 in the hour ending 5h. a.m., making a total of 279 meteors whose paths, colours, size, &c., were fully described. For the space of 12 minutes during the last hour, the paths, colours, and sizes were not recorded, but all the meteors which were visible in the west and south-west quarters of the heavens were counted to the number of 25; and the meteors were quite as numerous in the east and north-east portions of the sky as in the west and south-west. Therefore, at this time the meteors were appearing fully at the rate of 250 per hour, and these were for the most part of the first and brightest class. It is calculated that, for every meteor recorded, at least two additional meteors passed without their places, &c being registered. At 5h. the moon was shining brightly, and still many meteors were seen till half-past 5, some of them situated very near to the moon. On laying down the paths of these meteors a well-defined radiant point is very clearly shown, in right ascension about 165 deg., and polar distance about 60 deg. Of the meteors observed, 197 were blue, 34 white, 30 bluish white, 4 yellow and 4 red; a few were rose-coloured, and 1 was green. The blue meteors till 1h. were 43 per cent. of the whole observed; in the next hour the per centage was 66, between 3 and 4 it was 85, and afterwards 72 per cent. Four of the meteors were equal in brightness to Jupiter, 2 twice as bright as Sirius, and 138 equal to or brighter than first magnitude stars. Meteors with trains numbered 16 in the first hour, 54 in the second hour, 37 in the third, 38 in the fourth, and 27 in the last hour of observation, making 172 meteors with trains, leaving about 100 without trains.

"On the evening of the 13th day a watch was kept up at the Observatory from the hour of 6 p.m. till midnight, with the exception of a short interval between half-past 7 and 8 o'clock, and two meteors only were observed during this time. From the circumstance of so few meteors being visible both before and after the calculated time, it would seem that this epoch is determined with a good deal of precision. The display is the finest ever noticed at the Royal Observatory, Greenwich."

DEATHS BY LIGHTNING.

Few people are aware how many are the yearly Deaths from Lightning; nor have we ever seen a return of fatal lightning accidents happening in the British Islands. M. Boudin has drawn out a statement for France, which shows that during the thirty years ending in 1863, 2238 people were struck dead. There were

880 killed during the last decade of the three; of these only 243 were females. When the lightning falls among a crowd it does more mischief to the men than to the women. Animals again are frequently stricken, while the persons in charge of them are spared. The most important point brought out in M. Boudin's report is that the beech is no protection against lightning. The old classical belief, then, endorsed by our *savans* at the recent Manchester meeting, is an error.—*Pall Mall Gazette.*

FULMINATING POWER.

M. Boudin, in the paper which he has presented to the Academy of Sciences, on the Fulminating Power of Bodies recently struck by Lightning, adduces these remarkable instances. On the 30th of June, 1854, a man was killed by lightning near the Garden of Plants, at Paris; the body remained for some time exposed to a pouring rain. After the storm, two soldiers, in attempting to lift up the body, received two violent shocks. In the other case, which occurred at Zara, Dalmatia, two artillerymen who had been ordered to set up again in their former places two telegraphic posts that had been thrown down during a storm, took hold of the telegraphic wire. Although it was two hours after the storm, there was so much electricity left that the men first experienced a few slight shocks, and then were both thrown to the ground. The hands of both were scorched, and one of them did not even for a time show any signs of life. The other, in attempting to get up, sank down again, and in so doing touched a comrade, who was coming to his assistance, with his elbow. The third man was then thrown down in his turn, experienced various nervous effects, and his arm was marked with a burn at the spot where he had been touched by the other man's elbow.

SIROCCO WIND AT MELBOURNE.

In the *Melbourne Argus* we read of this visitation:—Monday, Feb. 27, 1865—hereafter to be styled "Black Monday" in the annals of Victoria—was a day which will not soon pass from the memory of those who endured its terrible weather. The sun rose sullenly; the day had scarcely set in when began a fierce Sirocco Wind from the north-north-west, exceeding in its velocity and overpowering heat the experience of the last fourteen years. It was felt in nearly equal degree all over the country. Awful bush-fires speedily commenced, and in Melbourne the heavy smoke filled the city like a thick fog. The blasts, which came with the force of a hurricane, were as though they had left the mouth of an oven. The dust filled up every wrinkle of one's clothes and every pore of one's skin. In the streets it was impossible to see many yards ahead. The gloomy atmosphere and semi-opaque sky foreboded that the whole country was on fire, a prognostication nearly warranted by the circumstances. It was remarkable, however, that in the shade in Melbourne the thermometer only stood at 98·50 deg. Such weather could not last, and just before 5 p.m. came the welcome relief of a sudden change of wind to the cool south and a slight fall of rain, which, however, left the atmosphere still sultry in doors. Night brought telegrams telling fearful tales of the devastation in the country. At Ballarat the heat reached 99 deg., and bush-fires raged from Springhill and Learmouth to the border of Bullarook Forest. From Geelong to Ballarat was nearly a line of fire, and numerous houses, fences, and crops, were either burnt up or with difficulty saved. In the country round Daylesford similar disasters occurred. Riddell and Tredennick's large sawmills were saved with extreme difficulty, but many huts were burnt, and the coaches on the road were hardly driven through the lines of burning timber. More directly north of Melbourne, where the Black Forest stretches over such a vast extent of country, matters were even worse, and a striking picture of the trade passing between Taradale and Elphinstone, the flames curling within a few yards of the carriages and destroying even the railway fence. At Sandhurst the thermometer in the shade stood at 105 deg., the heat of the sun was consuming, and the hot blast and heavily-charged atmosphere suffocating. Mr. W. Lockhart Morton, an experienced Australian traveller, has described the country between the Campaspe and Sandhurst as nearly all ablaze. "Between Sandhurst and Castlemaine," he said, "the Alexandrine range, and Mount Alexander itself, presented a magnificent spectacle. The grass had been all consumed, and millions of burning trees and logs were seen over the whole face of the hills." At night, though the wind had changed, the dark canopy of the clouds was lit up with a lurid glare.

CYCLONE AT CALCUTTA.

DR. ANDERSON'S official Report on the damages caused to the Calcutta Botanical Gardens by the Cyclone of the 5th of October, 1864, has only just been published, owing to the mass of detail it was necessary to collect. The gale was more violent at the garden than at Calcutta itself, owing to the place being nearer the centre of the cyclone, and more exposed to the full force of it. Few trees fell before 11 o'clock a.m., and none after 4·30 p.m., yet within this short space of time a paradise was converted into a wilderness. The great baobab-tree of Africa was uprooted, and came down with a crash that caused vibrations in the earth felt at a distance of some hundred yards. Three gigantic specimens of iron-wood, the oldest in the garden, none less than 150 feet high, were levelled to the ground. Many of the most picturesque parts of the garden, resulting from the grouping of trees, no longer exist. Of the whole fine teak avenue leading to Kyd's monument only two mutilated trees remain. Of the splendid grove of mahogany trees, some of which were planted in 1796, thirty-one specimens are blown down. The iron-wood avenue planted by Dr. Wallich, has suffered severely. The water breaking through the river embankment, and flooding the grounds, helped to complete the ruin. The scene presented the morning after the cyclone outdoes description. More than one thousand trees, and innumerable shrubs, lay prostrate. Nothing had been spared. Trees that had not fallen were more or less stripped of their branches. Not a vestige of a leaf, flower, or fruit remained; the lawn, roads, and tanks were blocked up by trees and fallen branches, and hundreds of cartloads of straw had been carried by the water into the grounds. More than seventy years will be required to restore the garden to the splendour in which it was on the night previous to the cyclone. The most singular part about this devastation is that, of the two great classes of plants into which the vegetable kingdom is divided, the endogens suffered the least injury. This produced a striking effect on the scenery. All the exogens being laid low, the country about Calcutta appeared to be covered with only four kinds of trees, the bamboo, the cocoa-nut, the wild date, and the Palmyra.

HEAT IN INDIA.

THE Heat in part of June, 1865, was extraordinary. At Lucknow such heat had not been experienced for years; at seven in the morning of Midsummer-day the thermometer marked 96 deg. At Delhi, for two weeks, it ranged from 106 to 109 deg. At Umballa it reached 120 deg. in the shade. Even natives succumbed in scores to the intense heat. At Lahore it proved fatal to Nuwab Alli Reza Khan, who will be remembered as the guardian of the lives of the Cabul prisoners in 1842. He saved the Lawrences and many others, and for his humanity forfeited his property and his country. He held a large jaghir from the Government in acknowledgment of his invaluable services.—*Delhi Gazette.*

MEAN TEMPERATURE.

MR. GLASHIER has communicated to the British Meteorological Society a paper on the secular increase of mean Temperature, including various records of observations and tables, from which he derives the following remarkable results, and which he states he has tested in various methods in order to prove their accuracy:— "1, That our climate in the last hundred years has altered; 2, That the temperature of the year is two degrees warmer now than it was then; 3, That the month of January is three degrees warmer; and 4, That the winter months are all much warmer, and every month in the year seems to be somewhat warmer than before." He considers that the effect will be to influence agricultural produce and cause the introduction of new fruits. He hopes that the series of observations now in progress all over the world will be patiently continued, in order to ascertain whether any part of the world has become two degrees colder in its mean annual temperature in the last one hundred years, or the world itself has increased generally two degrees in warmth.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the year 1865.

1865. 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 24 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	Gr.		Grs.							In.
Jan.......	29·405	50·2	19·6	30·6	40·9	31·8	9·1	36·3	−1·9	33·0	·188	2·2	0·4	89	550	5	4	9	13	7·2	15	3·3
Feb.......	29·722	52·7	15·5	37·2	42·2	32·2	10·0	36·6	−2·1	32·1	·182	2·1	0·5	83	555	7	5	7	9	7·8	19	1·9
March...	29·720	58·7	23·7	35·0	44·0	31·1	12·9	36·6	−5·4	30·8	·172	2·0	0·5	82	555	14	6	4	7	7·7	10	0·9
April....	29·954	81·5	31·9	49·6	66·3	41·5	24·8	52·3	+5·7	44·0	·288	3·3	1·1	73	542	8	9	7	6	4·2	7	0·4
May......	29·768	78·5	31·4	47·1	67·9	46·3	21·6	56·1	+3·2	47·5	·329	3·6	1·4	73	534	4	3	12	12	6·4	13	4·4
June.....	30·029	87·6	41·2	46·4	73·6	49·9	23·7	60·2	+1·2	50·4	·366	4.1	1·7	70	534	10	7	5	8	5·9	5	2·4
July......	29·796	85·0	47·0	38·0	75·7	54·3	21·4	63·8	+2·1	54·2	·421	4·7	1·9	72	527	5	2	8	16	6·5	11	2·3
Aug......	29·712	78·0	43·2	34·8	70·9	51·5	19·4	59·9	−1·4	53·4	·409	4·5	1·2	80	529	6	2	8	15	7·0	17	4·0
Sept......	30·071	86·0	40·2	45·8	76·4	53·6	22·8	63·9	+7·0	55·9	·447	5·0	1·6	76	531	5	8	8	9	3·2	1	0·2
Oct.......	29·440	71·7	33·5	38·2	60·0	43·7	16·3	50·9	+0·4	47·0	·323	3·6	0·6	87	533	5	7	9	10	6·2	19	5·9
Nov.......	29·720	56·4	31·0	25·4	50·8	38·7	12·1	44·8	+0·8	41·4	·261	3·0	0·4	88	546	6	5	11	8	6·2	18	2·4
Dec.......	30·056	52·7	29·2	23·5	46·7	38·1	8·6	42·4	+2·1	39·4	·241	2·8	0·4	89	554	5	4	13	9	8·3	10	0·9
Means...	29·783	69·9	32·3	37·6	59·6	42·7	16·9	50·3	+1·0	44·1	·302	3·4	1·0	80	541	80 Sum	62	101	122	6·4	145 Sum	29·0 Sum

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 col. 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 50°·3, being 1°·0 above the average of the preceding 24 years; the temperature of the dew point was 44°·1. The mean degree of humidity was 80, complete saturation being represented by 100. Rain fell on 145 days during the year, being 13 days more than in 1863, and 32 days more than last year; the amount of rain collected was 28¾ inches, being 5 inches above the average amount.

The temperature of the first 3 days in the year were considerably below the average, but, with this exception, the first two weeks in January were 5¼ inches above the average temperature. On the 17th day a sudden and marked change set in, cold weather continuing almost uninterruptedly till February 22nd. The mean daily deficiency of temperature during this period was 4°, and on some occasions the daily values varied from 10° to 14° below the average. For a few days after this, a high temperature was experienced, but during the whole of the month of March the average was only exceeded on two days.

During the first 3 or 4 days of April the temperature varied, but on the 5th day a long warm period set in, continuing till the 28th—the mean excess of temperature amounting to as much as 8° daily. An unsettled period followed, which continued till the 16th of May. The temperature was alternately in defect and excess, sometimes to considerable amounts. On the following day (May 17) a change came, bringing more settled and warm weather, lasting with scarcely any intervention till the 10th of June, the temperature being in excess to the mean daily amount of 4¾°. After this period unsettled weather again predominated till the end of the month.

During the whole of the month of July the weather was generally warm, although some few exceptions were experienced. The mean temperature was 2° in excess of the daily amount.

With August very different weather set in, frequent showers occurred, and the temperature decreased considerably. Harvest work was retarded, and fell into arrear. The temperature was particularly low at the commencement of the month, but afterwards became somewhat modified. The mean amount of deficiency from July 31st to August 19th was nearly 3°. After this time the weather was generally cold and unsettled, although the temperature was sometimes above the average.

With September, however, came an auspicious change; the temperature was high, there was but little cloud either during the night or day, the sun shone with great brilliancy, and farmers were enabled to resume the harvest without intermission, and to complete it successfully. Remarkably little rain fell. The average daily excess of temperature of the month amounted to 7¼°; the excess over the average was on several days as much as 14°. The first two weeks of October still continued very warm, the temperature being 3¼° higher than the average. After this time the weather became very unsettled, and the temperature was frequently very low. On the 14th day of November the temperature again became above the average, and from this time till the close of the year the temperature was in excess of the average to the mean daily amount of 3¾°.

The mean temperature of January was 36½°, being nearly 2° below the average of the preceding 24 years, and slightly lower than in 1864.

The mean temperature of February was 36½°, being 2¼° below the average, but 0°·6 above that of 1864.

The mean temperature of March was 36°·6, being 5½° below the average, and 4¾ below that of 1864.

The temperature of March is therefore very remarkable, as we have to go back 20 years to find one so cold—viz., in the year 1845, when it was 35°·2; in 1837 it was 35°·8. The next very cold March was in 1814, when the temperature was 35°·1: and for 25 years before that, there was no instance of such low temperature; in 1789 it was 34°·4; in 1786, 34°·2; in 1785, 33°·9; in 1784, 36°·2; and in 1771 it was 34°·7. From this it will be seen that the month of March was much more frequently cold towards the end of the last century than lately. Usually, February is 2° warmer, and March 5° warmer than January. This year the mean temperature of each month has been almost the same, the usual increase not having taken place.

The mean temperature of April was 52°·3, being 5¾° above the average, and 4°·1 above last year. This temperature is indeed remarkable; there is no instance on record of one so warm, the nearest approach to it occurring in 1844, when it was 51°·7. There have been only three instances of the temperature exceeding 50° during the last 94 years.

The usual increase in the mean temperature from March to April, is about 5°. In this year, at places south of Lat. 53°, April was from 12° to 17° warmer than March, and at stations more North, the increase varied from 8° to 10°.

The mean temperature of May was 56°·1, being 3°½ above the average of the preceding 24 years, and 2°½ above 1864. This temperature was also remarkable, as we have to refer back 17 years to find one so high.

The mean temperature of June was 60°·2, being 1°·2 above the average.

The average temperature of April, May, and June, was as high as 56°½, and there is no instance on record of such a high temperature.

The mean temperature of July was 63°¾, being 2° above the average, and above that of last year to the same amount.

The mean temperature of August was 59°·9, being 1°·4 below the average of the preceding 24 years.

The mean temperature of September was 63°·9, being 7° above the average, and above the same month of last year, to a like amount.

The temperature of September was remarkable indeed; back to 1771 there is no instance of one so warm, the nearest approach being 3°½ lower—namely, 60°·3, which occurred in 1858.

The mean temperature of these three months was 62°·5. There have only been six instances in which the same period exceeded this amount back to 1771.

Equally, if not more remarkable, is the average temperature of the six months ending September, which, notwithstanding the low temperature in August (which was 1°¼ below its average), ranks the highest period on record. The mean temperature of these six months was 59°·37, the nearest approach to this period occurred in 1846, when it was 59°·13. The difference was 0°·24; still this amount, although apparently small, is considerable, when we remember that the period is one half of a year.

The mean temperature of October was 50°·9, being 0°·4 above the average of 24 years.

The mean temperature of November was 44°·8, being 0°·8 above the average, and 2°·8 above 1864.

The mean temperature of the month of December was 42°·4, being 2°·1 in excess of the average, and 3°·9 above that of last year.

GREAT MAGNETIC STORM.

There has been read to the British Association a "Description of the Magnetic Storm of the beginning of August, 1865, as recorded by the Self-recording Magnetographs at the Kew and Lisbon Observatories," by Messrs. J. B. Capello and B. Stewart. This great magnetic storm will be remembered as occurring at the time when anxiety began to be felt respecting the fate of the Atlantic cable. It first commenced about 40 minutes past five (G.M.T.) in the afternoon of the 2nd of August; but it broke out with great violence, and with those rapid motions which form the mark of a large disturbance, about five o'clock in the morning of the 3rd of August, and this outbreak lasted until midnight of that day or early morn of the 4th of August. The disturbance then ceased for about 24 hours, recommencing a little before midnight of the 4th of August, and lasting till about four o'clock in the afternoon of the next day. There remained, however, traces of the disturbance for a considerable time after.

Obituary

LIST OF PERSONS EMINENT IN SCIENCE OR ART, 1865.

ROBERT LUCAS CHANCE, of Summerfield, Birmingham, of one of the oldest and best-known families engaged in trade at Birmingham. In 1851 it was owing to his firm that the glass for the erection of the Exhibition Building was produced. At that time there was no firm existing in this country capable of producing the glass of the size and weight required under the contract, within the time specified; and had it not been for his capital and enterprising spirit, the work could not have been carried out. The microscopist is indebted to him for the thin glass for mounting his objects; and he did much for the improvement of glass for optical purposes, as well as for the large construction of lighthouse lenses, in which he competed successfully with the French manufacturers.

SAMUEL HUNTER CHRISTIE, who for a long period occupied the post of Professor of Mathematics at Woolwich, being also for several years Secretary to the Royal Society. His numerous papers on magnetism, most of which are given in the *Philosophical Transactions* (1823-36), are evidence of high scientific attainments. He was also author of *An Elementary Course of Mathematics*, of which two parts appeared in 1845, and the third in 1847.

EDWARD EVERETT, the American man of letters and statecraft, formerly editor of the *North American Review*. His long and honourable life was divided between literature and politics.

WILLIAM HUMPHRYS, the line-engraver. He was much employed in making steel vignettes for the ornamentation of bank-notes and other paper securities, at first in Philadelphia and afterwards in London; and it is interesting to record that the well-known portraits of Queen Victoria on the postage-stamps are all produced by mechanical multiplication from the one steel plate engraved by Humphrys.

THOMAS HOLBEIN, who believed himself to be a descendant of Holbein, the famous painter: and having much artistic taste, and a passion for collecting illustrations of every accessible work, whether painting or engraving, of his namesake, he has left a large collection.

SIR ROBERT SCHOMBURGK, known for his famous explorations in British Guiana. He died at Berlin, where his funeral was attended by a large number of scientific men. He leaves behind him a solid scientific reputation.

DR. H. SCHOTT, Director of the Botanical and Geological Gardens at Schönbrunn, near Vienna, who travelled in the Brazils at the beginning of this century; and, almost to the day of his death, continued to publish a great number of sterling works and memoirs on those branches of science which he cultivated.

MELANIE, the wife of WILLIAM LIBRI. Madame Libri gained a Gold Medal from the Institute for an essay on Pascal, and wrote on the subject of the Port-Royalists in the *Quarterly Review*.

WILLIAM LEE, many years a member of the Institute of Painters in Water-Colours (New Society of Painters in Water-Colours).

WILLIAM FREEMAN DANIELL, M.D., well known for his ardour in the pursuit of scientific knowledge during a long residence in various parts of the West Coast of Africa and several successful journeys in the interior of that continent, as well as during his two visits to the West Indies and one to Northern China.

DR. CHARLES RICHARDSON, the laborious compiler of the *Dictionary* which bears his name. It was published by Mr. Pickering, who provided Dr. Richardson with two thousand pounds' worth of books before he sat down to his great labour.

EBENEZER TROTMAN, architect; he was an excellent draughtsman, and had obtained a great mastery in the details of Gothic architecture, which he exhibited in a paper read by him at the Institute about 13 years ago, wherein he showed the results of his curious researches in hundreds of our country churches. He wrote, amongst other contributions, an article on Tudor architecture in Loudon's *Encyclopædia*, which attracted much notice at that comparatively early period.

W. F. WITHERINGTON, R.A., the well-known landscape painter, of whom the *Athenæum* says:—"A very simple set of ideas were presented by this artist's works; these were at any rate unobtrusive and unaffected. Of late years his pictures served to mark what might be called the point of departure of recent landscape-painting in oil, as practised by artists of his own calibre. Since 1849 the general advance in this respect has been great; it seems as if the whole body of artists had gone forward—it may be to secure ground from which a new genius shall start." He died at the age of 79.

MR. GOMPERTZ, well known as the discoverer of the law of diminution of the vital forces—namely, that they lose, on an average, equal proportions in equal times.

LOVELL REEVE, an excellent conchologist, and the Editor of more than one popular book on Shells. He was some time Editor of the *Literary Gazette*.

CHARLES NANTEUIL-LEBŒUF, the eminent French sculptor, and pupil of Cartellier. Several of the statues at Versailles, and a naiad at St. Cloud, are by him.

DR. JOSEPH E. WORCESTER, the American lexicographer, and compiler of "Worcester's Dictionary."

W. C. BURDER, the well-known meteorologist, a frequent contributor of letters on the subject of his favourite science to the *Times*. He was the discoverer of the small but beautiful Comet of March and April, 1864, and also of the large Comet of June and July, 1861, the appearance of which was first publicly notified by him in the *Times* of July 1 that year.

CHRISTIAN H. PANDER, the celebrated Russian naturalist. His long and successful career of scientific activity commenced in 1817 by the publication of his famous memoir on the development of chicks. After publishing, in common with D'Alton, a well-known *Atlas of Comparative Osteology*, his activity took a new direction, as manifested by his geological illustrations of the countries lying between Orenburg and Bokhara, his journey in the Crimea; and particularly by his *Contributions to the Geology of the Russian Empire*. To this last-mentioned work Murchison, De Verneuil, and von Keyserling were greatly indebted, as they fully acknowledged in their large work, *Russia in Europe and the Ural Mountains*. The same authors also benefited much by the assistance of Mr. Pander in their identification of the fossil fishes of the Devonian period in Russia with those of the old red sandstone of Scotland, a subject which was subsequently worked out with great ability by Pander in his remarkable palæontological publication, *The Ichthyolites of the Devonian Rocks of Russia*. Finally, when he died, Dr. Pander had advanced far in the preparation of an elaborate work on the fossils of the carboniferous rocks of the same Empire. Dr. Pander was, we believe, a native of Riga, and, happily for the men of science of Western Europe and America, his works have all been published in the German language. He was member of the Imperial Academy of Sciences at St. Petersburg, and an honorary member of numerous scientific societies of other countries.

PROFESSOR G. P. BOND, the most eminent of American astronomers. The Royal Astronomical Society had just awarded to him the year's Gold Medal.

DR. SAMUEL P. WOODWARD, a distinguished naturalist and palæontologist, who held the office of first-class assistant in the department of Geology and Mineralogy in the British Museum; and had published several treatises on subjects connected with the branches of science he pursued. His father was well known as a geologist.

DR. FRUDENSDORFF, the professor of modern languages in Queen's College, Belfast. Dr. Frudensdorff set out less than a month previously on a tour to the Holy Land, but on reaching Alexandria he was seized with cholera, and died in a few hours.—*Athenæum.*

Encke, the discoverer of the period of revolution of the Comet which bears his name. In early life he was in the Hanseatic artillery, but at the termination of the war in 1815, he became assistant in the observatory at Gotha, and while there received the Cotta prize for a dissertation on the visit of the Comet of 1680. He is principally distinguished for his investigations regarding comets of short periods. About the year 1825, the Berlin observatory was committed to his charge, and in 1830 he became editor of the *Berliner Astronomischen Jahrbuch.*

August Kiss, Professor of Sculpture, known to all the world by his magnificent group of the Amazon, a copy of which was the marvel of Hyde Park, in 1851. Kiss was born in Silesia, received his early training at Gleiwitz, and became a pupil of Rauch in Berlin. His principal works, after the Amazon, were a statue of Frederick the Great, and a group of George and the Dragon.

M. Piria, who was especially remarkable for having laid the foundation of the modern school of chemistry in Italy. As examples of his faculty of combining, by meditation, a long series of experiments, and of producing the results with great accuracy, M. Dumas has referred to M. Piria's researches upon the unpromising substance salicine, from which he produced successively helicine, the sugar of fruits, salicetine and saligenine, formic acid, the oil of spiræa, ulmaria, salicylic acid, &c.

William Sharp M'Leay, A.M., naturalist, formerly of Trinity College, Cambridge, who adopted a Circular System of arrangement in Zoology, by which means the series returned into itself at any point; he, moreover, considered that every group of animals contained five primary and five subordinate, or osculant, types; and that although the arrangement of these five primary types in their own circle was regulated by their affinities, yet their relative positions were tested and proved by relations of analogy existing between the relative points of the various adjacent circles. These were the principles of the circular quinarian system of nature, which were developed with amazing skill in the *Horæ Entomologicæ*. the first part of which appeared in 1819, the second in 1821. This work was followed by various memoirs, published in the *Transactions of the Linnean Society and Zoological Journal*, and the views set forth in these writings were adopted and developed by various naturalists of eminence—namely, by Mr. Vigors in ornithology, Dr. Horsfield in lepidoptera, and especially by Mr. Swainson, who, however, maintained a primary quinarian division of groups. Mr. M'Leay was for several years engaged in Cuba in connexion with the suppression of the slave trade, and where he formed large collections of insects, which, together with those of his father (one of the founders of the Linnean Society), were removed to Australia on Mr. W. S. M'Leay taking up his residence in that country.—*Abridged from the Athenæum.*

Sir William Jackson Hooker, D.C.L., eminent botanist, Director of the Royal Gardens at Kew. From early youth he devoted himself to botanical studies, eventually becoming Regius Professor of Botany in the University of Glasgow. That appointment, however, he gave up for the directorship of the Royal Gardens at Kew. Sir William was the author of *The British Flora, Flora Borealis Americana, Icones Filicum, Genera Filicum*, &c., and the botanical portion of the work to Admiral Beechey's account of his voyage of discovery in the Arctic regions. He was a member of nearly all the learned and scientific societies, both upon the Continent and in America, and Knight of the Legion of Honour. He, with the assistance latterly of his son, Dr. Joseph Hooker, a botanist of no less reputation, made the collection of living plants, and the museum of botanical specimens at Kew, the most extensive, and in every way the most perfect, in the world. As Editor of the *Journal of Botany and Kew Garden Miscellany*, Sir William Hooker has described and classified a great number of new plants; while his little manual, *The Guide to Kew Gardens*, has been of equal popular usefulness to the multitude of inquiring visitors, who owe much of their enjoyment of Kew Gardens to the sound and practical qualifications of Sir William Hooker.

Alexander Smith, Curator of the Herbarium at Kew, and only son of Mr. John Smith, one of our leading pteridologists. By untiring industry he had made himself the best economic botanist in Europe.

Leon Dufour, one of the veteran naturalists of France. Intimately connected with Cuvier, Latreille, and other eminent zoologists, who during the first half of the present century, by their minute investigations into the structure both internal and external of animals, formed such a perfect contrast to the vague school of French philosophers of the preceding century, M. Dufour ceased not for fifty-four years to bring before the public the results of his microscopical examinations of the insect world; these were published, for the most part, as detached memoirs, in the *Annales Générales de Bruxelles*, the *Annales des Sciences Naturelles*, the *Annales* of the Entomological Society of France, and indeed in almost every French periodical devoted to the Natural Sciences, the first in date having appeared in the *Annales du Muséum d'Histoire Naturelle* for 1811, and the last having been published since the author's decease.

G. H. R. Young, sculptor.

C. B. Neilson, engineer.

Colonel Charras, military tactics.

Dr. Hugh Falconer, botanist and palæontologist: Vice-President of the Royal Society.

Francis Pierre Gratiolet, physiologist.

The Rev. C. H. Hartshorne, antiquary.

Amand Gressby, Swiss geologist.

Henry Christie, antiquary.

Charles Waterton, the celebrated traveller and naturalist.

Hugh Cuming, the distinguished natural history traveller, and the possessor of the finest and most extensive conchological collection that has ever been formed. Even as a child, his love of plants and shells displayed itself in a most remarkable manner. In 1819 he made a voyage to Valparaiso, and settled in business as a sail-maker. Here his passion for collecting shells found an ample field for its development, and was greatly stimulated and assisted, among others, by Lieutenant Frembly, and the officers of the surveying ships, under the command of Captains King and Fitzroy. In 1826, Mr. Cuming gave up his business, and built a yacht expressly fitted for the stowage of objects of Natural History, and made a cruise of upwards of twelve months among the islands of the South Pacific, in dredging and collecting by sea and shore. On his return to Valparaiso, he made a more extended voyage along the western coast of America. After two years spent in exploring the coast from the Island of Chiloe, in lat. 44° S., to the Gulf of Conchagau, in lat. 13° N., dredging, while under sail and at anchor, in the bays and inlets, searching among the rocks, turning over the stones at low water, and rambling inland over the plains, rivers, banks, and woods, Mr. Cuming returned with all his accumulated stores of plants and animals to his native land. In 1835 he determined to undertake a new expedition, and fixed upon the Philippine Islands, rich in natural productions, and little explored. After four years spent among the Philippine group, and short visits to Malacca, Singapore, and St. Helena, Mr. Cuming returned to England with the richest booty that had ever been collected by a single man. His dried plants, which numbered 130,000 specimens, large numbers of birds and reptiles, quadrupeds and insects, also were added to the museums at home and abroad. But his collection of shells formed by far the most important part of the spoils which he had secured. It is stated by Mr. Reeve that his collection contains not fewer than 30,000 species and varieties, and in most cases several specimens of each. "The great object of my ambition," wrote Mr. Cuming in the year 1858, "is to place my collection in the British Museum, so that it may be accessible to all the scientific world, and where it would afford to the public a striking example of what has been done by means of the personal industry of one man." This object, it is hoped, will be realized.—*Abridged from the Athenæum.*

Dr. John Lindley, F.R.S., Professor of Botany in University College. After leaving the Grammar School of Norwich, Lindley devoted his attention to botanical science. In 1819 he published a translation of *Richard's*

Analyse du Fruit, and in 1820, a work entitled *Monographia Rosarum*, in which he described several new species of roses. About the same period he contributed to the *Transactions of the Linnæan Society* various papers on botanical subjects. He was next engaged by Mr. Loudon to write the descriptive portion of his *Encyclopædia of Plants*, completed in 1829. In the same year he was appointed Professor of Botany at the London University. At this period the Linnæan system was almost universally followed by English botanists. Dr. Lindley early saw the necessity of superseding the artificial by the natural classification of plants. In an essay on this subject published in 1830, he showed very clearly what the advantages of this system were. Two years later he published the *Introduction to Systematic and Physiological Botany, and a Synopsis of the British Flora*, in which our indigenous plants are arranged and described for the first time according to the natural system. In a *Natural System of Botany*, published in 1836, Dr. Lindley took new views of botanical classification, and proposed a new nomenclature for the families of plants. Ten years later, his great work, *The Vegetable Kingdom*, was published. This work, the most elaborate that had appeared on systematic botany, gives a description of all the families of plants, and more especially of those useful to man. While engaged in writing these works, Dr. Lindley was most diligently employed, as a practical botanist, in describing new species, on which he wrote a large number of papers contributed to botanical publications. In 1841 he became Editor of the *Gardeners' Chronicle*, which he conducted with great ability.

JOSEPH PARKES, politics.

SIR JOHN WILLIAM LUBBOCK, Bart., astronomer, F.R.S., and its Vice-President and Treasurer. He closed his career at Cambridge in January, 1825, obtaining only the degree of first Senior Optime. This at the time surprised those who knew that he was one of the strongest mathematicians of the year. The truth was that he turned his particular attention to the branches of astronomy in which he was afterwards distinguished; and, having no reason to seek University honours for aid in his future life, he was content to take what he could get on his own terms as to study. Throughout his life he applied himself to the lunar theory and subjects connected with it. Out of the higher departments of astronomy he was known by the excellent work on *Probability*, which he contributed to the *Library of Useful Knowledge*, in conjunction with his friend Drinkwater (afterwards Drinkwater-Bethune). Sir John Lubbock, especially when young, had very decided opinions, and, in a scientific discussion, would not unfrequently stand alone. But he had a genuine modesty of character which kept him far within what was due to others. He was keenly sensible to difference of opinion; but a scientific comrade used to say of him that it made him angry with himself, and not with his opponents. He has left behind him a son who is well known to the scientific world, and will add new honour to the name.—*Athenæum*.

THOMAS HANCOCK, of Stoke Newington, the father of the India-rubber or Caoutchouc manufactures. Some years ago he published a work entitled *The Origin and Progress of the India Rubber Manufactures*. This work must have cost a man seventy-three years of age a considerable amount of labour. The statistics are elaborately given, as also engravings of most of the goods manufactured by Messrs. Macintosh and Co., of Manchester, of which firm he was for some years the senior partner. The late Mr. Brockedon always spoke of him as having done service to Science and Art, especially in the matter of elastic moulds for bas-reliefs.

DR. WILLIAM FERGUSSON, medicine.

WILLIAM FRANCIS DANIEL, naturalist.

CHARLES OCTAVIUS PARNELL, architect.

SIR JOHN RICHARDSON, F.R.S., the distinguished naturalist. After long service as navy surgeon, he was employed in three separate Expeditions of search and discovery in the Arctic Regions, being seven years in those territories. He was the companion of Sir John Franklin, and went, accompanied by Dr. Rae, in search of the unfortunate Expedition under command of his former companion and relative. Sir John, who received the honour of knighthood in 1846, was a Fellow of the Royal Society and of several other learned Societies, and an honorary D.C.L. of Trinity College, Dublin. He was the author of *The Fauna Borealis—America, The Zoological Appendix to Sir Edward Parry's Second Voyage, The Ichthyology of the Erebus and Terror and of the Sulphur*, and of several Reports and scientific papers on Arctic travels. He was a most amiable and kind friend and companion, with untiring energy and great firmness of purpose ; indeed, there are few accounts on record more instructive, and showing greater energy and kindness, than this narrative of the hardships he and his party underwent, so simply recorded by him in Franklin's *Overland Journey.—Athenæum.*

SIR WILLIAM ROWAN HAMILTON, LL.D., Andrews Professor of Astronomy in the University of Dublin (Trinity College), Astronomer Royal of Ireland. When only six years old he was acquainted with Greek and Latin; and before he attained the age of fourteen he had a knowledge of no less than thirteen languages, including Arabic, Hindustanee, Persian, Sanscrit, Malay, and Syriac. With the study of languages, he combined mathematics in an eminent degree. He was the inventor of that new algebra, which he called the theory of *Quaternions*. He was, it is known, occupied upon a new work in development of his invention: those who take interest in the matter will be glad to hear that the printing of this new work was all but finished when he died.

JOHN F. HERRING, animal painter.

M. DUPIN (l'Ainé), jurisprudence.

ADMIRAL W. H. SMYTH, F.R.S., one time an active and prominent member of the scientific life of the metropolis. As president of the Astronomical Society; founder, and subsequently president, of the Geographical Society; vice-president, foreign secretary, and for many years member of the council of the Royal Society; director of the Society of Antiquaries, Visitor of Greenwich Observatory, one of the founders of the United Service Institution; in these and many similar capacities his untiring energy, extensive and varied acquirements, sterling integrity and honour, and his genial, social qualities, exercised a great influence for good through the important circle in which he moved. He entered the navy at an early age, and served with considerable distinction in nearly all parts of the world, during the war which terminated in 1815. He employed the following ten years in making those Surveys of the less known parts of the bed and coasts of the Mediterranean which will ever associate his name with the history of that sea. Retiring in 1825 from marine life, he entered upon another phase in his scientific career, and commenced in his observatory at Bedford that laborious and accurate series of astronomical observations which resulted in the publication of the "Cycle of Celestial Objects," including the "Bedford Catalogue," a work universally acknowledged as one of the best handbooks of practical astronomy extant. Besides hydrography and astronomy, the Admiral was an ardent cultivator of some branches of archæology, more especially numismatics. Admiral Smyth married at Messina, in 1815, the only daughter of Mr. T. Warrington, of Naples, a lady of great accomplishments, and who was the constant and devoted companion of all his scientific labours. He left in MS., complete, a "Nautical Dictionary," which will shortly be printed.

ADMIRAL ROBERT FITZROY, whose valuable services to the country, in his surveying expedition to the coasts of South America, cost him beyond 6100*l*., for which he was never compensated in any way. Admiral Fitzroy rendered other services to the country. The latest and the most important of these were his labours in the Meteorological Department of the Board of Trade. It is only necessary to allude to "Fitzroy's drum," to recall the advantages which have resulted from the extension round our shores of the means devised by him of forecasting the weather. The work was not accomplished without immense labour, and indeed it was to the over-exertion of body and mind which it involved that we must attribute the premature loss of this distinguished officer.

TRAUGOTT BROMINE, German geographer.

ISAAC TAYLOR, writer and inventor. His mind presented a rare union of artistic, mechanical, and literary genius. The originality and power exhibited in some of his early designs, engraved for Boydell's Bible, have been noticed in Gilchrist's *Life of Blake*. One of the most complicated and beautiful pieces of mechanism now at work in Manchester is Mr. Taylor's machine for engraving patterns on rollers for calico-printing. The plates which illustrate Trail's *Josephus* were engraved by this process. Two volumes of Essays have recently been gathered from various publications.

THOMAS JOSEPH PETTIGREW, F.R.S., F.S.A., who devoted himself to the study of archæology, in which he became so proficient that he was one of the greatest authorities in England on the subject. He was a leading member of the Society of Antiquaries, and treasurer of the British Archæological Association, in whose deliberations he took a constant and most useful part; he was connected with other of the leading antiquarian societies in England, with that of Normandy, and with many more in different parts of Europe. His publications are very numerous; but that by which he will be best known is the *Bibliotheca Sussexiana*. Mr. Pettigrew's high character, intellectual and agreeable manners, and benevolent disposition, had won for him a host of friends.

GEORGE APPOLD, F.R.S., well known among engineers and men of science for his great ingenuity as an amateur mechanician. His centrifugal pumps formed striking features of our Great Exhibitions both in 1851 and 1862. The paying-out apparatus used in laying submarine telegraphs was mainly his contrivance; and he, at least, shared with Mr. Hawkshaw the credit of first suggesting the use of syphons for draining off the flood waters in the fen country, when the embankment there gave way some time ago. The most remarkable proofs of his cleverness as an inventor, however, were collected in his own house and the works adjoining it. There everything that could be made so was automatic. The doors opened as you approached them, and closed after you had entered; water came unbidden into the basins; when the gas was lighted the shutters closed; a self-acting thermometer prevented the temperature rising or falling above or below certain fixed points; and the air supplied for ventilation was both washed to cool and screened to cleanse it from blacks. Even the gates of his stableyard opened of themselves as he drove through, and closed again without slamming. Mr. Appold was a dresser of furs by a secret process, which he practised successfully for many years, and which secured him a practical monopoly of the trade; and he always maintained that this was a far more effectual way of working an invention than any patent.

SIR JOSEPH PAXTON, who rose from the ranks to be the greatest gardener of his time, the founder of a new style of architecture, and a man of genius, who devoted it to objects in the highest and noblest sense popular. Though humbly born, he was still a young man, and in the employ of the Royal Horticultural Society, when he attracted the attention of the late Duke of Devonshire; and it is a striking example of the opportunities which men of high rank possess of winning reputation, that the house of Cavendish should have had a sensible addition made to its lustre by the judicious selection of a gardener. Under the skill of Paxton the wild Derbyshire region in which Chatsworth stands became the wonderful place which drew visitors from far and near; its hothouses, where the Victoria Regia was first compelled to blossom; and the great conservatory, which was the precursor of the Crystal Palaces in Hyde Park and at Sydenham—all are now become familiar objects of admiration. When the scheme of the first Great Exhibition threatened to fall through for want of a suitable building, and the architects and engineers had brought matters to a dead lock, Paxton came with his simple but comprehensive design, and all difficulty vanished. The genial gardener was so clearly and unmistakeably right in what he proposed, and he had so many backers in every direction, that, after 233 plans had been rejected, Paxton's was accepted. The fairy structure was erected, and, as all the world well remembers, the greatest triumph of the Great Exhibition was loudly proclaimed to be the Building. After the Exhibition, the Crystal Palace was removed from Hyde Park to the first slope of the Surrey hills, and reconstructed there by Sir Joseph Paxton, amidst terraces and fountains, and a landscape of surpassing beauty and extent. It has cost a million and a half of money, but bit by bit its self-supporting character becomes more firmly established. Paxton had many fellow-workers, and he was not the man to deny any of them their share, but he was the foremost among them. This was Paxton's *magnum opus*, and will now be his monument. He built several great country-houses. During the Crimean War he organised a Navvy Corps, which did excellent service in road-making and other works for the army. He wrote and published several horticultural works. He followed the profession of an architect and civil engineer from the time he constructed the Crystal Palace. His friend and patron, the Duke of Devonshire, died a few years before him, and shortly before his death, handed him a life policy for 20,000*l*. Paxton sat in Parliament for Coventry. His real title to the regrets of his contemporaries and the regard of those who come after, is the work which he did as a gardener and garden architect; the impulse which he has given to the love of the beautiful in nature, especially among our great town populations; above all, the English breadth and genuineness of his character, which made him the object of affectionate regard to so many friends. Paxton's great good fortune threw him among persons and engaged him upon objects which made his case from the commencement an exceptional one. We abridge this truthful *précis* from the *Times* journal. A judicious estimate of Sir Joseph Paxton's professional attainments has appeared in the *Builder*.

CAPTAIN FOWKE, R.E., designer of the International Exhibition, 1862, and of the South Kensington Museum. At the Society of Arts, in a brief but touching memoir of this officer and fellow-member, Mr. Henry Cole, C.B., said with regard to Captain Fowke's great work:—"On a former occasion I explained in this room the reasons for which he had been chosen as architect of the International Exhibition of 1862. In this case the problem was not to erect a gay building to last a few months only, but to fill a very large space in such a way, and at a limited cost, that it might hereafter be made permanent. It is obvious he had no funds for decoration. Although for the purposes of exhibition, the exhibitors pronounced the structure as the most successful for the purpose which had hitherto been made in respect of lighting, ventilation, and general convenience, the public did not believe that it could be made properly decorative, and the House of Commons declined to purchase it at the cost of the old materials. Looking back dispassionately on the past, I have learnt to think that this was a wise decision; but during the controversy, which bore very hard upon the architect, it was impossible that any man could show higher qualities of patience, resignation, and gentlemanly bearing than did Captain Fowke, and at last the public made amends to him for its injustice. In an open competition to the world, in which some of the most eminent architects competed, the five judges, of whom three had taken an active personal part in causing the pulling down of the Exhibition building, unanimously awarded to his design the first prize, and the architectural press and public fully confirmed the decision. We may hope to see this magnificent design properly realised. Moreover, in the forthcoming Paris Exhibition, the exact proportions and size of the picture galleries of the Exhibition of 1862 have been avowedly adopted as incapable of improvement. 'I firmly believe that the arts of construction in this country have sustained a great loss by Captain Fowke's death.'"

NICHOLAS WOOD, F.R.S., F.G.S., and member of the Institution of Civil Engineers. Wherever the early history of the two Stephensons and of the locomotive is known there also is known the name of Nicholas Wood. He was the first English writer of note on Railway Travelling, and to have been one of the pioneers in this gigantic march of human progress is an honour of which the relatives and friends and fellow-countrymen of Mr. Wood may well be proud. He lived long, not only to witness the extraordinary progress of one of the greatest improvements the world has ever known, but to take a most active part in the actual execution of such works. When public opinion was most divided on the relative value of canal and railroad transit, Mr. Wood professed to give only the result of such facts as had come under his own knowledge, and of experiments made with the express view of obtaining the requisite information. Many minute details were embodied in his work, *A Practical Treatise on Railroads and Interior Communication in General*, first published in April, 1825. It was followed in 1831 and 1838 by greatly enlarged and improved editions. In the preface to the third edition we find a full explanation of that which constitutes the great merit of Mr. Wood's first efforts. Railways, he states, were when the first edition appeared "quite in a state of infancy." They had been almost exclusively confined to private purposes, for the conveyance of coal, lead, iron, &c. And he adds, that, though their utility for such works was never questioned, "it yet remained to be proved how far they were applicable and useful as an independent and distinct mechanical process for the purposes of general traffic." That George Stephenson took an active part in the various experiments does in no way take away from the merit of him who authorised and found the means for extensive and expensive trials with engines, inclined planes, and other modes of moving heavy goods, and committed to writing and gave to the public the result of their united labours. True it is that in 1825 it was thought even by Mr. Wood a visionary hope that a speed of 12, 16, 18, or 20 miles an hour could be accomplished. Equally true that in 1838 Mr. Wood acknowledged with some surprise that on the Liverpool railway an average rate of 15 miles was kept up with the greatest ease; and on an extraordinary occasion nearly double that rate, or 30 miles in one hour, had been attained. It is by such admissions that we perceive the slow degrees by which a knowledge of practical results is advanced. Mr. Wood was the calm and patient investigator who paved the way for the illustrious Stephensons, and prepared the public mind to listen to and sanction innovations in travelling such as are without parallel in the history of the world. After giving a general account of various modes of internal travelling and of their successive transitions into then existing modes, Mr. Wood described the first introduction of railroads (the name of "railway" had not then obtained)—the gradual improvement from wooden to cast and malleable iron rails. He confined his experiments on rails to such as were then actually in use, and described the form and construction of such carriages as were then employed, and which we may here observe were almost entirely waggons for conveying coal. The various rates of inclination of lines of railway were specially experimented upon, and numerous tables were given of the results both as regards self-acting and other inclined planes, and the work of the few and very imperfect locomotive engines then known. Experiments were made on the strength of cast and malleable iron with a view to ascertain the proper strength of rails, and many trials were made to ascertain the friction or resistance of carriages when moving on rails.—Abridged from the *Hexham Courant*.

George Richards Elkington, patentee of the electro-plating and gilding processes, which he introduced commercially in the year 1840.

GENERAL INDEX.

THE END.

JOHN TIMBS'S POPULAR WORKS—*continued.*

Walks and Talks About London. By JOHN TIMBS, F.S.A., Author of 'Curiosities of London,' 'Things not Generally Known,' &c. Contents:—About Old Lyons Inn—Last Days of Downing Street—Walks and Talks in Vauxhall Gardens—Last of the Old Bridewell—The Fair of May Fair—From Hicks's Hall to Campden House—Talk about the Temple—Recollections of Sir Richard Phillips—Curiosities of Fishmongers' Hall—A Morning in Sir John Soane's Museum—A Site of Speculation—Changes in Covent Garden—Last of the Fleet Prison—Forty Years in Fleet Street—Changes at Charing Cross Railway London—Blackfriars Bridge—Raising of Holborn Valley—An Old Tavern in St. James's. With Frontispiece, post 8vo. cloth gilt, 8s 6d.

'The London of the last generation is, day by day, being rent away from the sight of the present, and it is well that Mr. Timbs is inclined to walk and talk about it ere it vanishes altogether, and leaves the next generation at a loss to understand the past history of the metropolis so far as it has a local colouring, as so very much of it has. Much of this has now gone for ever, but our author has watched the destructive course of the "improver," and thanks to his industry, many a memory that we would not willingly let die, is consigned to the keeping of the printed page, which in this instance, as in so many others, will doubtless prove a more lasting record than brass or marble.'—GENTLEMAN'S MAGAZINE.

Things to be Remembered in Daily Life. With Personal Experiences and Recollections. By JOHN TIMBS. F.S.A., Author of 'Things not Generally Known,' &c. &c. With Frontispiece. Fcp. 3s. 6d. cloth.

'While Mr. Timbs claims for this volume the merit of being more reflective than its predecessors, those who read it will add to that merit—that it is equally instructive.'—NOTES AND QUERIES.

'No portion of this book is without value, and several biographical sketches which it contains are of great interest. . . . . "Things to be Remembered in Daily Life" is a valuable and memorable book, and represents great research, and considerable and arduous labour.'—MORNING POST.

'Mr. Timbs's personal experiences and recollections are peculiarly valuable, as embodying the observations of an acute, intelligent, and cultivated mind. "Things to be Remembered" carries with it an air of vitality which augurs well for perpetuation.'—OBSERVER.

School-days of Eminent Men. Containing Sketches of the Progress of Education in England, from the Reign of King Alfred to that of Queen Victoria; and School and College Lives of the most celebrated British Authors, Poets, and Philosophers; Inventors and Discoverers; Divines, Heroes, Statesmen, and Legislators. By JOHN TIMBS, F.S.A. Second Edition, entirely revised and partly re-written. With a Frontispiece by John Gilbert, 13 Views of Public Schools, and 20 Portraits by Harvey. Fcap. 5s. handsomely bound in cloth.

☞ Extensively used, and specially adapted for a Prize-Book at Schools.

'The idea is a happy one, and its execution equally so. It is a book to interest all boys, but more especially those of Westminster, Eton, Harrow, Rugby, and Winchester; for of these, as of many other schools of high repute, the accounts are full and interesting.'—NOTES AND QUERIES.

Something for Everybody; and a Garland for the Year. By JOHN TIMBS, F.S.A., Author of 'Things Not Generally Known,' &c. With a Coloured Title, post 8vo. 5s. cloth.

'This volume abounds with diverting and suggestive extracts. It seems to us particularly well adapted for parochial lending libraries.'—SATURDAY REVIEW.

'Full of odd, quaint, out-of-the-way bits of information upon all imaginable subjects is this amusing volume, wherein Mr. Timbs discourses upon domestic, rural, metropolitan, and social life; interesting nooks of English localities; time-honoured customs and old-world observances; and, we need hardly add, Mr. Timbs discourses well and pleasantly upon all.'—NOTES AND QUERIES, July 20, 1861.

BOOKS FOR NURSERY OR MATERNAL TUITION.

The First or Mother's Dictionary. By Mrs. JAMESON (formerly Mrs. MURPHY). Tenth Edition. 18mo. 2s. 6d. cloth.

*** Common expletives, the names of familiar objects, technical terms and words, the knowledge of which would be useless to children, or which could not well be explained in a manner adapted to the infant capacity, have been entirely omitted. Most of the definitions are short enough to be committed to memory; or they may be read over, a page or two at a time, till the whole are sufficiently impressed on the mind. It will be found of advantage if the little pupils be taught to look out for themselves any word they may meet with, the meaning of which they do not distinctly comprehend.

School-Room Lyrics. Compiled and Edited by ANNE KNIGHT. New Edition. 18mo. 1s. cloth.

La Bagatelle; intended to introduce Children of five or six years old to some knowledge of the French Language. Revised by Madame N. L. New Edition, with entirely New Cuts. 18mo. 2s. 6d. bound.

This little work has undergone a most careful revision. The orthography has been modernized, and entirely new woodcuts substituted for the old ones. It is now offered to parents and others engaged in the education of young children, as well adapted for familiarizing their pupils with the construction and sounds of the French language, conveying at the same time excellent moral lessons.

'A very nice book to be placed in the hands of children; likely to command their attention by its beautiful embellishments.'—PAPERS FOR THE SCHOOLMASTER.

'A well-known little book, revised, improved, and adorned with some very pretty new pictures. It is, indeed, French made very easy for very little children.'
THE SCHOOL AND THE TEACHER.

Chickseed without Chickweed: being very Easy and Entertaining Lessons for Little Children. In Three Parts. Part I. in words of three letters. Part II. in words of four letters. Part III. in words of five or more letters. New Edition, with beautiful Frontispiece by Anelay, 12mo. 1s. cloth.

A book for every mother.

Peter Parley's Book of Poetry. With numerous Engravings New Edition, revised, with Additions, 16mo. 1s. 6d. cloth.

This little volume consists, in part, of extracts from various publications, and in part of original articles written for it. It is designed to embrace a variety of pieces, some grave, and some gay; some calculated to amuse, and some to instruct; some designed to store the youthful imagination with gentle and pleasing images; some to enrich the mind with useful knowledge; some to impress the heart with sentiments of love, meekness, truth, gentleness, and kindness.

Cobwebs to Catch Flies; or Dialogues in short sentences. Adapted for Children from the age of three to eight years. In Two Parts. Part I. Easy Lessons in words of three, four, five, and six letters, suited to children from three to five years of age. Part II. Short Stories for Children from five to eight years of age. 12mo. 2s. cloth gilt.

*** The Parts are sold separately, price 1s. each.

DELAMOTTE'S WORKS
ON ILLUMINATION, ALPHABETS, &c.

A Primer of the Art of Illumination, for the use of Beginners, with a Rudimentary Treatise on the Art, Practical Directions for its Exercise, and numerous Examples taken from Illuminated MSS., and beautifully printed in gold and colours. By F. DELAMOTTE. Small 4to. price 9s. cloth antique.

'A handy book, beautifully illustrated; the text of which is well written, and calculated to be useful......The examples of ancient MSS. recommended to the student, which, with much good sense, the author chooses from collections accessible to all, are selected with judgment and knowledge, as well as taste.'—ATHENÆUM.

'Modestly called a Primer, this little book has a good title to be esteemed a manual and guide-book in the study and practice of the different styles of lettering used by the artistic transcribers of past centuries....An amateur may with this silent preceptor learn the whole art and mystery of illumination.'—SPECTATOR.

'The volume is very beautifully got up, and we can heartily recommend it to the notice of those who wish to become proficient in the art.'—ENGLISH CHURCHMAN.

'We are able to recommend Mr. Delamotte's treatise. The letterpress is modestly but judiciously written; and the illustrations, which are numerous and well chosen, are beautifully printed in gold and colours.'—ECCLESIOLOGIST.

The Book of Ornamental Alphabets, Ancient and Mediæval, from the Eighth Century, with Numerals. Including Gothic, Church-Text, large and small; German, Italian, Arabesque. Initials for Illumination, Monograms, Crosses, &c., &c., for the use of Architectural and Engineering Draughtsmen, Missal Painters, Masons, Decorative Painters, Lithographers, Engravers, Carvers, &c. &c. Collected and Engraved by F. DELAMOTTE, and printed in Colours. Fourth Edition, royal 8vo. oblong. price 4s. cloth.

'A well-known engraver and draughtsman has enrolled in this useful book the result of many years' study and research. For those who insert enamelled sentences round gilded chalices, who blazon shop legends over shop-doors, who letter church walls with pithy sentences from the Decalogue, this book will be useful. Mr. Delamotte's book was wanted.'—ATHENÆUM.

Examples of Modern Alphabets, Plain and Ornamental. Including German, Old English, Saxon, Italic, Perspective. Greek, Hebrew, Court Hand, Engrossing, Tuscan, Riband, Gothic, Rustic, and Arabesque. with several original Designs. and Numerals. Collected and Engraved by F. DELAMOTTE, and printed in Colours. Royal 8vo. oblong, price 4s. cloth.

'To artists of all classes, but more especially to architects and engravers, this very handsome book will be invaluable. There is comprised in it every possible shape into which the letters of the alphabet and numerals can be formed, and the talent which has been expended in the conception of the various plain and ornamental letters is wonderful.'—STANDARD.

Mediæval Alphabet and Initials for Illuminators. By F. G. DELAMOTTE. Containing 21 Plates, and Illuminated Title, printed in Gold and Colours. With an Introduction by J. WILLIS BROOKS. Small 4to. 6s. cloth gilt.

'A volume in which the letters of the alphabet come forth glorified in gilding and all the colours of the prism interwoven and intertwined and intermingled, sometimes with a sort of rainbow arabesque. A poem emblazoned in these characters would be only comparable to one of those delicious love letters symbolised in a bunch of flowers well selected and cleverly arranged.'—SUN.

The Embroiderer's Book of Design, containing Initials, Emblems, Cyphers, Monograms, Ornamental Borders, Ecclesiastical Devices, Mediæval and Modern Alphabets and National Emblems. By F. DELAMOTTE. Printed in Colours. Oblong royal 8vo. 2s. 6d. in ornamental boards.

The Fables of Babrius. Translated into English Verse from the Text of Sir G. Cornewall Lewis. By the Rev. JAMES DAVIES, of Lincoln Coll. Oxford. Fcap. 6s. cloth antique.

'"Who was Babrius?" The reply may not improbably startle the reader. Babrius was the real, original Æsop. Nothing is so fabulous about the fables of our childhood as their reputed authorship.'—DAILY NEWS.

'A fable-book which is admirably adapted to take the place of the imperfect collections of Æsopian wisdom which have hitherto held the first place in our juvenile libraries.'—HEREFORD TIMES.

NEW ANECDOTE LIBRARY.

Good Things for Railway Readers. 1000 Anecdotes, Original and Selected. By the Editor of 'The Railway Anecdote-book.' Large type, crown 8vo. with Frontispiece, 2s. 6d.

'A capital collection, and will certainly become a favourite with all railway readers.'—READER.

'Just the thing for railway readers.'—LONDON REVIEW.

'Fresh, racy, and original.'—JOHN BULL.

'An almost interminable source of amusement, and a ready means of rendering tedious journeys short.'—MINING JOURNAL.

'Invaluable to the diner-out.'—ILLUSTRATED TIMES.

Sidney Grey: a Tale of School Life. By the Author of 'Mia and Charlie.' Second Edition, with six beautiful Illustrations. Fcp. 4s. 6d. cloth.

The Innkeeper's Legal Guide: What he Must do, What he May Do, and What he May Not Do. A Handy-Book to the Liabilities, limited and unlimited, of Inn-Keepers, Alehouse-Keepers, Refreshment-House Keepers, &c. With verbatim copies of the Innkeeper's Limited Liability Act, the General Licensing Act, and Forms. By RICHARD T. TIDSWELL, Esq., of the Inner Temple, Barrister-at-Law. Fcap. 1s. 6d. cloth.

'Every licensed victualler in the land should have this exceedingly clear and well arranged manual.'—SUNDAY TIMES.

The Instant Reckoner. Showing the Value of any Quantity of Goods, including Fractional Parts of a Pound Weight, at any price from One Farthing to Twenty Shillings; with an Introduction, embracing Copious Notes of Coins, Weights, Measures, and other Commercial and Useful Information: and an Appendix, containing Tables of Interest, Salaries, Commissions, &c. 24mo. 1s. 6d. cloth, or 2s. strongly bound in leather.

☞ Indispensable to every housekeeper.

Science Elucidative of Scripture, and not antagonistic to it. Being a Series of Essays on—1. Alleged Discrepancies; 2. The Theories of the Geologists and Figure of the Earth; 3. The Mosaic Cosmogony; 4. Miracles in general—Views of Hume and Powell; 5. The Miracle of Joshua—Views of Dr. Colenso: The Supernaturally Impossible; 6. The Age of the Fixed Stars—their Distances and Masses. By Professor J. R. YOUNG, Author of 'A Course of Elementary Mathematics,' &c. &c. Fcap. 8vo. price 5s. cloth lettered.

'Professor Young's examination of the early verses of Genesis, in connection with modern scientific hypotheses, is excellent.'—ENGLISH CHURCHMAN.

'Distinguished by the true spirit of scientific inquiry, by great knowledge, by keen logical ability, and by a style peculiarly clear, easy, and energetic.' NONCONFORMIST.

'No one can rise from its perusal without being impressed with a sense of the singular weakness of modern scepticism.'—BAPTIST MAGAZINE.

Mysteries of Life, Death, and Futurity. Illustrated from the best and latest Authorities. Contents:—Life and Time; Nature of the Soul; Spiritual Life; Mental Operations; Belief and Scepticism; Premature Interment; Phenomena of Death; Sin and Punishment; The Crucifixion of Our Lord; The End of the World; Man after Death; The Intermediate State; The Great Resurrection; Recognition of the Blessed: The Day of Judgment; The Future States, &c. By HORACE WELBY. With an Emblematic Frontispiece, fcp. 5s. cloth.

'This book is the result of extensive reading, and careful noting; it is such a common-place book as some thoughtful divine or physician might have compiled, gathering together a vast variety of opinions and speculations, bearing on physiology, the phenomena of life, and the nature and future existence of the soul. We know of no work that so strongly compels reflection, and so well assists it.'
LONDON REVIEW.

'A pleasant, dreamy, charming, startling little volume, every page of which sparkles like a gem in an antique setting.'—WEEKLY DISPATCH.

'The scoffer might read these pages to his profit, and the pious believer will be charmed with them. Burton's "Anatomy of Melancholy" is a fine suggestive book, and full of learning: and of the volume before us we are inclined to speak in the same terms.'—ERA.

Predictions Realized in Modern Times. Now first Collected. Contents:—Days and Numbers; Prophesying Almanacs; Omens; Historical Predictions; Predictions of the French Revolution; The Bonaparte Family; Discoveries and Inventions anticipated; Scriptural Prophecies, &c. By HORACE WELBY. With a Frontispiece, fcp. 5s. cloth.

'This is an odd but attractive volume, compiled from various and often little-known sources, and is full of amusing reading.'—CRITIC.

'A volume containing a variety of curious and startling narratives on many points of supernaturalism, well calculated to gratify that love of the marvellous which is more or less inherent in us all.'—NOTES AND QUERIES.

Tales from Shakespeare. By CHARLES and MISS LAMB. Fourteenth Edition. With 20 Engravings, printed on toned paper, from designs by Harvey, and Portrait, fcp. 3s. 6d. cloth elegant.

The Tongue of Time; or, The Language of a Church Clock. By WILLIAM HARRISON, A.M., Domestic Chaplain to H.R.H. the Duke of Cambridge: Rector of Birch, Essex. Sixth Edition, with beautiful Frontispiece fcp. 3s. cloth, gilt edges.

Hours of Sadness; or, Instruction and Comfort for the Mourner: Consisting of a Selection of Devotional Meditations, Instructive and Consolatory Reflections, Letters, Prayers, Poetry, &c., from various Authors, suitable for the bereaved Christian. Second Edition, fcp. 4s. 6d. cloth.

The Pocket English Classics. 32mo. neatly printed, bound in cloth, lettered, price Sixpence each:—

THE VICAR OF WAKEFIELD.
GOLDSMITH'S POETICAL WORKS.
FALCONER'S SHIPWRECK.
RASSELAS.
STERNE'S SENTIMENTAL JOURNEY.
LOCKE ON THE UNDERSTANDING.
THOMSON'S SEASONS.
INCHBALD'S NATURE AND ART.
BLOOMFIELD'S FARMER'S BOY.
SCOTT'S LADY OF THE LAKE.
SCOTT'S LAY.
WALTON'S ANGLER, 2 PARTS, 1s.
ELIZABETH; OR, THE EXILES.
COWPER'S TASK.
POPE'S ESSAY AND BLAIR'S GRAVE.
GRAY AND COLLINS.
GAY'S FABLES.
PAUL AND VIRGINIA.

WORKS BY THE AUTHOR OF 'A TRAP TO CATCH A SUNBEAM.'

'In telling a simple story, and in the management of dialogue, the Author is excelled by few writers of the present day.'—LITERARY GAZETTE.

A Trap to Catch a Sunbeam. Thirty-fifth Edition, price 1s.

'*Aide toi, et le ciel t'aidera*, is the moral of this pleasant and interesting story, to which we assign in this Gazette a place immediately after Charles Dickens, as its due, for many passages not unworthy of him, and for a general scheme quite in unison with his best feelings towards the lowly and depressed.'—LITERARY GAZETTE.

☞ *A Cheap Edition of the above popular story has been prepared for distribution. Sold only in packets price 1s. 6d. containing 12 copies.*

Also, by the same Author,

'COMING HOME;' a New Tale for all Readers, price 1s.
OLD JOLLIFFE; not a Goblin Story. 1s.
The SEQUEL to OLD JOLLIFFE. 1s.
The HOUSE on the ROCK. 1s.
'ONLY;' a Tale for Young and Old. 1s.
The CLOUD with the SILVER LINING. 1s.
The STAR in the DESERT. 1s.
AMY'S KITCHEN, a VILLAGE ROMANCE: a New Story. 1s.
'A MERRY CHRISTMAS.' 1s.
SIBERT'S WOLD. Third Edition, 2s. cloth, limp.
The DREAM CHINTZ. With Illustrations by James Godwin. 2s. 6d. with a beautiful fancy cover.

Sunbeam Stories. A Selection of the Tales by the Author of 'A Trap to Catch a Sunbeam,' &c. Illustrated by Absolon and Anelay. FIRST SERIES. Contents:—A Trap to Catch a Sunbeam—Old Jolliffe—The Sequel to Old Jolliffe—The Star in the Desert—'Only'—'A Merry Christmas.' Fcap. 3s. 6d. cloth, elegant, or 4s. gilt edges.

Sunbeam Stories. SECOND SERIES. Illustrated by Absolon and Anelay. Contents:—The Cloud with the Silver Lining—Coming Home—Amy's Kitchen—The House on the Rock. Fcap. 3s. 6d. cloth elegant; 4s. gilt edges.

Minnie's Love: a Novel. By the Author of 'A Trap to Catch a Sunbeam.' In 1 vol. post 8vo. 6s. cloth.

'An extremely pleasant, sunshiny volume.'—CRITIC.

'We were first surprised, then pleased, next delighted, and finally enthralled by the story.'—MORNING HERALD.

Little Sunshine: a Tale to be Read to very Young Children. By the Author of 'A Trap to Catch a Sunbeam.' In square 16mo. coloured borders, engraved Frontispiece and Vignette, fancy boards, price 2s.

'Just the thing to rivet the attention of children.'—STAMFORD MERCURY.
'Printed in the sumptuous manner that children like best.'—BRADFORD OBSERVER.
'As pleasing a child's book as we recollect seeing.'—PLYMOUTH HERALD.

THE FRENCH LANGUAGE.

M. de Fivas' Works for the Use of Colleges, Schools, and Private Students.

The attention of Schoolmasters and Heads of Colleges is respectfully requested to the following eminently useful series of French class-books, which have enjoyed an unprecedented popularity. A detailed prospectus will be sent on application.

De Fivas' New Grammar of French Grammars; comprising the substance of all the most approved French Grammars extant, but more especially of the standard work 'La Grammaire des Grammaires,' sanctioned by the French Academy and the University of Paris. With numerous Exercises and Examples illustrative of every Rule. By Dr. V. DE FIVAS, M.A., F.E.I.S., Member of the Grammatical Society of Paris, &c. &c. Twenty-fourth Edition, price 3s. 6d. handsomely bound.

'At once the simplest and most complete Grammar of the French language. To the pupil the effect is almost as if he looked into a map, so well-defined is the course of study as explained by M. de Fivas.'—LITERARY GAZETTE.

. A KEY to the above, price 3s. 6d.

De Fivas' New Guide to Modern French Conversation; or, the Student and Tourist's French Vade-Mecum; containing a Comprehensive Vocabulary, and Phrases and Dialogues on every useful or interesting topic; together with Models of Letters, Notes, and Cards; and Comparative Tables of the British and French Coins, Weights, and Measures; the whole exhibiting, in a distinct manner, the true Pronunciation of the French Language. Fourteenth Edition, 18mo. price 2s. 6d. strongly half-bound.

'Voulez vous un guide aussi sur qu' infallible pour apprendre la langue Française, prenez le Guide de M. de Fivas: c'est l'indispensable manuel de tout étranger.'
L'IMPARTIAL.

De Fivas, Beautés des Écrivains Français, Anciens et Modernes. Ouvrage Classique à l'usage des Collèges et des Institutions. Dixième Edition, augmentée de Notes Historiques, Géographiques, Philosophiques, Littéraires, Grammaticales, et Biographiques. Eleventh Edition, 12mo. 3s. 6d. bound.

'An elegant volume, containing a selection of pieces in both prose and verse, which, while it furnishes a convenient reading book for the student of the French language, at the same time affords a pleasing and interesting view of French literature.'—OBSERVER.

De Fivas, Introduction à la Langue Française; ou, Fables et Contes Choisis; Anecdotes Instructives, Faits Mémorables, &c. Avec un Dictionnaire de tous les Mots traduits en Anglais. A l'usage de la jeunesse, et de ceux qui commencent à apprendre la langue Française. Seventeenth Edition, 12mo. 2s. 6d. bound.

'By far the best first French reading book, whether for schools or adult pupils.'
TAIT'S MAGAZINE.

De Fivas, Le Trésor National; or, Guide to the Translation of English into French at Sight. Second Edition, 12mo. 2s. 6d. bound.

☞ Le 'Trésor National' consists of idiomatical and conversational phrases, anecdotes told and untold, and scraps from various English writers, and is especially intended to produce by practice, in those who learn French, a facility in expressing themselves in that language.

. A KEY to the above. 12mo. 2s. cloth.

THE FRENCH LANGUAGE—*continued.*

Le Brethon's French Grammar: A Guide to the French Language. By J. J. P. LE BRETHON. Revised and Corrected by L. SANDIER, Professor of Languages. Twelfth Edition, 8vo. 432 pages, 7s. 6d. cloth.—Key to ditto, 7s.

VOCABULAIRE SYMBOLIQUE ANGLO-FRANCAIS.

Pour les Elèves de tout Age et de tout Degré; dans lequel les Mots les plus utiles sont enseignés par des Illustrations. Par L. C. RAGONOT, Professeur de la Langue Française.

A Symbolic French and English Vocabulary. For Students of every Age, in all Classes; in which the most Useful and Common Words are taught by Illustrations. By L. C. RAGONOT, Professor of the French Language. The Illustrations comprise, embodied in the text, accurate representations of upwards of 850 different objects, besides nine whole-page copper-plates, beautifully executed, each conveying, through the eye, a large amount of instruction in the French Language. Eighth Edition, considerably improved, with new plates substituted, 4to. 5s. cloth.

☞ This work in the Anglo-French form having been extensively adopted, not only in Great Britain and on the Continent, but also in America, the publishers have determined to adopt it to other languages in a more portable form. The following is now ready;—

Symbolisches Englisch-Deutsches Wörterbuch: the Symbolic Anglo-German Vocabulary; adapted from RAGONOT'S 'Vocabulaire Symbolique Anglo-Français.' Edited and Revised by FALCK LEBAHN, Ph.D., Author of 'German in One Volume,' 'The German Self-Instructor,' &c. With 850 woodcuts, and eight full-page lithographic plates. 8vo. 6s. red cloth, lettered.

New Book by one of the Contributors to 'The Reason Why' Series, and Assistant Editor of 'The Dictionary of Daily Wants.'

Now ready, Second and Cheaper Edition, 1 vol. crown 8vo. pp. 384, 2s. 6d. cloth.

The Historical Finger-Post: A Handy Book of Terms, Phrases, Epithets, Cognomens, Allusions, &c., in connexion with Universal History. By EDWARD SHELTON, Assistant Editor of 'The Dictionary of Daily Wants,' &c. &c.

'A handy little volume, which will supply the place of "Haydn's Dictionary of Dates" to many persons who cannot afford that work. Moreover, it contains some things that Haydn's book does not.'—BOOKSELLER.

'It is to the historical student and antiquarian what "Enquire Within" is to the practical housewife—not dispensing with stores of hard-acquired and well-digested knowledge, but giving that little aid which, in moments of hurry and business, is the true economiser of time.'—VOLUNTEER SERVICE GAZETTE.

'The idlest reader would find it convenient to have it within reach.'
PUBLISHERS' CIRCULAR.

'Really a very useful work; and, at the present day, when everybody is expected to be up in everything, as good a handy-book for cramming on the current subjects of conversation as any that we know. About 3000 subjects have all their place in this extraordinary collection, and although tersely given, the account of each is sufficient for ordinary purposes.'—ERA.

'A very desirable companion, as containing a variety of information, much of which could only be got by diligent inquiry and research. . . . Deserves a place as a book of reference on the shelves of the study or library.'
NAVAL AND MILITARY GAZETTE.

'This most useful and admirably arranged handy-book will in most cases greatly lighten the labour of investigation, and obviate a long and tedious search through voluminous publications.'—WEEKLY TIMES.

Just published, in a closely-printed Volume, in a clear and legible type, post 8vo. 6s. cloth.

The Domestic Service Guide to Housekeeping; Practical Cookery; Pickling and Preserving; Household Work; Dairy Management; the Table and Dessert; Cellarage of Wines; Home-Brewing and Wine-Making; the Boudoir and Dressing-room; Invalid Diet; Travelling; Stable Economy; Gardening, &c. A Manual of all that pertains to Household Management: from the best and latest authorities, and the communications of Heads of Families; with several hundred new recipes.

'A really useful Guide on the important subjects of which it treats.'—SPECTATOR.

'The best cookery-book published for many years.'—BELL'S MESSENGER.

'This "Domestic Service Guide" will become, what it deserves to be, very popular.'—READER.

'This book is characterised by a kindly feeling towards the classes it designs to benefit, and by a respectful regard to religion.'—RECORD.

'We find here directions to be discovered in no other book, tending to save expense to the pocket, as well as labour to the head. It is truly an astonishing book.'—JOHN BULL.

'This book is quite an encyclopædia of domestic matters. We have been greatly pleased with the good sense and good feeling of what may be called the moral directions, and the neatness and lucidity of the explanatory details.'—COURT CIRCULAR.

NO MORE LAWYERS' BILLS!

Just published, 4th Edition, much enlarged, and brought down to end of 1865 Session. 12mo. cloth, price 6s. 8d. (saved at every consultation.)

Every Man's Own Lawyer: a Handy Book of the Principles of Law and Equity. By a BARRISTER. Comprising the Rights and Wrongs of Individuals, Mercantile and Commercial Law, Criminal Law, Parish Law, County Court Law, Game and Fishery Laws, Poor Men's Law; the Laws of

Bankruptcy	Merchant Shipping
Bets and Wagers	Mortgages
Bills of Exchange	Settlements
Contracts	Stock Exchange Practice
Copyright, Patents, and Trade Marks	Trespass, Nuisances, &c.
Elections and Registration	Transfer of Land, &c.
Insurance (Marine, Fire, and Life)	Warranties and Guaranties
Libel and Slander	Forms of Wills, Agreements, Bonds, Notices, &c.
Marriage and Divorce	

Also Law for

Landlord and Tenant	Farmers
Master and Servant	Contractors
Husband and Wife	Stock and Share Brokers
Executors and Trustees	Sportsmen, Gamekeepers
Heirs, Devisees, and Legatees	Farriers and Horse-dealers
Guardian and Ward	Auctioneers, House Agents
Married Women and Infants	Innkeepers, &c.
Partners and Agents	Bakers, Millers, &c.
Lender and Borrower	Pawnbrokers
Debtor and Creditor	Surveyors
Purchaser and Vendor	Railways, Carriers, &c.
Companies and Associations	Constables
Friendly Societies	Labourers
Clergymen, Churchwardens, &c.	Seamen
Medical Practitioners, &c.	Soldiers
Bankers	&c. &c.

'What it professes to be, a complete epitome of the laws of this country, thoroughly intelligible to non-professional readers. The book is a handy one to have in readiness when some knotty point requires ready solution, and will be found of service to men of business, magistrates, and all who have a horror of spending money on a legal adviser.'—BELL'S LIFE.

'A clearly-worded and explicit manual, containing information that must be useful at some time or other to everybody.—MECHANIC'S MAGAZINE.

'A work which has long been wanted, which is thoroughly well done, and which we most cordially recommend.—SUNDAY TIMES.'

WORKS IN ENGINEERING, &c.—*continued.*

A MANUAL on EARTHWORK. By Alex. J. S. Graham, C.E., Resident Engineer, Forest of Dean Central Railway. With Diagrams. 18mo. 2s. 6d. cloth.

THE OPERATIVE MECHANIC'S WORKSHOP COMPANION: comprising a great variety of the most useful Rules in Mechanical Science, with numerous Tables of Practical Data and Calculated Results. By W. Templeton, Author of 'The Engineer's Common-Place Book,' &c. Seventh Edition, with 11 Plates. 12mo. price 5s. bound and lettered.

THEORY of COMPOUND INTEREST and ANNUITIES, with TABLES of LOGARITHMS for the more difficult computations of Interest, Discount, Annuities, &c., in all their Applications and Uses for Mercantile and State Purposes. By F. Thoman, of the Société Crédit Mobilier. 12mo. 5s. cloth,

THE ENGINEER'S, ARCHITECT'S, and CONTRACTOR'S POCKET BOOK (Lockwood and Co.'s, formerly Weale's), published Annually. With Diary of Events and Data connected with Engineering, Architecture, and the kindred Sciences. The present year's Volume is much improved by the addition of various useful articles. With 10 plates, and numerous Woodcuts, in roan tuck, gilt edges, 6s.

THE BUILDER'S and CONTRACTOR'S PRICE BOOK (Lockwood and Co.'s. formerly Weale's), published Annually. Containing the latest prices for work in all branches of the Building Trade, with items numbered for easy reference. 12mo. cloth boards, lettered, 4s.

THE TIMBER MERCHANT'S and BUILDER'S COMPANION. Containing new and copious TABLES, &c. By William Dowsing, Timber Merchant, Hull. Second Edition, revised. Crown 8vo. 3s. cloth.

A SYNOPSIS of PRACTICAL PHILOSOPHY. Alphabetically Arranged. Designed as a Manual for Travellers, Architects, Surveyors, Engineers, Students, Naval Officers, and other Scientific Men. By the Rev. John Carr, M.A., of Trinity Coll., Camb. Second Edition, 18mo. cloth, 5s.

THE CARPENTER'S NEW GUIDE; or, Book of Lines for Carpenters, founded on the late Peter Nicholson's standard work. A New Edition, revised by Arthur Ashpitel, Arch. F.S.A.; together with Practical Rules on Drawing, by George Pyne, Artist. With 74 Plates, 4to. price £1 1s. cloth.

TREATISE on the STRENGTH of TIMBER, CAST IRON, MALLEABLE IRON, and other Materials. By Peter Barlow, F.R.S. V.S., Hon. Mem. Inst. C.E., &c. A New Edition, by J. F. Heather, M.A., of the Royal Military Academy, Woolwich, with Additions by Prof. Willis, of Cambridge. With Nine Illustrations, 8vo. 16s. cloth.

MATHEMATICS for PRACTICAL MEN; being a Commonplace Book of Pure and Mixed Mathematics, for the Use of Civil Engineers, Architects, and Surveyors. By Olinthus Gregory, LL.D. Enlarged by Henry Law. Fourth edition, revised, by J. R. Young, Author of 'A Course of Mathematics,' &c. With 13 Plates, 8vo. £1 1s. cloth.

THE LAND VALUER'S BEST ASSISTANT, being Tables on a very much improved Plan, for Calculating the Value of Estates. By R. Hudson, Civil Engineer. New Edition, with Additions and Corrections, 4s. bound.

A MANUAL of ELECTRICITY. Including Galvanism, Magnetism, Dia-Magnetism, Electro-Dynamics, Magno-Electricity, and the Electric Telegraph. By Henry M. Noad, Ph.D., F.C.S., Lecturer on Chemistry at St. George's Hospital. Fourth Edition, entirely re-written, illustrated by 500 Woodcuts, 8vo. £1 4s. cloth. Sold also in Two Parts: Part I. Electricity and Galvanism, 8vo. 16s. cloth. Part II. Magnetism and the Electric Telegraph, 8vo. 10s. 6d. cloth.

DESIGNS and EXAMPLES of COTTAGES, VILLAS, and COUNTRY HOUSES. Being the Studies of Eminent Architects and Builders, consisting of Plans, Elevations, and Perspective Views; with approximate Estimates of the cost of each. 4to. 67 Plates, £1 1s. cloth.

THE APPRAISER, AUCTIONEER, and HOUSE-AGENT'S POCKET ASSISTANT. By John Wheeler, Valuer. Second Editon, 24mo. cloth boards, 2s. 6d.

PRACTICAL RULES on DRAWING, for the Operative Builder, and Young Student in Architecture. By George Pyne, Author of 'A Rudimentary Treatise on Perspective.' With 14 Plates, 4to. 7s. 6d. boards.

THE BOOK FOR EVERY FARMER.

New Edition of Youatt's Grazier, enlarged by R. Scott Burn.

The Complete Grazier, and Farmer's and Cattle Breeder's Assistant. A Compendium of Husbandry, especially in the departments connected with the Breeding, Rearing, Feeding and General Management of Stock, the Management of the Dairy, &c.; with Directions for the Culture and Management of Grass Land, of Grain and Root Crops, the Arrangement of Farm Offices, the Use of Implements and Machines; and on Draining, Irrigation, Warping, &c., and the Application and Relative Value of Manures. By WILLIAM YOUATT, Esq., V.S., Member of the Royal Agricultural Society of England, Author of 'The Horse,' 'Cattle,' &c., Eleventh Edition, enlarged, and brought down to the present requirements of Agricultural Practice by ROBERT SCOTT BURN, one of the Authors of 'The Book of Farm Implements and Machines,' and of 'The Book of Farm Buildings,' Author of 'The Lessons of My Farm,' and Editor of 'The Year-Book of Agricultural Facts.' In one large 8vo. volume, pp. 784, with 215 Illustrations, price £1 1s. strongly half-bound.

'The standard, and text-book, with the farmer and grazier.'
FARMER'S MAGAZINE.

'A valuable repertory of intelligence for all who make agriculture a pursuit, and especially for those who aim at keeping pace with the improvements of the age. . . . The new matter is of so valuable a nature that the volume is now almost entitled to be considered as a distinct work.'—BELL'S MESSENGER.

'The public are indebted to Mr. Scott Burn for undertaking the task, which he has accomplished with his usual ability, making such alterations, additions, and improvements as the changes effected in husbandry have rendered necessary.'
SPORTING MAGAZINE.

'A treatise which will remain a standard work on the subject as long as British agriculture endures.'—MARK LANE EXPRESS.

'The additions are so numerous and extensive as almost to give it the character of a new work on general husbandry, embracing all that modern science and experiment have effected in the management of land and the homestead.'
SPORTING REVIEW.

'It is, in fact, a compendium of modern husbandry, embracing a concise account of all the leading improvements of the day.'—NEW SPORTING MAGAZINE.

The Lessons of My Farm: A Book for Amateur Agriculturists; being an Introduction to Farm Practice in the Culture of Crops, the Feeding of Cattle, Management of the Dairy, Poultry, Pigs, and in the Keeping of Farm-work Records. By ROBERT SCOTT BURN, Editor of 'The Year-Book of Agricultural Facts,' and one of the Authors of 'Book of Farm Implements and Machines,' and 'Book of Farm Buildings.' With numerous Illustrations, fcp. 6s. cloth.

'A very useful little book, written in the lively style which will attract the amateur class to whom it is dedicated, and contains much sound advice and accurate description.'
ATHENÆUM.

'We are sure the book will meet with a ready sale, and the more that there are many hints in it which even old farmers need not be ashamed to accept.'
MORNING HERALD.

'A most complete introduction to the whole round of farming practice. We believe there are many among us whose love of farming will make them welcome such a companion as this little book in which the author gives us his own experiences, which are worth a great deal.'—JOHN BULL.

'Never did book exercise a more salutary effect than "My Farm of Four Acres." Mr. Burn has followed suit in a very practical and pleasant little work.'
ILLUSTRATED LONDON NEWS.

SPOTTISWOODE AND CO., PRINTERS, NEW-STREET SQUARE, LONDON.